



# City for all?

A geospatial approach to equity, sustainability,  
and gentrification in Seattle, Washington



Nicolas Welch

# City for all?

## A geospatial approach to equity, sustainability, and gentrification in Seattle, Washington

A thesis submitted by

Nicolas Welch

in partial fulfillments of the requirements for the degree of  
Master of Arts in Urban and Environmental Policy and Planning  
Tufts University

August 2013

Adviser: Julian Agyeman

Cover images: Kay M. Gänsler (top); *Arrival of Steamship Portland with a ton of gold*, Photo Collection, University of Washington Library (bottom)

*“I am concerned and I am frustrated because I don’t know what the alternatives to gentrification are. The process clearly isn’t racist; it’s economic. The real question you have to ask yourself is: Is this good or bad?”*

**Former Seattle Mayor Norm Rice, 2006**

# ABSTRACT

Seattle is at a crossroads. Despite ambitious plans for sustainability and equitable development, there is no consensus about how to achieve these two seemingly compatible goals. A recent period of considerable economic and population growth has led to rising rents and home values. As a result, gentrification is a significant concern. Recent research has sought to use geospatial analysis to identify areas that are vulnerable to gentrification and displacement. These studies vary in the methodology they employ. This thesis reviews previous efforts to measure gentrification susceptibility using GIS, assesses their strengths and weaknesses, and proposes an improved methodology for Seattle. The results of this new approach show that the neighborhoods most vulnerable to gentrification are First Hill, the Central District, Columbia City, High Point, and Northgate.

# ACKNOWLEDGEMENTS

I owe tremendous thanks to my thesis advisor, Julian Agyeman, and thesis reader, Barbara Parmenter, both of whom were exceptionally patient and helpful not only with this project but during the entirety of my three years at UEP. I would also like to thank my parents for their unwavering support during my 20 years of education.

This thesis grew out of my love for my hometown of Seattle and a desire to see it continue as an exemplar of both sustainable and equitable development. In 1951, historian Murray Morgan differentiated his portrait of Seattle from the many formal histories of the city that depicted “the folk who dreamed the right dreams at the appropriate times.” Instead, his was

the story of the others, of some who tried and failed and of some who achieved success without becoming respectable, of the life that centered on the mills and on the wharves. That is Seattle from the bottom up (p. 10).

I hope Seattle remains a city where we can try and fail, where many achieve success, and where everyone at the bottom can move up.

# TABLE OF CONTENTS

- Chapter 1: Introduction** .....1
  - What is gentrification? .....3
  - Growth in Seattle.....4
- Chapter 2: Literature Review**..... 10
  - Gentrification..... 10
    - Competing definitions* ..... 10
    - Theories of gentrification* ..... 13
    - Displacement* ..... 15
    - Positive impacts*..... 16
  - GIS..... 18
    - Overlay mapping* ..... 18
    - Indicators* ..... 18
    - The use of GIS to predict gentrification*..... 19
- Chapter 3: Gentrification Indicators** ..... 21
  - Non-GIS studies of gentrification indicators..... 21
  - GIS studies of gentrification indicators ..... 27
- Chapter 4: Study Area** ..... 45
- Chapter 5: Neighborhood Change in Seattle**..... 50
  - Using the NCDB..... 51
  - Results..... 53
  - Gentrification from 2000 to 2010 ..... 67
  - Conclusion ..... 75
- Chapter 6: Gentrification Susceptibility** ..... 77
  - Gentrifiable tracts..... 77
  - Methodology..... 78
    - Housing indicators*..... 80
    - Location indicators* ..... 82
    - Demographic indicators* ..... 86
  - Findings and analysis..... 87
  - Limitations and recommendations for future research ..... 96
- Chapter 7: Conclusion** ..... 99
- Works Cited** ..... 101
- Appendix A: Neighborhood Change Maps** ..... 109
- Appendix B: Indicators of Gentrification Susceptibility** ..... 159

# TABLES AND FIGURES

Table 1: Factors associated with gentrification identified by Aka (2010)..... 25

Table 2: Factors associated with gentrification identified by Kolko (2007) ..... 27

Table 3: Factors associated with gentrification identified by Nesbitt (2005) ..... 29

Table 4: Factors associated with gentrification identified by Heidkamp and Lucas (2006) ..... 31

Table 5: Factors associated with gentrification identified by Levy (2009) ..... 32

Table 6: Factors associated with gentrification identified by Chapple (2009) ..... 34

Table 7: Factors associated with gentrification identified by Gafvert (2011) ..... 37

Table 8: Factors associated with gentrification identified by Fouch (2012) ..... 38

Table 9: Factors associated with gentrification identified by Bates (2013) ..... 42

Table 10: Comparison of geospatial approaches to measuring gentrification vulnerability ..... 44

Table 11: Trends identified in gentrifying tracts, 2000-2010 ..... 75

Table 12: Factors included in weighted gentrification susceptibility index ..... 88

Table 13: Description of geospatial approach to measuring gentrification vulnerability ..... 95

Figure 1: Study area context ..... 48

Figure 2: Neighborhoods of Seattle ..... 49

Figure 3: Composite gentrification susceptibility index ..... 90

Figure 4: Areas of highest susceptibility to gentrification ..... 91

Figure 5: Gentrification susceptibility by neighborhood ..... 92

Figure 6: Change in median household income by tract, 1970-1980 ..... 110

Figure 7: Change in median household income by tract, 1980-1990 ..... 111

Figure 8: Change in median household income by tract, 1990-2000 ..... 112

Figure 9: Change in median household income by tract, 2000-2011 ..... 113

Figure 10: Change in total housing units by tract, 1970-1980 ..... 114

Figure 11: Change in total housing units by tract, 1980-1990 ..... 115

Figure 12: Change in total housing units by tract, 1990-2000 ..... 116

Figure 13: Change in total housing units by tract, 2000-2010 ..... 117

Figure 14: Rental share by tract, 1980 ..... 118

Figure 15: Rental share by tract, 1990 ..... 119

Figure 16: Rental share by tract, 2000 ..... 120

Figure 17: Rental share by tract, 2010 ..... 121

Figure 18: Change in rental share by tract, 1970-1980 ..... 122

Figure 19: Change in rental share by tract, 1980-1990 ..... 123

Figure 20: Change in rental share by tract, 1990-2000 ..... 124

Figure 21: Change in rental share by tract, 2000-2010 ..... 125

Figure 22: Residents in poverty by tract, 1980 ..... 126

Figure 23: Residents in poverty by tract, 1990 ..... 127

Figure 24: Residents in poverty by tract, 2000.....	128
Figure 25: Residents in poverty by tract, 2011.....	129
Figure 26: Change in share of residents in poverty by tract, 1980-1990.....	130
Figure 27: Change in share of residents in poverty by tract, 1990-2000.....	131
Figure 28: Change in share of residents in poverty by tract, 2000-2011.....	132
Figure 29: Change in median home value by tract, 1990-2000.....	133
Figure 30: Change in median home value tract, 2000-2011.....	134
Figure 31: Change in median gross rent by tract, 1980-1990.....	135
Figure 32: Change in median gross rent by tract, 1990-2000.....	136
Figure 33: Change in median gross rent by tract, 2000-2011.....	137
Figure 34: Change in share of residents with a Bachelor's degree by tract, 1970-1980.....	138
Figure 35: Change in share of residents with a Bachelor's degree by tract, 1980-1990.....	139
Figure 36: Change in share of residents with a Bachelor's degree by tract, 1990-2000.....	140
Figure 37: Change in share of residents with a Bachelor's degree by tract, 2000-2011.....	141
Figure 38: Change in ratio of 25-34 & 55-64 age cohorts to total population by tract, 1970-1980.....	142
Figure 39: Change in ratio of 25-34 & 55-64 age cohorts to total population by tract, 1980-1990.....	143
Figure 40: Change in ratio of 25-34 & 55-64 age cohorts to total population by tract, 1990-2000.....	144
Figure 41: Change in ratio of 25-34 & 55-64 age cohorts to total population by tract, 2000-2011.....	145
Figure 42: Black residents by tract, 1970.....	146
Figure 43: Black residents by tract, 1980.....	147
Figure 44: Black residents by tract, 1990.....	148
Figure 45: Black residents by tract, 2000.....	149
Figure 46: Black of African American residents by tract, 2010.....	150
Figure 47: Hispanic residents by tract, 1970.....	151
Figure 48: Hispanic residents by tract, 1980.....	152
Figure 49: Hispanic residents by tract, 1990.....	153
Figure 50: Hispanic residents by tract, 2000.....	154
Figure 51: Hispanic or Latino residents by tract, 2010.....	155
Figure 52: Nonwhite residents by tract, 2000.....	156
Figure 53: Nonwhite residents by tract, 2010.....	157
Figure 54: Change in median household income in gentrified tracts, 2000-2010.....	158
Figure 55: Eligibility for gentrification.....	160
Figure 56: Concentration of pre-1940 housing.....	161
Figure 57: Concentration of historic buildings.....	162
Figure 58: Concentration of renter-occupied housing.....	163
Figure 59: Low dwelling value.....	164
Figure 60: Rent burden.....	165
Figure 61: Share of buildings with 3 or more units.....	166
Figure 62: Residential vacancy in quarter-mile radius.....	167
Figure 63: Foreclosure rate (2000 HUD data).....	168
Figure 64: Proximity to parks and open space.....	169
Figure 65: Proximity to the waterfront.....	170
Figure 66: Proximity to a university or college.....	171

Figure 67: Proximity to a community garden .....	172
Figure 68: Proximity to high-quality bus service .....	173
Figure 69: Proximity to Link light rail station.....	174
Figure 70: Proximity to streetcar station .....	175
Figure 71: Location in an Urban Village .....	176
Figure 72: Neighborhood spillover effect .....	177
Figure 73: Heterogeneous racial composition .....	178
Figure 74: Hispanic residents by block group .....	179
Figure 75: Black residents by block group .....	180
Figure 76: Nonwhite residents by block group .....	181
Figure 77: Population over 25 without a Bachelor's degree.....	182

# 1 INTRODUCTION

In recent years, middle- and upper-class residents have started to reject suburban life and return to city centers across the United States. Whether due to demand for urban amenities, environmental concerns, job growth, or rising transportation costs, the result in many metropolitan areas is an increase in rents and consequent pressure on lower-income households. Development is booming in many once-declining urban areas, and many cities are experiencing a resurgence of investment in neighborhoods occupied by low- and very low-income residents. This has only intensified the longstanding debate around gentrification, one of the most contentious and problematic concepts in urban planning. As housing costs grow and affordable housing is replaced with higher-end units, these residents are often at risk of being displaced. Entire neighborhoods are remade in character and design. Of course, gentrification can also generate positive impacts through new public amenities, higher property tax revenue, or a reduction in crime, and increasing median household income in a neighborhood may reflect improved access to education and jobs for immigrant residents. Or it may coincide with or result from new transit infrastructure that advances sustainability goals. But reinvestment in a neighborhood disproportionately benefits higher-income households rather than the community as a whole. Gentrification tends to reduce socioeconomic diversity.

This is the central dilemma confronting Seattle, Washington. The city is at a crossroads. Housing and jobs are both on the rise. From 2011 to 2012, employment increased 2.6 percent in Seattle, and its economy is forecast to grow four percent over 2010-2016, ahead of all European cities (City of Seattle OED 2012b; Watson 2012). Much of that growth is fueled by the booming technology industry and a construction sector that built more than 35,000 units since 2005 (US Census). New residential development is everywhere, much of it in multifamily buildings of 20 or more units. A network of streetcar lines is breaking ground, and the new regional light rail network

# 1 INTRODUCTION

is expanding. Seattle regularly ranks highly on a broad range of “Best Cities” lists, whether for its landscape and job market (Konrad 2012), resilience to climate change (Meyer 2013), pedestrian- and bike-friendly streets (Benfield 2011), or environmental sustainability (Thompson 2009). By 2040, Seattle will need to accommodate another 200,000 residents, a challenge the City intends to meet while actively supporting urban sustainability and livability (Seattle Planning Commission 2007).

But as more residents seek housing in “walkable” urban neighborhoods close to downtown, near restaurants and shops, and accessible to transit, incumbent residents, many of them nonwhite, non-native English speaking, and low-income, find the character and affordability of their neighborhoods rapidly changing. Conspicuously absent from the accolades Seattle receives is any mention of its rising cost of living, or the challenges many incumbent residents face to keep pace with higher rents, or the true sustainability of a city increasingly unaffordable for lower-income households.

City officials are cognizant of this phenomenon and employ various tools to mitigate the negative effects of gentrification, such as displacement. But identifying where this process is currently underway and, more importantly, anticipating where it may occur down the road is more difficult. Existing research has demonstrated that geographic information systems (GIS), a method for of storing, analyzing, and manipulating geographical data, can assist policymakers in identifying at-risk neighborhoods by overlaying factors that contribute to gentrification to create a susceptibility index. However, there has been almost no meta-analysis of the various GIS models researchers have developed, each of which employs a unique set of indicators, has a different theoretical framework, and applies to a particular study area. Many of these models do not refer to one another nor make any reference to previous findings. To date, there has been no attempt to step back from this body of research and identify the key differences in the methodologies of these studies, appraise their limitations, or assess how they can learn from one another. Each one has, in some ways, reinvented the wheel.

# 1 INTRODUCTION

In this thesis, I seek to advance the use of GIS to predict gentrification susceptibility. I have three separate goals in mind. First, I catalog how previous studies have approached this topic and identifying the strengths and limitations in their methodologies so that future researchers can review these lessons in one place. Second, I explore how Seattle neighborhoods have changed in the last forty years and the factors that have contributed to or coincided with gentrification. This facilitates my third goal of developing an improved predictive GIS approach for identifying areas vulnerable to gentrification.

The rest of this introduction briefly covers the phenomenon of gentrification, growth and housing development in Seattle, and the role of gentrification in that context. A literature review discusses the competing theories about the causes and effects of gentrification, the tools of GIS and overlay mapping, and the use of indicators in measuring environmental and social processes, including gentrification. Chapter 3 analyzes previous attempts to identify indicators of gentrification, both with and without GIS. I then draw on these findings to make recommendations for improving this process. Chapter 4 describes the study area and Chapter 5 uses historical census data to evaluate neighborhood change in Seattle from 1970 to 2010. In Chapter 6, I run a new model for identifying where gentrification is most likely to take root or accelerate in Seattle. A concluding chapter assess the potential and limitations of using GIS to predict gentrification risk, explores how this research can assist efforts to mitigate the negative effects of gentrification, and suggests how future research can further develop the use of geospatial indicators to measure neighborhood-level phenomena.

## **What is gentrification?**

Kennedy and Leonard call gentrification “the process of neighborhood change that results in the replacement of lower income residents with higher income ones” (2001a, p. 1), yet there is no shortage of competing definitions for this phenomenon. Though many are familiar with the term, no one can agree completely on how to define it (Galster and Peacock 1986). Over the years,

# 1 INTRODUCTION

scholars have described as broadly as “the upgrading of devalued urban property” (Aka 2010, p. 1) or “an upward shift in class” (Morrill 2007, p. 44) and as narrowly as

the process by which the socioeconomic status of a neighborhood populated mostly by lower-income households is substantially elevated by renewed interests and investments by higher-income households, including homebuyers, renters and commercial interests from outside the neighborhood so as to change the overall character of the neighborhood... result[ing] in widespread displacement of the lower-income residents already living in the neighborhood as well as the businesses they support (Nesbitt 2005, p. 11-12).

In his analysis of gentrification and growth in Seattle from 1990 to 2000, Morrill (2007, p. 43) ponders whether during this time the phenomenon was “displacement of the poorer by the richer...Blacks by Whites...the older by the younger” or simply the “redevelopment of relatively unused areas with minimal social impact.” Chapter 2 explores this theoretical uncertainty in more depth. Most research, however, agrees on a handful of demographic and socioeconomic changes that tend to accompany gentrification: an increase in median household income, whether driven by incumbent residents or in-migrants; an increase in educational attainment, frequently quantified as the share of residents with Bachelor’s or graduate degrees; and a tightening of the housing market and the concomitant increase in rents. There is also growing consensus on the importance of the local context in determining the causes and impacts, be them positive or negative, of gentrification in a particular city or region (Kolko 2007).

## **Growth in Seattle**

What residents in Seattle observe locally—escalating rents, ubiquitous new construction, redevelopment of entire neighborhoods—is driven by global forces of capital flowing into and out of cities. The term “flowing,” though, is misleading given its connotation of passive movement; in truth, cities compete fiercely to attract investment and maximize growth. Competitiveness in this marketplace is determined not only by economic might and growth but also a city’s “business and regulatory environment, the quality of human capital and...quality of life” (Watson 2012, p. 3). The *Economist’s* “Global City Competitiveness Index” takes a holistic look at eight factors that shape a

# 1 INTRODUCTION

city's relative power in the global economy. Seattle scores highly on these measures: 29th overall and 12th among U.S. cities thanks to high marks on institutional effectiveness (10th globally) and human capital (8th globally). These categories reward high taxation and pluralism, and population growth, entrepreneurship, and high quality education and healthcare, respectively (Watson 2012, p. 32). Another indicator of human capital is the hiring of foreign nationals, a metric where Seattle's high performance only further reveals the global component of its recent growth. In fact, while one of the most salient trends from the Index is the shift in competitiveness from West to East and developed to developing countries, another is the rise of mid-sized cities like Seattle that punch above their weight when it comes to economic strength. At 30 percent, this is the highest-weighted category in the Index since factors like "GDP size, pace of growth, [and] income levels" are "undisputedly...a key driver of attractiveness" (Watson 2012, p. 30-31). No doubt the boom in high-end apartments and condominiums, restaurants and nightlife, and boutique retail in Seattle is an expression of firms' constant efforts to attract highly education and skilled employees.

This growth manifests itself most visibly in the construction of new multifamily housing throughout the city but particularly in the rapidly popularizing neighborhoods of South Lake Union, Belltown, and Capitol Hill. Not only is "flowing" misleadingly calm, but it also belies the rapidity with which these changes can gentrify a neighborhood, particularly so in Seattle (Kennedy and Leonard 2001a). There are two competing schools of thought on the development progressing across the city. First, the economic tenet of supply and demand is an oft-cited justification for new housing. Constrain supply of any good in an environment of increasing demand and prices will continue to rise. As a result, many believe the construction of new housing is the easiest, if not only, way to maintain affordability as the population grows in the Puget Sound region.

In opposition, many housing advocates counter that, despite the boom in housing development, living in Seattle is less affordable now than ever before. They lament the effect these steady rent increases have had on the character of the city's neighborhoods. Long-time residents of many communities have been displaced as rents become unaffordable and their buildings are upgraded

## 1 INTRODUCTION

to cater to a higher-income audience. In the Capitol Hill neighborhood, where every block seems to have new, upscale market-rate housing, students and lower-skill workers are trading places with two rapidly growing cohorts: 35- to 44-year-olds and children under five (Balk 2013). When people look at Seattle today, they either see reinvestment in dilapidated, undercapitalized properties and a vibrant economy, or deplore a market catering only to the high-incomes of the booming tech industry and a city increasingly unlivable for the lower and middle classes.

Fox and Colter (2012) outline how this discrepancy between theory and practice unfolds in Seattle. “The pro-density argument to legitimize runaway growth in Seattle is that increasing the supply of market-rate units will lower housing prices and guarantee a larger stock of affordable housing,” which, on paper, stands to reason. But given the scarcity of vacant land in Seattle, new development means demolition of existing lower-density housing. Over 5,000 units were torn down from 2005 to 2012, of which Fox and Colter estimate at least 3,000 served low-income families. “Housing that’s older, non-debt-supported and affordable gives way to new, more expensive housing.” In other words, more units overall, but all of them targeting a wealthier demographic.

These two visions have squared off time and again in public discourse and the media over the last several years. In January 2013, an article in *The Stranger* covered rent hikes at the Prince of Wales, a brick apartment building at the south end of Capitol Hill (Jonjak 2013). Under new management, tenants began receiving notices of rent increases of 45 to 90 percent. Within five months, two thirds of the units had been vacated. The new development company saw below-market rents in booming Capitol Hill as an opportunity to upgrade a rundown building. “This is a building that’s underperforming because the electrical system is bad, the plumbing is horrible, the meters in the basement are old, the mortar is falling apart,” the building manager said. “From a structural standpoint, the building is not functioning as it should” (Jonjak 2013). But along with modern appliances and a redesigned aesthetic came a new price point that had many wondering if it is “...ethically questionable to buy a property and raise the rent so high that the artists, writers, seamstresses, music teachers, retirees, and caregivers who live there—the sort of people who bring texture to

## 1 INTRODUCTION

the neighborhood—can no longer afford to stay” (Jonjak 2013). It is no surprise, then, that areas like Capitol Hill are struggling to maintain age or income diversity as the housing market trends upwards.

The third line of thinking straddles these two points of views and deals with sustainability, where Seattle’s goals are as ambitious and laudable as any city in the United States. Both from an environmental and social perspective, many believe density is central to the city’s sustainability agenda. Density figures prominently in current sustainability thinking; it’s the central thesis of David Owen’s (2010) *Green Metropolis: Why Living Smaller, Living Closer, and Driving Less Are the Keys to Sustainability* and a core tenet of the Smart Growth Network, a coalition of organizations whose housing, environmental, and transportation goals hinge on compact development (Smart Growth Network 2006). It also connects with the notion of Just Sustainabilities, which synthesizes the concepts of social justice and the development of sustainable communities (Agyeman 2013). But density is particularly crucial in Seattle, where a majority of greenhouse gas (GHG) emissions come from transportation: higher density means more people living closer to where they work and play and lower vehicle miles traveled (VMT) as a result (Lazarus et al. 2011, p. 7). Getting people out of cars and onto buses, bikes, or feet is integral to the city’s goal of reducing GHG emissions from passenger vehicles by 82 percent by 2030 compared to a 2008 baseline (City of Seattle OSE 2013).

Density is thought to beget a more equitable city, too. More housing options in central locations reduces the transportation costs associated with long commutes from the suburbs, where currently many lower-income households move in order to find housing in their price range. This suburbanization of poverty has taken root throughout the U.S. but particularly in the Pacific Northwest in places like Tualatin and Oregon City, Oregon (Friedman and Nirappil 2013) and Tukwila, Washington, a small Seattle suburb once home to refugees from Bosnia and Somalia and immigrants from Central America but now seeing a wave of in-migration from popularizing South Seattle neighborhoods where housing has become unaffordable (Kneebone and Berube 2013). The Center for Neighborhood Technology’s (2012) Housing and Transportation Affordability Index presents a

## 1 INTRODUCTION

more comprehensive picture of housing costs by revealing the transportation expenses associated with a home's location.

Yet despite evidence that scarce housing options in central neighborhoods take the largest financial toll on lower-income families—in essence a form of spatial injustice (Soja 2010)—current efforts to add density to predominantly single-family neighborhoods, however paltry, are met with resistance from homeowners. In some ways, there is a remarkable contradiction between Seattle's reputation as a vanguard of sustainability and the opposition that coalesces against efforts to advance environmental goals like dense transit-oriented projects or equity goals like income and housing diversity (Holden 2013). Feit (2009) sees an “ongoing battle is between green urbanists who want density and mass transit, and economic populists who want to preserve Seattle's working class neighborhoods.”

It is not difficult to imagine what comes from a resistance to new housing. In San Francisco, the technology boom has pushed rents to astronomical levels and raised the overall cost of living. Tension grows daily between the prosperous “digital technocracy” and average San Franciscans for whom life in the city is less affordable than ever. They worry about what this rapid growth will do to the environment, or class divisions, or the availability of parking spaces, let alone housing affordability. These are understandable concerns, but the response of many residents is to stop the growth, to stem the tide of “techie” newcomers whom developers target with increasingly smaller studios instead of affordable family housing. It is almost as though, in Manjoo's words, “San Francisco can't deal with its good fortune” (2012). Instead, he says, San Francisco needs to “accept its fate as a large metropolis” and build more tall buildings. That means changes to the zoning code, which is filled with height and density restrictions.

Today, Seattle finds itself in a very similar situation. The City has already upzoned areas of Downtown, South Lake Union, Northgate, and Interbay (Seattle Planning Commission 2007, p. 1). A booming tech industry, swollen housing demand, resistance to density—it's all there. San Franciscans object to new 220-square-foot “Twitter apartments,” Seattleites to “aPodments” (Manjoo

## 1 INTRODUCTION

2012; Holden 2013). Just as many claim that density is the sole way to maintain reasonable rents as argue that upzones and new development only replace affordable housing with high-end apartments. How Seattle manages to rectify/balance these two seemingly/superficially complementary/compatible but subtly conflicting/incompatible/incongruent objectives—vibrant, walkable, and climate-neutral communities that are also affordable to residents of all socioeconomic levels—will determine whether the city deserves any of its accolades.

## 2 LITERATURE REVIEW

The literature on gentrification and its drivers is vast. This section first details the main schools of thought and points of contention regarding what causes gentrification, how we know when it is occurring, and what effect it has. A survey of how GIS has been and can be used in the social sciences follows. Chapter 3 focuses more intensively on the specific geospatial indicators that can identify gentrification in progress or in the near future.

### **Gentrification**

In 1964, the British sociologist Ruth Glass coined the term “gentrification” to describe the process of wealthy Londoners moving into working-class districts displacing incumbent residents and upending the character of the neighborhood:

One by one, many of the working class quarters of London have been invaded by the middle classes, upper and lower. Shabby, modest mews and cottages—two rooms up and two down—have been taken over, when their leases have expired, and have become elegant, expensive residences....Nowadays, many of these houses are being subdivided into costly flats or ‘houselets’ (in terms of the new real estate snob jargon). The current social status and value of such dwellings are frequently in inverse relation to their size, and in any case enormously inflated by comparison with previous levels in their neighbourhoods. Once this process of ‘gentrification’ starts in a district, it goes on rapidly until all or most of the original working class occupiers are displaced, and the whole social character of the district is changed (Glass 1964, p. xviii-xix).

For nearly fifty years since, researchers have dissected and disagreed on the causes, consequences, and responses to this phenomenon. This section surveys how the existing literature has defined and operationalized gentrification, why it occurs, and how GIS can help policymakers anticipate and mitigate its negative effects.

### **Competing definitions**

Many definitions of gentrification center on the entry of capital and higher-income households

## 2 LITERATURE REVIEW

into lower-income neighborhoods. Smith (1996, p. 30) articulates this as the process “by which poor and working-class neighborhoods in the inner city are refurbished by an influx of private capital and middle-class homebuyers and renters.” Hamnett (1984, p. 284) is less passive, calling gentrification the “invasion by middle-class or higher-income groups of previously working-class neighborhoods or multi-occupied ‘twilight areas’ and the replacement or displacement of many of the original occupants.” But capital and reinvestment do not necessarily come from wealthy suburbanites relocating to the urban core as the etymology of the term “gentrification” implies. Instead it may be marginally middle-income households that relocate from elsewhere in the city (Keating 2003, quoted in Aka 2010) attracted to comparatively moderate real estate prices where they can use their own labor to increase the value of their homes (London and Palen 1984).

Others posit that the phenomenon is in fact much broader. According to Sassen, until the 1970s gentrification was understood as the “rehabilitation of decaying and low-income housing by middle-class outsiders in central cities,” but a more holistic vision of “spatial, economic, and social restructuring” took hold in the 1980s (1991, p. 255). There is disagreement “whether gentrification should refer only to the residential rehabilitation described by Ruth Glass, or whether it refers to a much more large-scale production of urban space for middle-class consumers” (Slater 2011, p. 573). The latter of these two concepts—broad growth aimed at an affluent market—fits the type of development occurring in much of Seattle. Many parcels in the wholly transformed South Lake Union neighborhood were vacant or contained underutilized warehouse structures; now this area is home to corporate headquarters, high-end housing, and upscale restaurants and bars. Without upgrades to existing residences or significant displacement, is this not gentrification? Slater gives an emphatic response:

To label as anything other than gentrification the construction of upmarket housing aimed at young professionals in or on formerly working-class industrial spaces...and to use a term like ‘revitalization’ or ‘regeneration’ to characterize the implosion of low-income public housing projects in favor of mixed-income developments, is analytically erroneous and politically conservative” (2011, p. 573).

In other words, displacement is not a prerequisite. 25 years prior, Smith and Williams said as much:

## 2 LITERATURE REVIEW

In reality, residential gentrification is integrally linked to the redevelopment of urban waterfronts for recreational and other functions, the decline of remaining inner-city manufacturing facilities, the rise of hotel and convention complexes and central-city office developments, as well as the emergence of modern 'trendy' retail and restaurant districts. Gentrification is a visible spatial component of this social transformation. A highly dynamic process, it is not amenable to overly restrictive definitions" (1986, p. 3).

All of these facets of redevelopment are present today in Seattle. One wonders if Shaw had them in mind when she described gentrification as

a generalised middle-class restructuring of place, encompassing the entire transformation from low-status neighbourhoods to upper-middle-class playgrounds. Gentrifiers' residences are no longer just renovated houses but newly built townhouses and highrise apartments. Their workplaces are as likely to be new downtown or docklands office developments as warehouse studios....Designer shops, art galleries, bars and restaurants form the background to a landscape of people in semi-public space (tables on the footpath they must pay to occupy) watching the passing parade and sipping chardonnay from a boutique winery, beer from a microbrewery, coffee from organic beans grown in the developing country *du jour* (2008, p. 2).

The socioeconomic and demographic changes that accompany gentrification are a contentious space as well. Kennedy and Leonard find gentrification often, though not always, has "a very clear racial component, as higher-income white households replace lower-income minority households, sometimes in the very same neighborhoods that experienced "white flight" and traumatic urban renewal in the 50s and 60s" (2001b, p. 2).

Not only is there substantial breadth in how researchers define gentrification, but these differences have significant implications for any attempt to identify areas that have gentrified, let alone anticipate areas that are likely to. Galster and Peacock (1986) demonstrate this phenomenon in Philadelphia census tracts by modeling changes in four separate measures of gentrification: the share of black residents, the share of college-educated residents, median income, and property values. Both the quantity and location of tracts identified as gentrified varied remarkably in each scenario. Moreover, when these tracts are compared along their pre-gentrification characteristics—13 explanatory variables like the proportions of elderly, foreign-born, or owner-occupied units or proximity to a CBD or university—there is little consistency in the determinants of gentrification. Requiring that two of the definitions be met, such as a decrease in the black share *and* rise

## 2 LITERATURE REVIEW

in median income, improved the consistency among gentrified tracts, but the explanatory variables remain scattered and insignificant. Their study shows “unambiguously that how one defines gentrification crucially affects which and how many tracts are identified as having undergone gentrification, and which initial characteristics of those tracts appear to hold the greatest explanatory power for such changes” (Galster and Peacock 1986, p. 333–334). This is a critical conclusion for the present study and any attempt to model gentrification susceptibility and speaks to the need for local context in formulating a methodology for identifying gentrified, gentrifying, or likely to gentrify areas.

### **Theories of gentrification**

Not surprisingly, the range of definitions of what exactly gentrification looks like has coincided with several theories as to its causes. The two most prominent branches in the literature are supply- or production-side theories and demand- or consumption-side theories. A third, more contemporary approach seeks to account for both the social and economic components of gentrification in the modern context of urban development.

The supply-side theory of gentrification originates with Smith (1986), who posits that cheap suburban land incentivizes new commercial and residential investment and draws the middle class out of the central city. This abandonment leads to poorly maintained and neglected buildings in the inner city and causes a devalorization of land there. As a result, over time there arises a rent gap, or a discrepancy between the “actual capitalized ground rent (land value) of a plot of land given its present use and the potential ground rent that might be gleaned under a ‘higher and better’ use” (Smith 1987, p. 462). Further, the rent gap refers has both an economic component in the undervaluation of land and a historical one resulting from a “complex pattern of investment and disinvestment in the built environment” over many years that “can be closed through gentrification” (p. 463). That is, when the rent gap becomes sufficiently wide, profit-seeking developers reinvest in undervalued properties in the central city looking to capitalize on a higher potential rent. This crucial relative difference in the price of land in the city and suburbs is not driven only by market

## 2 LITERATURE REVIEW

forces, however. Various public and private actors influence the availability of land for commercial or residential development, via public-private partnerships, government efforts to promote inner-city revitalization through housing policy, and other policies like urban renewal or zoning changes (Ley 1986; Wyly and Hammel 1998). In sum, supply-side theorists attribute gentrification primarily to economic changes in the housing market and physical ones in the housing stock.

Smith's causal logic met with criticism almost immediately. The primary objection is his disregard for individual preferences (Hamnett 1991). Gentrifiers, after all, are people whose tastes and consumption patterns continually evolve. Furthermore, critics argue that gentrification occurs not just through the upgrading of derelict housing but via new development as well (Fouch 2012). This has given rise to a countervailing demand-side theory of gentrification, first advanced by Ley (1987). He introduces two new drivers of gentrification that derive from consumer consumption patterns. First, the amenities that accompany an urban lifestyle, such as distinctive landscapes like parks, historical architecture, or counterculture movements, are consistently found in gentrifying neighborhoods. Many of these cultural and environmental amenities have been "vigorously promoted" by city administrations, further suggesting the influence of the public sector on demand for central city living. Second, growth in higher-income households in the urban core is closely associated with the shift to a "postindustrial metropolitan economy oriented toward advanced services" (p. 524). Hamnett adds that gentrification begins with this new service class and its preferences (1991). Ley does not discount outright the value of housing market hypotheses, but he subordinates them relative to the urban amenity and economic components of gentrification. In formulating an operational definition of gentrification for a recent study of displacement in Portland, Oregon, Bates (2013) provides a useful and concise synthesis of these schools of thought:

Gentrification occurs when a neighborhood has attractive qualities—for example, location or historic architecture—but remains relatively low value. This disconnect between potential value and current value (called "the rent gap") may occur due to historic disinvestment by public and private sectors. When the area becomes desirable to higher-income households and/or investors, there are changes in the housing market. As demand rises for the neighborhood, higher-income households are able to outbid low-income residents for housing, and new development and economic activity begins to cater to higher-income tastes. Lower-income

## 2 LITERATURE REVIEW

households and/or households of color migrate out of the neighborhood and new in-migrants change the demographics of the neighborhood (p. 9).

While demand- and supply-side explanations have traditionally been the two schools of thought on the causes of gentrification, other more nuanced theories have arisen in response to particular forms of neighborhood change. Gafvert (2011, p. 16) describes the phenomenon of black gentrification, where majority black neighborhoods experience in-migration of higher-income black gentrifiers. Many of the same supply- and demand-side drivers are present here, but Boyd (2008, p. 754, quoted in Gafvert 2011) argues that black gentrifiers relocate to predominantly black neighborhoods in order to avoid the discrimination they experience elsewhere and invest there to support that community. Other variants have evolved as well, such as “greentrification” and “studentification,” which refer to change brought on by in-migrants into rural areas and student populations, respectively (Smith and Holt 2007; Smith and Phillips 2001; Butler 2007, p. 170).

### **Displacement**

The most frequently cited negative consequence of gentrification is the displacement of lower-income households that cannot keep pace with escalating rents or property taxes in a tightening housing market. There is often, though not always, a racial component. In Atlanta, for example, whites moving into predominantly black neighborhoods create a volatile and “reversed racial tension” (Aka 2010). Struggles between gentrifiers and incumbent residents or groups opposed to gentrification are not uncommon (Heidkamp and Lucas 2006, p. 104). In Seattle, though, race is merely a corollary of a larger process of socioeconomic change. According to McGee (2007b),

Most observers in Seattle and across urban America have been concerned about the racial displacement that seems to inevitably follow gentrification. Those concerns miss the mark. The gentrification of the Central District, and much of Seattle, is much more about class than race.

Kneebone and Berube have done excellent research on how gentrification has pushed many working-class families out of the city completely. The geography of poverty in many U.S. metro areas has changed through what they call the suburbanization of poverty (2013).

Their research speaks to a more recent effort by some scholars to decouple the gentrification

## 2 LITERATURE REVIEW

debate from its limited origins in 1960s deindustrialization and working-class displacement. Butler has vociferously pushed back against the conventional understanding of gentrification as merely a force for displacement of working-class individuals (2007). That notion fit a particular historical context but is now outdated. In another era, it was our occupations that primarily determined social class and, in large part, how we “make sense of our lives” (p. 163). Today, though, we increasingly express our cultural preferences through where we choose to live and with whom. Accordingly, gentrification no longer occurs only in places like “London’s working-class inner suburbs” of fifty years ago but in a range of neighborhoods and exurbs throughout the “metropolitan hinterland” (p. 163). As a result, Smith and Holt (2007, p. 43) argue for a “wider lifecourse perspective on gentrifiers” that explores in more depth the “formative phases of [their] social and cultural preferences.”

Empirical evidence that displacement is the primary mechanism by which gentrification effects socioeconomic change has generally been difficult to find. Two of the first studies to challenge the conventional wisdom that gentrification inevitably displaces lower-income households are methodologically problematic (Freeman and Braconi 2004 and Vigdor 2002, quoted in Freeman 2005). Though they find that poor and less educated households in gentrifying neighborhoods are in fact less likely to move than similar households elsewhere, but their broad unit of analysis and lack of a baseline level of displacement weaken the conclusion. Freeman (2005) addresses these shortcomings. He finds a modest link between gentrification and displacement, concluding that other factors such as the vacancy rate are greater determinants of whether someone moves. Furthermore, the characteristics of the in-movers have an important effect on how gentrifying neighborhoods change.

### **Positive impacts**

Despite its resoundingly negative connotation, gentrification is not inevitably a harmful process. Newcomers to a neighborhood, for example, can bring positive change. Chapple (2009, p. 1) notes that in-migration of college-educated artists may be “renovating former commercial spaces, creating public art, or offering low-cost art classes.” Though rising median income is a

## 2 LITERATURE REVIEW

frequently used telltale sign of gentrification in progress, it may be driven in full or in part by long-time residents attending college and finding new employment opportunities. The amenities that reinvestment in a neighborhood provides, though liable to push real estate values up, can also benefit a range of households; public space improvements are a good example. And while displacement is without question a troubling phenomenon, the silver lining, so to speak, is that homeowners see new value in their property should they decide or be forced to sell (Chapple 2009). Still, Bates (2013) notes that “investments to improve a neighborhood, which can have many positive outcomes for current residents, can make the neighborhood more attractive and create upward pressure on rents and property values. The key distinction between revitalization and gentrification is the negative consequence of involuntary residential displacement” (p. 4).

Some cities also tie new development to investment in affordable housing. This is currently a contentious issue in Seattle (Barnett 2013a, 2013b; Copeland 2013). Even though everyone sees the need for subsidized units, there is disagreement whether it should be concentrated in the gentrifying areas or dispersed more evenly throughout the city. In any case, lots of residential development at least presents the opportunity for requirements or incentives to build affordable units along with market rate.

Nevertheless, evidence in the literature suggests rarely, if ever, does everyone benefit from this type of economic development. Nelson (1988, p. 24) argues that while gentrification may revitalize certain neighborhoods, it cannot reverse decline of an entire city. This is because gentrification is the movement of investment within a city or the “displacement of disinvestment” (Gafvert 2011, p. 22). In other words, prosperity is zero sum, one neighborhood upgraded only at the expense of another. In Seattle, however, this is not the case; no section of the city is experiencing disinvestment in any measure sufficient to balance the boom in development in areas like Capitol Hill or South Lake Union. Instead, the disinvestment may be displaced outside the city limits to places like Tukwila, where housing remains affordable (Kneebone and Berube 2013).

## 2 LITERATURE REVIEW

### GIS

#### Overlay mapping

A suitability analysis is a common type of GIS research that examines a number of criteria or indicators to identify the area or areas ideal for a particular use or most likely to experience a certain outcome. GIS allows these datasets to be overlaid on top of one another in order to visualize where positive and negative factors coincide spatially. The technique was pioneered in the 1960s by Ian McHarg, who wanted to synthesize large spatial datasets into a compelling vision of the costs and benefits of a contentious highway project. By overlaying transparent maps classifying social, housing, and environmental data on a scale of light to dark values, he produced a composite heat map showing where the impact of the highway on the public was least (Corbett). Critics of overlay mapping argue that the assumptions that underlie the map algebra, or the mathematical equation by which layers are summed into a final index, are often unknown or misunderstood. Surveying experts or stakeholders, however, can elucidate the relationships among the data layers and improve the accuracy of this method (Malczewski 2004).

Since McHarg's initial study, more complex applications of multi-criteria modeling have arisen. For example, overlay mapping is useful for determining where to locate infrastructure like power plants according to their social and environmental impacts; identifying areas most vulnerable to a natural disaster due to their socioeconomic, elevation, and transportation network; or finding the ideal route for a new transit line based on the demographic and socioeconomic characteristics of the areas it passes through. It facilitates the integration of social, environmental, and physical variables. In truth there are much more complex spatial phenomena that this approach can help to answer, and with technological improvements producing novel kinds of data there are continually new applications for spatial analysis.

#### Indicators

The sustainable development field has a long history of using indicators to measure progress

## 2 LITERATURE REVIEW

and performance on various measures. Many municipal governments, the City of Seattle among them, publish sustainability indicators to explore linkages among social, economic, and environmental trends and catalyze action on sustainability among the public, though if disconnected from the planning process they are often ineffective (Brugman 1997). Indicators also figure prominently in various geospatial suitability studies. Though it has its origins in the fields of ecology and landscape planning, GIS is frequently used to identify and measure social phenomena. Huber et al. (2009), for example, review how GIS has been employed to identify target neighborhoods for a community initiative based on their physical and demographic characteristics. Perkins, Larsen, and Brown (2009) use GIS to quantify community-level impacts of a neighborhood revitalization project. In housing research specifically, however, GIS has been underutilized, either due to lack of knowledge about available tools or difficulty acquiring data that are current and useful (Can 1998).

### **The use of GIS to predict gentrification**

Several previous studies use geospatial analysis to identify gentrifying or likely to gentrify areas. These are discussed in depth in Chapter 3. There is an important methodological distinction between using a set of pre-defined indicators to highlight gentrified or gentrifying areas and identifying currently lower-income neighborhoods whose mix of socioeconomic, demographic, and built environment characteristics signal vulnerability to gentrification in the near future. The latter is without question more difficult—and almost certainly more useful. Furthermore, a study's predictive power depends largely on data quality, but even when blessed with ample local and regional data sources it is a “significant challenge to determine which data are truly useful in predicting and acting on gentrification trends” (Kennedy and Leonard 2001a, p. 2). Regional forces like tight and imbalanced labor markets are often strong drivers of gentrification, but not always. Local trends in transit access or housing tenure are common precursors, though some transit-rich, rental-dominated neighborhoods go years without experiencing gentrification (Kennedy and Leonard 2001b). Despite the theoretical disagreement on drivers of gentrification, London et al. (1986) have found that both supply-side and demand-side factors contribute to gentrification.

## 2 LITERATURE REVIEW

The studies examined in Chapter 3 are not merely theoretical exercises. Spatial analysis of neighborhood change is a powerful tool for policymakers. Chapple (2009, p. 9) notes that each of the 19 factors she identifies as responsible for gentrification in the Bay Area has “a direct implication for planning.” If transit access makes a neighborhood more likely to gentrify, then along with transit improvements planners should examine how to preserve housing affordability. If amenities like open space are associated with gentrification, then open space improvements ought to come with plans for affordable housing and be designed to “support the existing population, rather than some potential future residents” (p. 10).

# 3 GENTRIFICATION INDICATORS

In addition to an extensive literature on gentrification, why it occurs, and whom it effects, there are several empirical studies of the factors that accompany and contribute to this phenomenon. This section looks closely at these indicators. First, I examine non-GIS studies, which take a statistical approach to identifying variables associated with gentrified neighborhoods. Then I review the relatively few studies that have employed GIS to measure gentrification susceptibility—a range of approaches, each one with a unique set of strengths and limitations—and present a critique of that research with the goal of advancing the process.

## **Non-GIS studies of gentrification indicators**

These studies draw heavily on census data or expert opinion to ascertain the changes that accompany gentrification. Some have attempted to model future trends to predict where gentrification and displacement will occur. One of the earliest is Melchert and Naroff's (1987) assessment of demand-side factors believed to attract gentrifiers in Boston. They establish a set of social, economic, housing, and amenity variables from the U.S. Census and run a logistic regression for a sample of blocks that did and did not gentrify over 1970–80. Those found most strongly correlated with gentrified areas were older housing stock, open spaces of six to ten acres, proximity to the CBD, and below-average housing prices (p. 678). However, their model considers the housing market only in how gentrifiers react to it (Gafvert 2011, 24). Alternatively, Torrens and Nara introduce a hybrid automata model for predicting where gentrification will occur (2007). In essence, this approach attempts to simulate the complex interaction of both demand- and supply-side variables over time to produce a future reality of gentrified and non-gentrified areas. Their primary limitation, of course, is that human behavior is extremely difficult to predict.

### 3 GENTRIFICATION INDICATORS

As a result, many have turned to suitability analyses wherein the present characteristics of a neighborhood determine its susceptibility to gentrification in the future. The key difference here is that modeling attempts to construct the future; a suitability analysis is valid only insofar as the current conditions persist. Chapter 2 highlighted the longstanding debate about the causes of gentrification. Some suitability analyses find support for social drivers like changing family structures, others for economic drivers such as fluctuations in housing demand and supply (Kennedy and Leonard 2001a). But none of these *always* leads to gentrification. Regional-level phenomena, for example, such as rapid job growth or tightening housing markets, sometimes enable gentrification—and sometimes do not (Kennedy and Leonard 2001b). There are inherent limitations in any suitability analysis.

Kennedy and Leonard (2001a, 2001b) enumerate several factors that have contributed to gentrification in Atlanta, Cleveland, Washington, D.C., and the San Francisco Bay Area. Both demand- and supply-led variables are present. First, rapid job growth increases housing demand. Second, housing markets tighten due to a combination of constrained supply, lack of affordability, lucrative investment potential, and a large rent gap, all of which lead many residents to move into currently lower-cost neighborhoods. Third, certain residents prefer the characteristics of urban living, such as access to a variety of businesses and amenities, cultural diversity, or vibrant street life. They note this is valuable indicator for neighborhoods most likely to gentrify in the future. Fourth, increases in congestion and commute time contribute to demand for central city housing and access to transit. Fifth, they note the effect of public sector policies either to facilitate or to impede gentrification (Kennedy and Leonard 2001a).

This is a helpful synthesis of supply- and demand-side drivers of gentrification. But more importantly for the present study, Kennedy and Leonard interview academics, community activists, and developers in their four case study cities to elicit “static and dynamic indicators [that] may provide insight as to which communities are beginning the gentrification process” (Kennedy and Leonard 2001a, p. 8). Among the factors indicating gentrification vulnerability are a high percentage

### 3 GENTRIFICATION INDICATORS

of renters; easy access to job centers (highways, existing transit lines, or planned transit stations); increasing congestion and commute times; high architectural value; and comparatively low housing values (i.e., a large rent gap). Other variables suggest gentrification that is already in progress, such as a shift from rental tenure to homeownership. A decline in Federal Housing Administration (FHA) financing reflects the changing income level of prospective homebuyers. Growth in urban amenities like entertainment and cultural venues or valet parking—as well as in the households interested in them, such as artists, young professionals, and gay/lesbian households—demonstrates that gentrification has fully taken root (Kennedy and Leonard 2001a, p. 8).

There are challenges, however, when it comes to quantifying these indicators. Some are not easily measured, such as largely subjective variables like architectural value. Many are context-specific, such as changes in commute time and the resulting value of proximity to highways and transit, both of which depend heavily on the particular street network and transportation system of a metropolitan area. Further, it is challenging to deduce from a single indicator how a neighborhood is changing. Does an increase in household income reflect a gentrifying census tract or “growth in incomes of original residents” (Kennedy and Leonard 2001a, p. 8)? Most importantly, some oft-cited characteristics of a gentrified neighborhood do not serve as indicators of vulnerability (Kennedy and Leonard 2001b). Kennedy and Leonard make the excellent observation that “descriptive data measuring gentrification largely *after* it occurs, such as increasing average incomes, a high rate of property turnovers, increasing housing values, declining minority populations, and displacement of original residents, could be useful in assessing gentrification but does little to aid policymakers and others as they attempt to address gentrification in progress” (Kennedy and Leonard 2001a, p. 7). In other words, there are crucial distinctions to make among the stages of gentrification—past, present, and forthcoming—and the signs that it is underway are not necessarily useful as predictors of vulnerability to future change.

Aka (2010) has a two-part exploration of neighborhood change in Atlanta. First, he discusses political, economic, and social drivers of gentrification. Through Atlanta’s Urban Enterprise Zone

### 3 GENTRIFICATION INDICATORS

(UEZ) program, property owners in designated distressed areas get substantial tax incentives for private development and investment. As a result, UEZ zones have seen significant increases in median home value and rent prices. Although a provision requires 20 percent of units be reserved as affordable, Atlanta uses metro area median income (\$63,000), not city median income (\$35,000), as its basis for affordability. In other words, tax abatement zones may contribute to gentrification if coupled with ineffectual affordability standards. On the economic side, Aka blames an imbalance between job growth and housing supply. Atlanta has seen rising home prices because of a large rent gap in dilapidated areas and demand to live close to job centers and downtown. Proximity to the CBD matters more than historic architecture here. Finally, he describes gentrifiers as individualistic and “able to emerge [sic] themselves in pro-urbanism—gaining acceptance of alternative lifestyles, different ethnic and racial groups, and taking responsibility for social injustices” (p. 4). Further, he argues that low-income and minority groups fall victim to displacement due to an inability to recognize the process of gentrification or unify against it. Presumably this is coupled with the economic challenge of simply being unable to afford rising rents and taxes (McGee 2007b).

Then, Aka uses five variables to trace the spread of gentrification through several Atlanta neighborhoods. First, he argues that change in the racial composition of a neighborhood—which he reduces to percent white and percent black, since together they total 90 percent of the population—is a primary indicator of gentrification. This is quite possibly true in Atlanta but would need to be reconsidered in studies of other metro areas. Second, he measures change in the senior citizen population (age 65 years and older) on the logic that, living on a fixed income of social security and retirement checks, many seniors cannot keep up with the rising cost of living in a gentrifying neighborhood. This logic is sound, though others have found a high concentration of seniors to deter potential gentrifiers (Helms 2003; Gafvert 2011). Third, his measure of education attainment is percentage change in residents without a high school diploma, with only a high school diploma, with an Associate Degree, and with a Bachelor’s Degree. Fourth, Aka considers changes in individual median income. Fifth, he looks at change in the cost of housing measured through median home

### 3 GENTRIFICATION INDICATORS

value and median gross rent prices, both of which soared from 1990 to 2000. These variables are listed in Table 1. Analyzed independently, each of these factors indicates that gentrification is progressing in these neighborhoods; as a set, these variables portray the complex restructuring taking place. Given that his primary objective is to provide recommendations on “how to minimize the negative effects of gentrification, how to create and preserve a stable community, and how to promote the idea that gentrification is not marketed for the whites only but for everybody,” Aka succeeds in assessing past neighborhood-level changes in Atlanta, though his approach does not directly consider identifying susceptibility to future gentrification (p. 6).

In addition to displacement, another defining characteristic of gentrification is residen-

Table 1: Factors associated with gentrification identified by Aka (2010)		Correlation
TRACT LOCATION		
1	Change in racial composition (increasing share of white residents and decreasing share of black residents)	-
2	Increase in senior citizen population	+
3	Neighboring tract income (average income of 10 closest tracts, weighted by tract population and the inverse of distance from the tract)	+
HOUSING		
4	Share of housing units built before 1940	+
5	Housing vacancy rate	+
DEMOGRAPHIC CHARACTERISTICS		
6	Share of non-Hispanic black residents	+
7	Share of Hispanic residents	+
8	Share of renters	+
9	Share of college graduates	-

tial renovation. Throughout the 1980s and 1990s, many empirical studies found evidence that building age was the only significant determinant of property upgrades. Helms (2003) challenges this conclusion and posits that neighborhood characteristics, access to amenities, and structural attributes other than building age also matter. Through a study of block- and parcel-level data on renovation activity in Chicago from 1995 to 2000, he confirms the significant role of building age but demonstrates that housing density, vacancy, accessibility to the CBD, neighborhood amenities, racial composition, median income, and age distribution are also significantly correlated with improvement activity. If home upgrades are a proxy for gentrification in progress, then Helms iden-

### 3 GENTRIFICATION INDICATORS

tifies several of its most robust correlates. Though not a predictive model per se, it does suggest that areas with higher residential density and closer to downtown are more likely to experience renovation, if they haven't already. Helms cautions, however, that while gentrification almost always entails residential upgrades, not all residential upgrades are indicative of a gentrifying neighborhood.

Kolko (2007) provides the first interregional analysis using census data from 1980 to 2000 from multiple cities to explore why certain areas gentrify. He analyzes changes in tract-level household income from 1990 to 2000 as a measure of gentrification and draws his explanatory variables—location, housing, and demographic characteristics—from the Neighborhood Change Database. Location is measured as distance from the CBD centroid to the tract centroid, though Kolko acknowledges the limitations of using straight-line distance (versus following the street network) and choosing a single CBD when many cities have multiple major employment centers. As a proxy for high potential rent, Kolko uses the percentage of pre-1940 units. Demographic measures include share of non-Hispanic black residents, Hispanic residents, and renters at the tract level. He also included the percentage of college graduates. Furthermore, Kolko is the first to look closely at the “neighborhood spillover” effect. His study evaluates the impact that high neighboring-tract household income has on potential gentrification of lower-income tracts. He defines neighboring tract income as “the average income of the ten closest tracts, weighted by tract population and the inverse of the distance from the tract” (p. 9).

His results, shown in Table 2, confirm what other previous studies had found: lower-income city neighborhoods gentrify if they are closer to the city center and have older housing stock. He finds demographic factors to have a less significant effect on likelihood of gentrification, though tract income grows faster where the shares of Blacks and renters are lower and college graduates higher. The neighborhood spillover effect, measured through neighboring-tract income, is also found contribute significantly to gentrification, though less so than distance to the CBD and pre-1940 housing units. With data from several cities, Kolko notes that the impact of these factors

### 3 GENTRIFICATION INDICATORS

varies depending on the characteristics of the metro area. Proximity to downtown, for example, matters more in sprawling cities. Older housing matters more in metros with less of it. In other words, these variables have a greater impact where they are scarce. The neighborhood spillover effect is also stronger in higher-density cities, presumably where neighborhood characteristics can more easily diffuse from one tract to another. Interestingly, though, he tests how these variables change in higher-income and suburban tracts where gentrification per se cannot occur and finds almost all associated with higher income growth. In other words, lots of pre-war housing and wealthy neighbors makes any tract likely to get trend upwards in income. This is not surprising. In sum, Kolko finds support for previous predictions that proximity to the city center and older housing stock increase likelihood of gentrification, especially in larger, newer metro areas. His primary addition is the significant effect of neighboring tract income.

Table 2: Factors associated with gentrification identified by Kolko (2007)		Correlation
TRACT LOCATION		
1	Distance from CBD centroid to tract centroid	-
2	Commute time from decennial census	+
3	Neighboring tract income (average income of 10 closest tracts, weighted by tract population and the inverse of distance from the tract)	+
HOUSING		
4	Share of housing units built before 1940	+
5	Housing vacancy rate	+
DEMOGRAPHIC CHARACTERISTICS		
6	Share of non-Hispanic blacks	+
7	Share Hispanic	+
8	Share of renters	+
9	Share of college graduates	-

### GIS studies of gentrification indicators

Not only have researchers addressed which factors correlate with gentrification but also used overlay mapping to identify where. Each of the following studies advances a particular methodology for choosing indicators of susceptibility to gentrification and structuring the GIS model. Several are Master’s theses or reports from non-profit or advocacy organizations. Many of these studies begin

### 3 GENTRIFICATION INDICATORS

with the same goal—to identify neighborhoods vulnerable to gentrification—but do not learn from the lessons of previous attempts. To date, there is no peer-reviewed literature advancing an ideal methodology for this complex process.

Nesbitt (2005) is one of the first to use GIS to this end. His analysis is a case study of St. Petersburg, Florida, a location in many ways similar to Seattle. Both have substantial job growth in high-paying sectors, are surrounded by water and thus constrained geographically, and are nearly fully built out. Nesbitt chooses at the outset four gentrifiable neighborhoods and identifies a “control neighborhood” that shares many of their characteristics but is not receiving the same level of attention from planners, officials, and the public as to its potential to gentrify. His study, then, tests the hypothesis that these four neighborhoods will gentrify as the city continues to grow economically. He considers 16 indicators based on the “gentrification literature and the researcher’s definition of gentrification” (2005, p. 26). They are divided in two groups, regional to neighborhood comparisons and neighborhood-specific indicators, and listed in Table 3. His 12 regional to neighborhood comparison indicators evaluate neighborhood-level variation in demographic or housing changes compared to the larger region. Included here are increases in residents with post-secondary degrees, population, housing units, age cohorts 25-34 and 55-65, area median income, percentage of occupied housing units, percentage of owner-occupied units, and unit size, among others.

Though he finds a positive relationship for all of them, some of his stated justifications make spurious connections. It is unclear, for example, how tract-level population change relative to regional population change over multiple decades indicates susceptibility to gentrification. The connection he advances is that “rapid population increase usually relates to a growing job market, one of the leading indicators of gentrification” (p. 27). But why not, then, measure job growth directly? Further, while larger homes do attract higher incomes, he makes a substantial leap to use unit size as an indicator of gentrification vulnerability. In fact, many gentrifying areas are characterized by growth in smaller units appropriate for childless households (Holden 2013; Balk 2013).

### 3 GENTRIFICATION INDICATORS

Nesbitt also incorporates change in mean commute time on the premise that longer commutes are a primary reason residents move back to central cities. Again, the connection between long commutes and a desire to relocate may well exist. But commute times across a region can change for other reasons, too, such as the strength of the local economy, the adequacy of the transit system, or changes in housing development. He posits that “the change in commute time is a major indicator of gentrification according to the gentrification literature, as neighborhoods experiencing gentrification should register decreasing commute times,” but he never fully articulates this logic and refers to only one study that mentions it (Kennedy and Leonard, cited in Nesbitt 2005, p. 15). Further, he presents no evidence that longer commutes could not just as easily motivate suburbanites to relocate to an entirely new city rather than the urban core of their current metro area. If anything, the former is much less of a lifestyle adjustment for a household moving solely for a shorter commute. On the other hand, his four neighborhood-specific indicators comport with similar studies. These include the share of pre-1950 housing, proximity to the CBD, proximity to major transportation corridors, and historical designations.

Table 3: Factors associated with gentrification identified by Nesbitt (2005)		Correlation
REGIONAL TO NEIGHBORHOOD COMPARISON INDICATORS		
1	Share of jobs requiring post-secondary education (AA, AS, BA, BS, MA, MS, Ph. D., technical certificate)	+
2	Change in population	+
3	Change in total housing units	+
4	Change in college-education population	+
5	Change in age-cohort 25-45	+
6	Change in age cohort 55-65	+
7	Change in area median income	+
8	Change in median owner-occupied unit value	+
9	Change in average commute time	+
10	Share of occupied housing units	+
11	Share of owner-occupied housing units	+
12	Unit size	+
NEIGHBORHOOD-SPECIFIC INDICATORS		
13	Share of pre-1950 housing	+
14	Proximity to CBD	+
15	Proximity to major transportation corridors	+
16	Historical designations	+

### 3 GENTRIFICATION INDICATORS

It is worth discussing the particular method Nesbitt proposes for determining the weight of each of his 16 indicators: a deterministic neighborhood value analysis. This is the methodological centerpiece of this thesis. Deterministic neighborhood value analysis computes a gentrification index using the following formula:

$$I = C_1X_1 + C_2X_2 + \dots + C_nX_n$$

where I = index

$C_1$  = weight of indicator  $X_1$

$C_2$  = weight of indicator  $X_2$

$C_n$  = weight of indicator  $X_n$

Nesbitt determines these weights using the pairwise comparison method (Saaty 1980, quoted in Nesbitt 2005). This method matches each variable head-to-head with each of the other variables to determine its relative weight. With these factor weights established, Nesbitt then performs a weighted suitability analysis with his two groups of indicators—regional to neighborhood comparisons and neighborhood-specific indicators. He concludes from the literature that the former are more significant determinants of gentrification susceptibility—factors like increasing commute times, rapid job and population growth, and demographic change—than the neighborhood-specific indicators like location and architectural character. As a result, he weights the “regional” factors with a coefficient of 0.8 and the “neighborhood” factors with a coefficient of 0.2, a ratio that “gives the regional to neighborhood comparison indicators the majority of the weight without marginalizing the effects of the neighborhood-specific indicators” (p. 35). The indicators are then reclassified in his GIS to the binary values of 0 and 1 using the “regional” values as the threshold for each factor. In other words, since the percent change in AMI for all of St. Petersburg over the 1980-2000 period was 193 percent, tracts experiencing a change greater than 193 percent are reclassified as 1 and those less than 193 percent as 0. This speaks to the lack of a universal methodology across the gentrification literature for identifying vulnerable neighborhoods: “Since gentrification literature gives neither universal thresholds nor any direction on how to stratify the reclassification of values based on preset thresholds, reclassification based on the city values using the binary system was the most appropriate and effective means of evaluating each indicator” (p. 51).

### 3 GENTRIFICATION INDICATORS

In the end, Nesbitt’s model computes a likelihood of gentrification ranging from 15.59 percent to 73.58 percent for the four target neighborhoods with the control neighborhood (40.72 percent) right in the middle, suggesting it “should be re-evaluated in its role as the control neighborhood” (p. 53). Despite a handful of methodological shortcomings, his study is still a valuable contribution to the gentrification indicators literature. He proposes to represent qualitative information like “affinity for architectural style or the desire to be close to the amenities of the central business district” through the quantitative measures of pre-1950 housing and proximity to CBD, however spurious some of those connections may have been (p. 60). Further, his analysis illuminates the difficulty in assessing gentrification risk *a priori*; choosing weights and thresholds; and determining “tipping points” to monitor neighborhood change for use in policymaking—all of which have a very substantial effect on the final results of the model and its predictive power.

Heidkamp and Lucas (2006) highlight the importance of proximity to a water body in their exploration of the gentrification frontier, the border between gentrified and non-gentrified areas, in Portland, Maine. This is an important lesson for the Seattle analysis given its surroundings. They also find that gentrified and non-gentrified areas are distinguished by differences in age, educational attainment, and housing tenure, among others listed in Table 4.

Table 4: Factors associated with gentrification identified by Heidkamp and Lucas (2006)		Correlation
1	Proximity to water body	+
2	Change in share of population living in owner-occupied housing	-
3	Change in share of population living below poverty line	-
4	Change in the share of population in technical, managerial, or professional occupations	+
5	Change in household median income	+
6	Change in the percentage of the population with four-plus years of college	+
7	Change in the percentage of persons aged 25–45 years	+

Levy (2009) performs a very limited GIS analysis of gentrification risk in the Pilsen neighborhood of Chicago using only the three variables listed in Table 5: the age of residential building stock, market value change, and property tax increases. Her model suffers from two primary shortcomings. First, it is unclear what stage of gentrification she seeks to identify. Older housing stock often predicts future gentrification, but her property tax and tax assessor’s data is four years old at the

### 3 GENTRIFICATION INDICATORS

timing of writing, so the above-average growth in housing value they indicate suggests gentrification already underway. Second, with only three variables her study ignores several factors commonly used to measure or portend gentrification, namely locational variables like proximity to transit. Finally, by her own admission, “Examining gentrification on such a small scale may require more comprehensive data and a longer timeframe for analysis” (p. 38).

Table 5: Factors associated with gentrification identified by Levy (2009)		Correlation
1	Age of residential building stock	+
2	Market value change	+
3	Property tax increases	+

In *Mapping Susceptibility to Gentrification: The Early Warning Toolkit*, Chapple (2009) takes a methodological step forward. She categorizes how neighborhoods changed in the Bay Area from 1990 to 2000 and extrapolates from the factors accompanying this change to predict where gentrification is likely to occur in the future. “If these factors caused gentrification in the past,” her logic goes, “then they are likely to make neighborhoods more susceptible to gentrification in the future.” By drawing on previous gentrification in the Bay Area to identify currently at-risk neighborhoods, she addresses the definitional predicament raised by Galster and Peacock (1986). Her study characterizes gentrification as “starting as a low-income neighborhood in a central location, and experiencing increases in household income and educational attainment greater than the Bay Area region as a whole” (p. 3). Nelson (1988) uses a similar definition of gentrification in her study of ten cities. With this starting point, Chapple finds 102 census tracts that gentrified from 1990 to 2000, or 7.3 percent of all tracts and 6 percent of all households. Nearly 93 percent of Bay Area tracts, therefore, fall into one of five other patterns of neighborhood change: becoming bipolar (seeing growth in both the lowest and highest income groups), becoming middle income, becoming lower income, becoming other income, and other. Note that the assumption built into this approach is that the drivers of gentrification in the past continue to have that effect today.

Chapple finds several factors responsible for the patterns of neighborhood change from 1990 to 2000. One of the most noteworthy is the relationship between transit and gentrification, a

### 3 GENTRIFICATION INDICATORS

link no research has previously examined (p. 2). Gentrifying neighborhoods were more than twice as likely as any other type of neighborhood to be located within a half-mile of a transit stations. In total, Chapple's multivariate regression of the 102 gentrifying tracts in the Bay Area identifies 19 factors categorized as income factors, demographic factors, housing factors, location, transportation access, and amenities, ranked by their influence in Table 6. Overall, the most significant drivers of gentrification, according to Chapple's findings, are access to public transit and amenities—more important than “who lived in the neighborhood in 1990, or where it was located in the region, or even the characteristics of the neighborhood” (p. 6). Proximity to amenities such as youth facilities and public space and proximity to a transit station top the list. Additionally, Chapple identifies not only predictors of gentrification but also factors that make a neighborhood less likely to gentrify. The presence of public or nonprofit recreational facilities, for example, may suggest a higher presence of disadvantaged groups in the neighborhood and deter gentrifiers. Likewise a concentration of households with more than three cars reflects auto-dependent suburban areas with poor transit access. These are not central locations and are generally not susceptible to gentrification.

To predict future vulnerability, Chapple scores each tract based on whether it is above or below the region average on each of the nineteen factors from 2000 shown in Table 6, the same approached used by Nesbitt (2005). A tract in the East Northside neighborhood of San Jose, for example, “has a below average share of non-Hispanic whites (13 percent compared to 50 percent in the region) but an above average share of overburdened renters (35 percent compared to 30 percent in the region). Since tracts with a below average share of non-Hispanic whites are more likely to gentrify, this neighborhood scores 1 on this factor; likewise, since tracts with above average rent-burdened households are more likely to gentrify, this neighborhood also scores 1 on the rent burden factor” (Chapple 2009, p. 7). The sum of these scores forms the susceptibility index, which Chapple maps across the Bay Area region. Tracts that are “highly susceptible” score 1 on at least 16 factors and have a median income below the regional median.

### 3 GENTRIFICATION INDICATORS

Table 6: Factors associated with gentrification identified by Chapple (2009)		Correlation	Rank
TRANSPORTATION			
1	% of workers taking transit	+	4
2	% dwelling units with 3 or more cars available	-	2
AMENITIES			
3	Youth facilities per 1,000	+	3
4	Public space per 1,000	+	5
5	Small parks per 1,000	+	17
6	Recreational facilities per 1,000	-	1
LOCATION			
7	Distance to San Jose	+	14
8	Distance to San Francisco	-	16
DEMOGRAPHIC			
9	% non-family households	+	8
10	% married couples with children	-	9
11	% non-Hispanic white	-	12
INCOME			
12	Income diversity	+	6
13	% renters paying > 35% of income	+	11
14	% owners paying > 35% of income	-	15
HOUSING			
15	% dwelling units in buildings with 5+ units	+	7
16	% dwelling units in buildings with 3-4 units	+	10
17	% renter-occupied	+	13
18	Public housing units	+	19
19	Median gross rent	-	18

Chapple's findings have influenced several subsequent studies of gentrification susceptibility. Gafvert's (2011) Master's thesis draws heavily on Chapple's work and presents likely the most comprehensive set of indicators to date. Like most of the literature seeking to predict neighborhood change, Gafvert follows the case study model and applies her work to Cincinnati, Ohio. Where Chapple develops her indicators exclusively from statistical analysis of past Bay Area change, Gafvert builds hers from the broad literature on gentrification indicators and, like Chapple, includes factors both positively and negatively associated with gentrification. She selects only those factors that appear in multiple studies, a decision that grounds her research in the existing literature but also somewhat limits her potential to advance it. Breaking with previous research, however, Gafvert distributes her list of indicators in a survey to Cincinnati-area experts and asks respondents to rank

### 3 GENTRIFICATION INDICATORS

the factors according to their importance in contributing to or preventing gentrification in Cincinnati. Though she does not refer to his advice, Nesbitt's (2005) study concludes that

community involvement in determining the weights and acceptable thresholds could greatly strengthen the validity of the model, as the value and thresholds related to community indicators are usually decided upon by members of the community.... More accurate weights could be developed by surveying other housing and planning experts as well as area residents through public meetings or written surveys. The range of weights relating to each indicator reported in the surveys could, perhaps, be averaged to determine the actual weight used in the model; therefore, creating a better equation with more accurate results (p. 59).

Respondents to Gafvert's survey are professionals in the real estate, community development, economic development, housing, and planning fields. Given the disagreement present in the literature about the causes of gentrification, the survey allows Gafvert to judge the weight of each factor according to expert opinions and "resolve some of the conflicting perspectives...in the literature" (p. 40). It also helps her analysis reflect the specific context of gentrification in Cincinnati.

The set of indicators distributed in the survey borrows many Chapple's factors but also draws heavily from Heidkamp and Lucas's (2006) analysis of the gentrification frontier in Portland, Maine; Galster and Peacock's (1986) work on alternative definitions of gentrification; Beauregard's (1986) study on demand- and supply-side drivers; and Aka's (2010) analysis of gentrification in Atlanta; among others. Gafvert makes several additions to Chapple's foundation, such as adding to the demand-side variables a concentration of historic buildings, proximity to the waterfront, and proximity to a university. These assets raise property values and increase potential rents. In the demographic category, a high minority or a foreign-born population are said to contribute to the overall diversity of a neighborhood, which "gentrifiers value over the homogeneity of the suburbs" (Gafvert 2011, p. 36). Paradoxically, though, these minority or immigrant populations are often those most vulnerable to displacement as gentrification occurs. On the economic side, Gafvert includes factors that indicate high potential rent, or a property that could be easily acquired and upgraded by developers or gentrifiers (p. 58). These are proximity to a CBD or to already-gentrified areas; low dwelling value and low gross rent; a concentration of foreclosures; a concentration of vacancies; and low median household income. Gafvert also incorporates factors that discourage

### 3 GENTRIFICATION INDICATORS

gentrification. In addition to proximity to public or nonprofit recreational facilities, drawn from Chapple (2009), Gafvert includes a concentration of seniors, which Helms (2000, p. 493) argues are not desirable for gentrifiers. Gafvert argues that a concentration of public housing units affects gentrification susceptibility in two opposing ways, either increasing it by lowering capitalized rent or decreasing it by deterring potential gentrifiers “due to stigma” (p. 33).

Where Gafvert most deviates from Chapple’s foundation, however, is by adding a fourth category of policy and regulatory factors. These six variables encourage private investment and create a favorable environment for developers to upgrade properties and attract gentrifiers. These factors include warehouse structures within or adjacent to a residential zone; location within a tax increment financing district; proximity to a brownfield redevelopment or in a Neighborhood Business District Improvement Program, a Cincinnati-specific program with counterparts elsewhere; location in a historic district; and proximity to an active community development corporation (CDC) (p. 35).

After enumerating 33 factors present in the literature, Gafvert excludes 16 of them (italicized in Table 7) either because of disagreement among survey respondents about the its effect on gentrification or difficulty representing it spatially (p. 46). All of her demographic factors—non-family households, non-Hispanic white population, concentration of households with 3 or more cars, and so on—are omitted. The remaining 17 data layers are used in her suitability analysis for gentrification susceptibility, but without the entire category of demographic data, as well as key other factors such as a concentration of rental units or multi-unit buildings, her predictive power is limited. Including more of the full suite of factors Gafvert develops is a primary way I can improve upon her analysis. Furthermore, she makes spurious links between certain factors and gentrification, like proximity to an area with growth in white collar jobs; while these employees are disproportionately gentrifiers, in many regions their companies are located outside the city. In sum, Chapple (2009) and Gafvert (2011) embody contrasting yet conceptually strong approaches to predicting future neighborhood change. Both approaches provide a rationale—historical data and expert opinion, respectively—for the scenarios they produce. But they are also prone to certain logical weaknesses, namely that the factors that caused gentrification in a previous decade might not cause it in the

### 3 GENTRIFICATION INDICATORS

next, or that surveyed experts are biased or incorrect in their responses.

Table 7: Factors associated with gentrification identified by Gafvert (2011)		Correlation
PHYSICAL AND BUILT ENVIRONMENT		
1	Concentration of historic buildings (built before WWII)	+
2	<i>Concentration of rental units</i>	+
3	<i>Concentration of multi-unit buildings</i>	+
4	Proximity to parks and open space	+
5	Proximity to the waterfront	+
6	Proximity to a university	+
7	Concentration of mixed-income public housing units programmed (i.e. HOPE VI developments)	+/-
8	Concentration of public housing units	+/-
9	Proximity to public/non-profit recreational facilities	-
10	Proximity to planned public transportation system (i.e. streetcar, light rail)	+
DEMOGRAPHIC		
11	<i>Concentration of non-family households</i>	+
12	<i>Heterogeneous racial composition</i>	+
13	<i>Concentration of black or other minority population</i>	+
14	<i>Concentration of international population</i>	+
15	<i>Concentration of non-Hispanic white population</i>	-
16	<i>Concentration of households with 3 or more cars</i>	-
17	<i>Concentration of seniors</i>	-
ECONOMIC		
18	<i>Concentration of private development in a low-value residential area</i>	+
19	Low dwelling value, gross rent, or mean monthly rent	+
20	<i>Concentration of foreclosures</i>	+
21	<i>Low median household income</i>	+
22	<i>Diversity of income level</i>	+
23	<i>Concentration of renters paying &gt;35% income for rent</i>	+
24	<i>Concentration of owners paying &gt;35% income for housing</i>	-
25	Proximity to CBD	+
26	Proximity to an area with increasing job growth, especially “white collar” jobs	+
27	Proximity to an already-gentrified area or areas where no disinvestment has occurred	+
POLICY AND REGULATORY		
28	<i>Presence of warehouse structures within or adjacent to an area zoned residential</i>	+
29	Location within a (non-industrial) TIF	+
30	Proximity to an NBD accepted into the Neighborhood Business District Improvement Program or within a neighborhood eligible for Neighborhood Stabilization Program funding	+
31	<i>Proximity to brownfield redevelopment or SPUR district programmed for industrial, park, or office use</i>	+
32	Location in a Historic District	+
33	Location in a neighborhood with an active CDC	+

Though she mentions Gafvert’s analysis in her bibliography, Fouch (2012) does not refer explicitly to the former’s methodology in her analysis of gentrification vulnerability in Asheville,

### 3 GENTRIFICATION INDICATORS

North Carolina, the most recent such study in the literature. As others have done, Fouch consults the gentrification literature to assemble her set of indicators, drawing on many of the same studies that Gafvert (2011) uses, such as Chapple (2009), Heidkamp and Lucas (2006), Beauregard (1986), Helms (2003), Aka (2010), and Galster and Peacock (1986). She groups her 20 indicators into three conceptual categories: people, property, and access to amenities. These are listed in Table 8.

Table 8: Factors associated with gentrification identified by Fouch (2012)		Correlation	Weight
PEOPLE			
1	Median income	-	3
2	Concentration of renters paying more than 35% of household income	+	2
3	Concentration of owners paying more than 35% of household income	-	2
4	Share of population with Bachelor's degree	-	2
5	Share of white residents	-	2
6	Share of Hispanic residents	+	1
7	Concentration of seniors	-	1
8	Concentration of non-family households	+	1
PROPERTY			
9	Concentration of rental units	+	2
10	Concentration of single-family detached rentals	+	2
11	Concentration of vacancies	-	1
12	Concentration of multi-unit buildings	+	1
13	Concentration of pre-1939 housing	+	3
14	Percent of area median owner-occupied housing value	-	2
15	Percent of area gross median rent	-	2
ACCESS TO AMENITIES			
16	Proximity to wealthy neighborhoods (median HH income > 120%)	+	2
17	Proximity to public housing	-	1
18	Proximity to historic districts	+	2
19	Proximity to universities and/or colleges (merged into one feature)	+	1
20	Proximity to a CBD	+	3
21	Proximity to waterfront	+	1

Fouch begins with an assessment of current conditions through in-person site visits, assigning parcels to one of the following ranks:

- 0 = new development or greenfield
- 1 = not yet redevelopable/gentrifiable—stable neighborhoods not in decline
- 2 = neighborhood once in decline with significant areas of redevelopment (potentially high stage of gentrification)
- 3 = neighborhood once in/in decline with moderate areas of redevelopment (potentially mid-stage of gentrification)

### 3 GENTRIFICATION INDICATORS

4 = neighborhood in decline with little to no areas of redevelopment (potentially low to no gentrification)

Unlike others who limit their analysis to a predefined “gentrifiable” area, Fouch runs her model for all of Asheville. She is also the first to use census block group as her unit of analysis, though some variables are city- or neighborhood-wide. Each indicator is substantiated with references to previous literature that have identified its effect on neighborhood change, and her overall suite of factors is comprehensive and balanced. Underneath her “people, property, and access to amenities” framework are the categories of income, education, race and ethnicity, age, household composition, occupancy, type of structures, cost, and proximity. To her credit, she casts a wide net.

That said, her discussion of how each factor contributes to gentrification susceptibility *per se* appears, at times, somewhat confounded. Some variables suggest risk to future gentrification, others can identify both past and future neighborhood change, and still others are signals that a neighborhood has *already* gentrified. For example, for racial composition Fouch writes that “race/ethnicity may provide insight into neighborhoods that have already gentrified or neighborhoods that are seen as disadvantaged.” She lists two measures in this category—percent non-Hispanic white and percent Hispanic—but posits that they identify different phenomena. “Primarily white neighborhoods,” she says, “signify little ‘ethnic flavor/identity’ and tend to be associated with already gentrified neighborhoods.” Yet a “Hispanic presence...provides a cultural attraction to some in-movers” (p. 35). This is problematic for two reasons. First, she has essentially dichotomized neighborhood type as either *already gentrified* or *vulnerable to gentrification*, though some predominantly white neighborhoods have always been predominantly white (i.e., haven’t gentrified) or have low household income. Second, she conflates her goal of predicting future gentrification vulnerability with describing past neighborhood change. Finally, despite evidence of its contribution to gentrification risk, no transit data is included from Fouch’s model.

Fouch also encounters the ambiguity around certain indicators that Gafvert wrestled with. Ultimately, Gafvert cut out almost half of her indicators at least in part because of a lack of

### 3 GENTRIFICATION INDICATORS

consensus in the literature and among her survey respondents about their weight, direction, and effect. Fouch, however, includes variables like concentration of non-family households, which may indicate domestic partners (i.e., potential gentrifiers) or single-parent households (i.e., disadvantaged or vulnerable populations). She concludes that this factor is “Traditionally seen to have a negative connotation to the neighborhood” and argues it has a positive correlation to gentrification risk (p. 35). This exemplifies the need for context in modeling gentrification susceptibility. Whether this census variable denotes primarily domestic partnerships or single parents depends on the city in question. Fouch touches on this when describing her approach for variable weighting as “dependent on the context and lifestyle associated with the City of Asheville” (p. 47). Yet housing value, housing cost, income, education, and race are weighted more heavily than other factors in Fouch’s study due to their emphasis in the literature. As previously mentioned, the effect of factor weighting can be substantial. Percent of AMI, for example, receives three times the weight of percent Hispanic and percent of population over 65 in Fouch’s model. This is not a criticism of that decision, but rather a reminder of the effect these decisions have on the model’s results and predictive power. Ultimately, all weightings are abstractions of reality. The important thing is to be cognizant of the values they reflect and their impact on findings.

Another contribution Fouch makes is to introduce a time series analysis by decade from 1980 to 2000 using the Neighborhood Change Database and extended to 2009 using American Community Survey data. This helps “shed light into areas that change from high susceptibility in the early years to low susceptibility in the later years” and provides “insight into the neighborhood characteristics of areas that gentrify, lending meaning to what variables trigger gentrification” (p. 39). She performs an Exploratory Regression (p. 52) that evaluates all possible combinations of her predefined set of indicators to determine what model best explains the observed neighborhood change in each decadal period. From this statistical analysis, Fouch is able not only to adjust her indicator weights but also to “better understand the significance between the variables,” though her methodology and rationale could benefit from clarification (p. 44).

### 3 GENTRIFICATION INDICATORS

Until now, comparing these studies has centered primarily on the elements of research design: the selection of indicators, their weights, and major findings. Fouch gives us the chance to discuss some of the more specific methodological steps involved in the GIS analysis. Among the variables weighted more heavily than others are proximity to historic districts or historic architecture and proximity to the CBD “determined by using the Euclidean Distance tool in ESRI’s ArcGIS software” (p. 47). This tool, which calculates straight-line or “as-the-crow-flies” distances, ignores the effect that the street network and connectivity have on walkability and access to neighborhood amenities. Dense urban areas with short blocks and high intersection density allow residents access to a greater geographic area within a given walking distance compared to more sprawling, automobile-centric locations. Fortunately, the Network Analyst extension in ArcGIS allows for the calculation of distance along a network of walkable streets. This is a small but significant improvement neighborhood analysis that will increase the reliability of these models’ predictions.

Finally, a recent study conducted by the Portland, Oregon, Bureau of Planning and Sustainability (BPS) establishes a methodology for identifying and monitoring neighborhoods that exhibit vulnerability to gentrification and displacement (Bates 2013). Like Seattle, Portland’s reputation as one of the most livable cities in the United States has led to significant private investment and housing price increases that have challenged that very characteristic. The study presents a “neighborhood typology of gentrification and displacement” to help policymakers anticipate where private investment and housing demand are currently producing or likely to produce the unintended consequence of displacing incumbent residents. The set of indicators is admittedly small, though its purpose is to make a first pass at identifying at-risk census tracts where a more thorough and detailed “drill-down look” at the neighborhood should follow. Though they are major components of other analyses and frequently cited as demand-side drivers of gentrification, location and accessibility features are not included in the typology. Instead, three criteria comprise the typology: residents’ vulnerability to displacement, recent demographic change, and housing market conditions (p. 26). First, vulnerability derives from above-average populations of renters, people of

### 3 GENTRIFICATION INDICATORS

color, non-college educated residents, and lower-income households—socioeconomic signals of a “reduced ability to withstand housing price increases caused by gentrification” (p. 28). Second, Bates looks for increases in homeowners, white residents, college-educated residents, and household income as indicators that gentrification is underway; these demographic changes are clearly the counterparts to the indicators of vulnerability. Third, the typology uses current home prices and recent real estate growth to identify lower-value areas experiencing rapid appreciation. This produces three housing market typologies: *adjacent* tracts, where housing value and appreciation rates are low but the tract touches the boundary of a high value or high appreciation tract; *accelerating* tracts, where housing value is low but recent appreciation high; and *appreciated* tracts, where home prices and appreciation over the last 20 years are both high. These categories essentially correspond to at-risk, gentrifying, and gentrified neighborhoods, respectively.

These indicators combine to create the six typologies of tract-level neighborhood change shown in Table 9. Once mapped, the typologies are overlain with other contributors to displacement risk, such as proximity to a planned light rail station or location within a public investment area like EcoDistricts or Neighborhood Prosperity Initiatives. Additionally, since housing demand is likely higher in areas that are highly accessible and near amenities, the study uses a “20-minute analysis” map that scores neighborhoods on “walkability and access to destinations that meet daily needs” as a further indicator of vulnerability (p. 33). These factors produce a baseline typology of displacement risk that policymakers can adjust as new data become available. That nearby Portland, similar on so many measures to Seattle, has undertaken this research on gentrification susceptibility speaks to its applicability in the Puget Sound region, if not everywhere.

**Table 9: Factors associated with gentrification identified by Bates (2013)**

NEIGHBORHOOD TYPE	VULNERABLE POPULATION?	DEMOGRAPHIC CHANGE?	HOUSING MARKET CONDITION
Susceptible	Yes	No	Adjacent
Early: Type 1	Yes	No	Accelerating
Early: Type 2	Yes	Yes	Adjacent
Dynamic	Yes	Yes	Accelerating
Late	Yes	Yes	Appreciated
Continued Loss	No	Increase in % white and % with a Bachelor’s degree	Appreciated

### 3 GENTRIFICATION INDICATORS

Collectively, these studies and their findings highlight several key questions that any attempt to model of gentrification susceptibility must answer at the outset.

- 1 How does one define gentrifiable neighborhoods, if they are defined at all? Does the model cover the entire city or only those areas?
- 2 How does one characterize the multiple stages of gentrification, if they are characterized at all? Is the study designed to identify already-gentrified neighborhoods, currently gentrifying neighborhoods, at-risk neighborhoods, or some combination of the three?
- 3 How does one decide what indicators to include in the model? How does one deal with factors where there is a lack of consensus about the effect they have on gentrification vulnerability?
- 4 What data is available for the study area geography? How does this constrain or enhance the explanatory power of the model?
- 5 How does one determine the relative weights of the indicators included in the model?
- 6 What efforts does one make to tailor the model to the particular context of the study area?

Table 10 summarizes how each of the GIS studies evaluated in this chapter addresses these questions.

Table 10: Comparison of geospatial approaches to measuring gentrification vulnerability

	How are gentrifiable neighborhoods defined? Does the model cover the entire city or only those areas?	How are the stages of gentrification characterized?	How are indicators chosen?	What data is available and used in the model?	How are relative weights determined?	Is the model tailored to the particular context of the study area?
Nesbitt (2005)	Nesbitt creates his own definition but never operationalizes it in the form of specific criteria for identifying a gentrifying or gentrified area. His model includes subjectively identified four target neighborhoods, chosen due to proximity to the CBD and age of housing stock, and one control neighborhood.	Most of his indicators signal gentrification in progress, though some represent demand-side variables that would attract future gentrifiers.	Indicators are based on “gentrification literature and the researcher’s definition of gentrification” (p. 26).	Almost exclusively census data is used, in addition to proximity based on the local street network and data from the National Register of Historic Places.	Nesbitt uses the pairwise comparison method, which tests the relative importance of each variable against every other variable.	No. The model is based only on factors identified in the literature.
Heidkamp and Lucas (2006)	<i>A priori</i> classification. In gentrified block groups, most residential buildings must have physical upgrades and businesses target middle- and upper-class consumers. Non-gentrified areas have below-average median income. The gentrification frontier has renovation at the time of the study.	The study explores the characteristics of a pre-defined set of block groups where gentrification is in progress.	<i>A priori</i> classification of block groups come from the literature, particularly Hammel and Wyly (1996).	Variables are all selected from the U.S. Census. The authors note that the gentrification frontier is highly localized and poorly suited to census data.	Stepwise discriminant analysis determines the extent to which census variables can distinguish the three neighborhood types.	Yes. The three neighborhood types are identified through in-person classification.
Levy (2009)	Gentrifiable neighborhoods are not defined a priori. The model covers only one neighborhood.	Variables chosen identify gentrification in progress, though that distinction is never made.	Only three indicators are used based on a literature review.	Building age and market value data cover the whole neighborhood; property tax data is collected only for a smaller focus area.	No weights are used.	Somewhat. The study neighborhood is chosen due to its transportation advantages, architecture, and nearby amenities.
Chapple (2009)	No gentrifiable tracts are identified, but gentrified tracts from 1990-2000 begin with median income below 80 percent of AMI and experience above-average growth in household income and educational attainment.	Six neighborhood types are identified: becoming bipolar, lower, middle, or upper income; gentrifying; and other.	Regression of variables associated with gentrified tracts from previous decade.	Chapple couples census data with neighborhood amenities and transportation. Not all data sources are specified.	Each tract is scored on a binary system according to whether it is above or below the regional average for each indicator.	Yes. Indicators of future vulnerability derive from past change in the same region.
Gafvert (2011)	Only income is used to determine gentrification eligibility. Gentrifiable areas have below-average median household income, adapted from Heidkamp and Lucas (2006).	Most factors indicate vulnerability to future gentrification.	Survey given to housing experts. Only those indicators where there was significant agreement on their contribution to gentrification are included.	Census and Cincinnati GIS data. Some indicators omitted due to difficulty representing them geospatially.	Survey respondents rank the indicators based on importance; weights derive from these rankings in aggregate.	Yes. The survey is distributed to housing experts in the Cincinnati area, so its results reflect the local housing context insofar as they are familiar with it.
Fouch (2012)	Block groups are subjectively classified through a site visit. Model covers all of Asheville, NC.	Subjective in-person assessment based on author’s observations.	All indicators are gathered from the gentrification literature.	Almost exclusively census data.	Housing cost, income, education, and race more heavily weighted due to their emphasis in the literature.	Somewhat. Indicators and study design come from the literature. Post-hoc regression validates results.
Bates (2013)	Displacement is the key concept, its likelihood governed by vulnerable populations, demographic change, and real estate appreciation.	Change in the housing market determines the six typologies.	The assessment follows Freeman’s (2005) methodology.	Tract-level census data is used to measure vulnerability. No location data is used.	City median values for each indicator are used as thresholds.	Somewhat. The overall model is based on Freeman (2005) but subsequent ‘drill-down’ analyses look closely at specific neighborhoods.

# 4 STUDY AREA

With over 634,000 residents, Seattle is the largest city in the Pacific Northwest region and one of the fastest growing the U.S (Figure 1). Its population has increased more than 20 percent since 1990 and more than 10 percent in the last 10 years (U.S. Census). The city is located in the western part of the State of Washington, bordered the cities of Shoreline and Lake Forest Park to the north by White Center, Tukwila, and Renton to the south. Seattle occupies a narrow isthmus created by Elliott Bay and Puget Sound to the west and Lake Washington to the east. Since the completion of the Ship Canal in 1934, Lake Washington has connected through Lake Union to the Sound, eventually emptying in the Pacific Ocean. Figure 1 shows the location of Seattle within the Puget Sound region and some of its noteworthy features.

Seattle is a city of neighborhoods, a vestige of its European founders who settled in dispersed autonomous communities on the surrounding hills. Residents have a strong allegiance to their neighborhoods, of which there are 91, and community advocacy groups are outspoken and effective lobbyists in development and planning issues (O'Donnell 2004). These neighborhoods and the larger districts to which they belong are shown in Figure 2. The 2010 U.S. Census contained 132 tracts in Seattle, eight more than the 2000 Census. Some tracts correspond closely to neighborhood boundaries, though others are completely incongruent.

Explorers are prominent throughout the history of Seattle since the Denny Party, the first Europeans to settle in Elliott Bay, arrived in 1851. The city began as a logging town in the middle of the 19th century and boomed as a major shipbuilding center and supply point for prospectors during the Klondike Gold Rush of the 1890s (Morgan 1995). A large maritime industry evolved into aircraft manufacturing through Boeing during World War II. Then, with Microsoft's establishment in nearby Bellevue in the 1980s, the technology sector took root and, along with biomedical and

## 4 STUDY AREA

health science companies, continues today as the city's dominant industry.

In recent decades, Seattle has seen substantial demographic changes. Throughout the middle of the 20th century, Seattle was very racially segregated. In 1990, black residents outnumbered white residents threefold in the Central District, the city's traditionally African American neighborhood. The arrival of anti-housing discrimination legislation, however, increased the rate at which black households were moving to the suburbs at the same time that white residents looking for shorter commutes and urban amenities were returning to the central city, particularly to areas with depressed housing prices like the Central District. Just ten years on, then, in 2000, white residents in the Central District had come to surpass black residents in number. With this demographic change came increases in household income and educational attainment. White in-movers were mostly between 22 and 39 years old, whereas black residents were under 22 or over 60. For blacks, the Central District became "a community of the very young or the very old with many better educated, working class African Americans moving southeast into Seattle's Rainier Valley or beyond into Renton and other inner suburbs" (McGee 2007b). This is a microcosm of the trends the Seattle region continues to experience: income growth, real estate appreciation, and a harder if not impossible road to homeownership for middle-class families. The result was that the Central District became the most ethnically diverse neighborhood in Seattle. In fact, the 98118 zip code, just south of the Central District, gained widespread notoriety as the most diverse in the nation; in 1996, 70 percent of all census blocks there had at least a 20 percent share of black, white, and Asian and Pacific Islander residents (Hoole 2011, p. 4). Still, McGee wonders what comes next. Will Southeast Seattle "become an urban rarity, a viable, vibrant interracial community, or will it do a reverse 'flip' and become an essentially nearly all-European American area?"

The answer is likely to depend not on race but on economics. It is not white residents displacing minorities so much as housing demand from higher-income earners driving up prices. Seattle has a long tradition of boom-and-bust cycles, from timber and gold in the late 19th century to the dot-com bubble one hundred years later. The last several years have been prosperous,

## 4 STUDY AREA

and the City anticipates hundreds of thousands of new residents and jobs over the next 25 years. The pace of change in Seattle will only quicken. Growth in the working-age population is double the national average (Pennington and Pastor 2013). Light rail is expanding throughout the region. A potential new basketball arena may be on indefinite hold, but a massive project to bury the elevated Alaskan Way Viaduct and redevelop the waterfront property in its shade is well underway. Naturally some are eager to reimagine Seattle's historic frontage onto Elliott Bay. Others lament a city increasingly disconnected from its maritime heritage. Not long ago, a local historian wrote that to know the Emerald City is to

know its waterfront. It is a good waterfront, not as busy as New York's, not as self-consciously colorful as San Francisco's, not as exotic as New Orleans', but a good, honest, working waterfront with big gray warehouse and trim fishing boats and docks that smell of creosote, and sea gulls and tugs and seafood restaurants and beer joints and fish stores.... (Morgan 1995, p. 5).

The waterfront has a different atmosphere today than 30 years ago, to be sure, though not all of Old Seattle has gone the way of the skidders and lumber schooners. The Pike Place Market, of course, remains a timeless icon of the city, largely unchanged since its inception in 1907. Surely, however, to know Seattle in twenty years will be a different experience.

**Figure 1:** Study area context

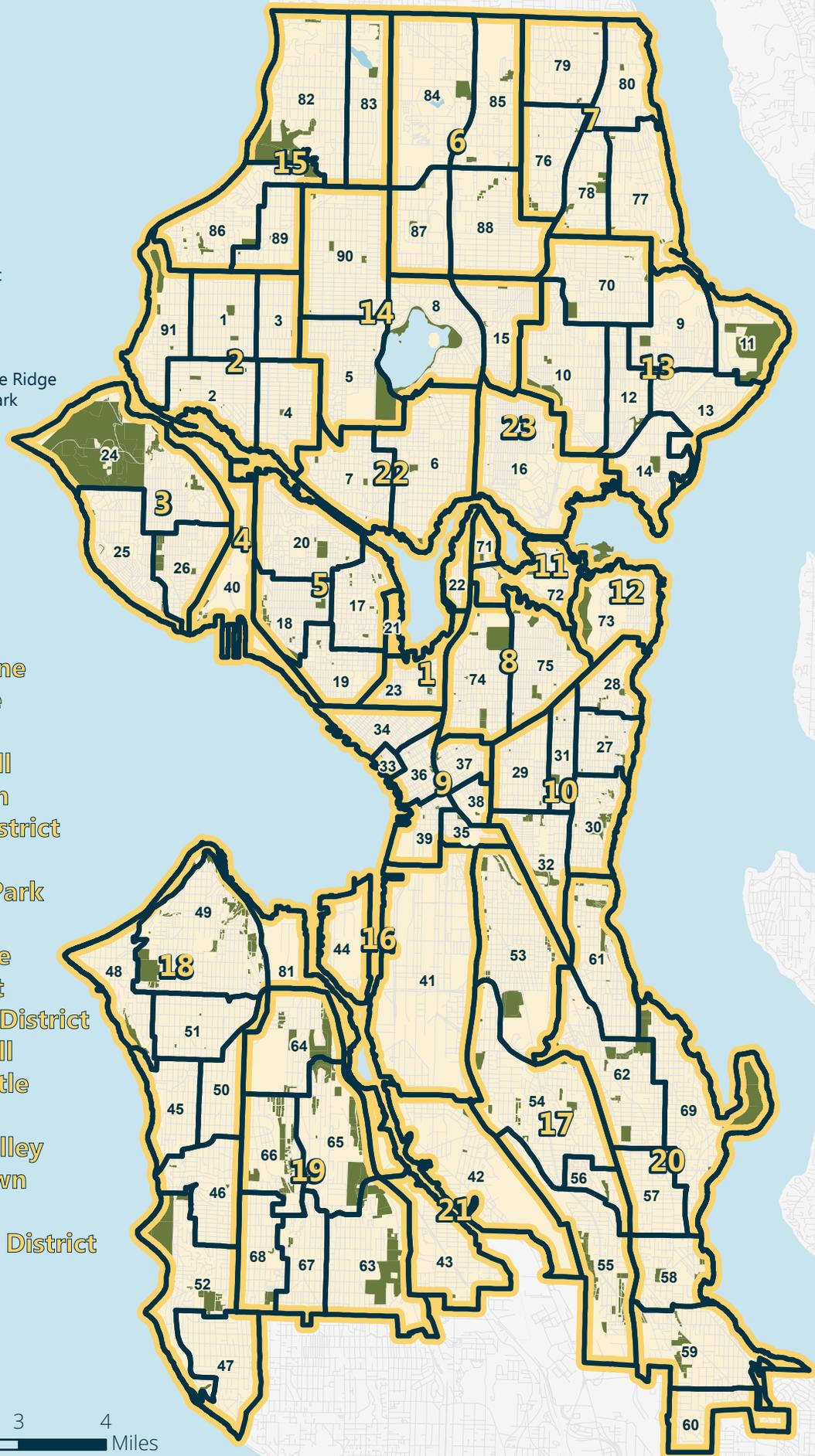


# Figure 2: Neighborhoods of Seattle

- 1 Loyal Heights
- 2 Adams
- 3 Whittier Heights
- 4 West Woodland
- 5 Phinney Ridge
- 6 Wallingford
- 7 Fremont
- 8 Green Lake
- 9 View Ridge
- 10 Ravenna
- 11 Sand Point
- 12 Bryant
- 13 Windermere
- 14 Laurelhurst
- 15 Roosevelt
- 16 University District
- 17 East Queen Anne
- 18 West Queen Anne
- 19 Lower Queen Anne
- 20 North Queen Anne
- 21 Westlake
- 22 Eastlake
- 23 South Lake Union
- 24 Lawton Park
- 25 Briarcliff
- 26 Southeast Magnolia
- 27 Madrona
- 28 Harrison/Denny-Blaine
- 29 Minor
- 30 Leschi
- 31 Mann
- 32 Atlantic
- 33 Pike Place Market
- 34 Belltown
- 35 International District
- 36 Central Business District
- 37 First Hill
- 38 Yesler Terrace
- 39 Pioneer Square
- 40 Interbay
- 41 Industrial District
- 42 Georgetown
- 43 South Park
- 44 Harbor Island
- 45 Seaview
- 46 Gatewood
- 47 Arbor Heights
- 48 Alki
- 49 North Admiral
- 50 Fairmount Park
- 51 Genesee
- 52 Fauntleroy
- 53 North Beacon Hill
- 54 Mid-Beacon Hill
- 55 South Beacon Hill
- 56 Holly Park
- 57 Brighton
- 58 Dunlap
- 59 Rainier Beach
- 60 Rainier View
- 61 Mount Baker
- 62 Columbia City
- 63 Highland Park
- 64 North Delridge
- 65 Riverview
- 66 High Point

- 67 South Delridge
- 68 Roxhill
- 69 Seward Park
- 70 Wedgwood
- 71 Portage Bay
- 72 Montlake
- 73 Madison Park
- 74 Broadway
- 75 Stevens
- 76 Victory Heights
- 77 Matthews Beach
- 78 Meadowbrook
- 79 Olympic Hills
- 80 Cedar Park
- 81 Industrial District
- 82 Broadview
- 83 Bitter Lake
- 84 Haller Lake
- 85 Pinehurst
- 86 North Beach/Blue Ridge
- 87 North College Park
- 88 Maple Leaf
- 89 Crown Hill
- 90 Greenwood
- 91 Sunset Hill

- 1 Cascade**
- 2 Ballard**
- 3 Magnolia**
- 4 Interbay**
- 5 Queen Anne**
- 6 Northgate**
- 7 Lake City**
- 8 Capitol Hill**
- 9 Downtown**
- 10 Central District**
- 11 Montlake**
- 12 Madison Park**
- 13 Northeast**
- 14 Green Lake**
- 15 Northwest**
- 16 Industrial District**
- 17 Beacon Hill**
- 18 West Seattle**
- 19 Delridge**
- 20 Rainier Valley**
- 21 Georgetown**
- 22 Fremont**
- 23 University District**



# 5 NEIGHBORHOOD CHANGE IN SEATTLE

Before considering where future gentrification is likely to occur, I examine how Seattle neighborhoods have changed in the last five decades using census data. Previous research has often begun by identifying tracts or zones that have gentrified, either through quantitative analysis of census data or geospatial analysis. Chapple (2009) establishes a precedent for this approach in her GIS analysis of neighborhood change in the Bay Area from 1990 to 2000. She defines gentrification as a neighborhood that experiences greater increases in household income and education attainment than the city or regional average and accordingly identifies 102 census tracts that gentrified during this time period. By examining what factors coincided with growth in these metrics, Chapple assembles a set of indicators of gentrification susceptibility that is grounded in past change. Her conclusions emerge from within the historical context of gentrification in the study area. Other studies rely on slightly different arrangements of variables according to how they define *gentrification a priori*, but the general pattern is to identify where this process has occurred and what other changes contributed to or coincided with it.

In this section, I present a time series GIS analysis of neighborhood change in Seattle from 1970 to 2010. These maps show tract-level variation along a handful of demographic and socioeconomic variables, illustrating gentrified areas, others experiencing disinvestment, and the changes that have accompanied these phenomena. I begin broadly with historical change in median household income, highlighting where increases have outpaced the city average. Expanding on Chapple's (2009) methodology, I then evaluate tract-level changes in housing units, renter-occupied housing, poverty, median home value, median gross rent, educational attainment, age distribution, percent

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

black, and percent Hispanic. These variables appear in the literature and various empirical studies as correlates of gentrification and create a comprehensive picture of the neighborhood-level demographic and socioeconomic change Seattle has experienced in the past forty years.

### **Using the NCDB**

Census geography boundaries have not remained static over time. As a result, time series analysis of census data presents certain geospatial challenges. Census tracts, for example, have frequently been redrawn or even divided into two tracts to account for population growth. To account for these adjustments, the Neighborhood Change Database (NCDB) published by GeoLytics, Inc. normalizes 1970-1990 census data to the 2000 geography, allowing for comparison of census tracts over time even as boundaries change. GeoLytics will release its next update, normalizing to the 2010 census geography, in late summer 2013—too late for the present study. Therefore, I used NCDB data for the period of 1970-2000 and then performed my own normalization of this data to the 2010 census tract boundaries in order to make use of the most recent census datasets.

In Seattle, the 2000 census geography contains eight tracts that in 2010 were divided in two. A handful of others saw essentially negligible boundary changes. I developed two methods for bridging 1970-2000 data from NCDB to the 2010 geography. First, for data representing geographic averages, such as median income or percent black, the figure for the 2000 census tract was joined to both of the two resulting 2010 tracts. Since these figures do not rely on population, the 2000 data can be joined to each of the 2010 tracts without concern for the adjustments in area and population these smaller new tracts represent.

More complicated, however, are count statistics like total housing units. For these measures, simply joining the 2000 data to the new 2010 geography leads to double counting and skewed percentage changes. A divided tract means some individuals and households—and the data describing them—are now in one of the smaller 2010 tracts and the rest in the other. For example,

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

a census tract that in 2000 had 400 units and then experienced a boom in housing development in one part of the tract could mistakenly show a negative change in total units in the 2010 geography. To account for this, I measured population at the census block level for each of the split tracts and calculated the share of the 2000 census tract population that each 2010 tract represents, storing this figure as a new variable called PopShare. Then, I joined the 2000 data to the 2010 geography and, for each split tract, multiplied every count statistic by the PopShare weighting.

This is similar to the approach used to bridge data from prior years to the 2010 census geography as part of the Longitudinal Tract Data Base (LTDB) at Brown University. To compare data from 2000 and 2010, for example, researchers at Brown estimate the share of the 2000 population at any level (tract, block, etc.) that lies within subgroups of that geography (blockgroups, newly created fragments of blocks, etc.). In particular, they apply this method to the intersection of blocks and tracts in the 2000 and 2010 census geography, instances that produce a small sub-block unit they call “fragments” (Brown University). Seattle has none of these—the arrangement of blocks within tracts was unchanged from 2000 to 2010—but the concept is the same as aggregating block populations to the tract level. Though it is the current standard for bridging census data, the primary source of error in this method comes from the assumption that “all population characteristics have the same distribution as the total population across blocks within a tract” (Brown University).

### **Results**

For each of the nine variables, I calculate decadal change (either percentage or absolute) for all years for which NCDB data was available. Citywide averages either come from the U.S. Census or are averages of all census tracts weight by the share of the population each tract represents. In general, I normalize the NCDB data to the most recent decennial census using 2010 Summary File data to maintain consistency with the decennial census data GeoLytics uses, though this dataset does not contain certain variables. In these instances, such as data on educational attainment or

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

poverty, I draw from the 2011 American Community Survey (ACS) five-year dataset and noted when this was necessary. The benefit of extending my analysis past the year 2000 outweighs the cost of the slightly higher margin of error inherent in ACS data.

### **Median income**

For median household income, I calculate percentage change for each decade. Since neighborhood comparisons are more noteworthy than absolute growth, I present the results as quartiles in order to highlight the tracts with the largest increases relative to the city as a whole. From 1970 to 1980, the highest growth occurred in Magnolia, Greenwood/Phinney Ridge, Madrona, the east side of Lake Union, Downtown, the industrial areas of South Seattle, and a large swath of the West Seattle peninsula (Figure 3). The largest increase was a downtown, where median household income in rose 189 percent from 1970 to 1980. A total of 56 of 132 tracts saw at least a doubling in median income.

From 1980 to 1990, several of the highest growing areas from the previous decade moved to the bottom quartile (Figure 4). A belt of tracts across North Seattle saw the largest increases, from Crown Hill and Greenwood in the west to Roosevelt, Ravenna, Wedgwood, and Sand Point in the east. Capitol Hill, the ridge of West Seattle, and Highland Park were also in the highest quartile. Only one tract, in the Stevens neighborhood of Capitol Hill, more than doubled in median income. Interestingly, this was an area noted over 30 years ago by leading theorist Neil Smith as “symbolic of a... middle- and upper-class pilgrimage back from the suburbs” (1979, p. 539).

Figure 5 shows that, in 2000, average growth in median household income by tract was 80 percent across the city, the largest increases in Ballard, Wallingford, Georgetown, and Downtown. Only 19 tracts saw at least a doubling in median income, but eight more than tripled, something that not a single tract experienced in either of the previous two decades.

Growth in household income leveled off somewhat from 2000 to 2011, likely a result of the global economic downturn (Figure 6). Tract-level growth in median household income averaged 39 percent, similar to the 1980-1990 figure of 40 percent. Ravenna was the only neighborhood to

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

experience a more-than-twofold increase. A cluster of tracts in the Central District, Ballard, and one tract in Fremont and Magnolia each saw growth over 60 percent. Except for a handful of tracts in Mount Baker and Delridge, all of South Seattle was outside the top quartile for this period. High-growth tracts are concentrated in the central and North ends of the city. Also of note, while the previous decade saw income increases in every Seattle tract, median household income fell in five tracts in the 2000-11 period. Some of those are near the University and may be due to small or fluctuating sample size, but others are in Wallingford and Rainier Valley.

A rise in median household income forms at least part of the definition of gentrification in every model of vulnerability. Many studies identify tracts where change in median household income has outpaced the city or regional average. In 2000, median household income in Seattle was \$45,736 and \$61,856 in 2011, an increase of 35.2 percent (U.S. Census). 77 of 132 tracts saw median income growth above this level. To identify gentrified tracts, Chapple (2009) couples this indicator with increase in education attainment above the regional average, discussed below.

### **Total housing units**

Tract-level changes in the number of total housing units reveal where residential development has been focused in each decadal period. Unlike median income, where quartiles best highlight the neighborhoods whose socioeconomic profile has changed the most relative to the city as a whole, housing units are better visualized with certain pre-defined classifications. The top 25 percent of tracts in terms of residential density may all boast high development or may simply be the highest quartile during a decade of low growth. More illustrative is to know where any housing development is occurring, where a lot of housing development is occurring, and where *the* most housing development is occurring. To that end, I choose cutoffs for decadal growth in total housing units of less than 0 (a decrease in housing units), 1-10 percent, 11-25 percent, and greater than 25 percent. This means the visualizations are not constrained by the number of tracts that fall into each level of development.

From 1970 to 1980, roughly two thirds of Seattle tracts (68.5 percent) saw an increase in

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

housing units (Figure 7). In eight tracts the total number of housing units in 1980 was more than 25 percent higher than the figure of ten years prior. This growth was highest at Northgate, where housing units nearly doubled, and otherwise concentrated at the north end of the city in tracts in Sand Point, Greenwood, and from North Matthews Beach to the city boundary at Shoreline. Except for one tract downtown, only one of these eight highest-growing tracts was south of the Cut, in South Delridge at the White Center boundary. For all of Seattle the total growth in housing units was 4 percent, and 54 tracts (44 percent of all tracts) were above this citywide mean.

In 1990, total housing units had increased by at least 25 percent since 1980 in only six tracts located in First Hill, Wallingford, and the area around North Seattle Community College (Figure 8). The largest changes occurred in two adjacent Belltown tracts where housing units were 51 percent and 53 percent higher than the 1980 counts. In 50 tracts (40 percent of all tracts) change in housing units was above the Seattle average of 8 percent. While 39 tracts saw a decrease in housing units from 1970-80, that statistic fell to 15 in 1990.

Housing development picked up markedly from 1990 to 2000. Figure 9 shows that nine tracts experienced a rise of at least 25 percent in total units, almost all of them in the downtown core and West Seattle. Three tracts, however, saw more than a doubling of housing units, an unprecedented rise in residential development. This growth occurred in South Lake Union and two waterfront tracts in Belltown and in the downtown central business district. At 8 percent, the citywide increase in housing units was similar to previous decade, but only 42 tracts surpassed this figure. From 1990 to 2000, growth was slightly more concentrated in certain neighborhoods. Furthermore, the number of tracts experiencing a decline in housing units fell again to 13.

The story of the 2000-2010 map has to start with South Lake Union. The burgeoning new home to online retailer Amazon.com was the highest-growing tract in terms of residential development, as units in 2010 were 163 percent above the 2000 figure. Though change in total housing units slowed to 4 percent across the city, the number of tracts with at least 25 percent growth rose to 12 in 2010 (Figure 10). The location of many of these tracts closely mirrors the new light

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

rail stations constructed during this period. Not only did South Lake Union open a new streetcar line in 2007, but in the South End, the tracts containing the Othello Station and adjacent to the Columbia City and Beacon Hill stations had 67 percent and 35 percent more housing units than in 2000. Three tracts in the International District, directly next to the eponymous light rail station, were in the highest classification of housing growth. Only one tract in Ballard and West Seattle each had at least 25 percent growth in units without being associated with new rail transit. That said, several tracts surrounding the Rainier Beach, Columbia City, and Beacon Hill remained in the lowest bracket of housing change, meaning they experienced slight decreases in residential units.

### **Housing tenure**

Figures 11 through 18 present data on how the share of all housing occupied by renters has changed by tract in each decadal period. Like total housing units, change in renters as a share of total residents is best visualized using certain meaningful classifications. Unlike median household income, which can be expected to increase gradually over time, change rental tenure in Seattle is by no means constant or even predictable. Therefore of note is where the share of renters is changing in specific ways. Chapple (2009) suggests that the higher the share of renters, the more likely gentrification is to occur as these residents are often more vulnerable to changes in real estate value and thus more easily displaced. Therefore, I choose two classifications where the change in the share of renters is negative (decreases of 0 to 20 and greater than 20 percent) and two where it is positive (increases of 0 to 20 percent and greater than 20 percent). These categories remain constant across the four decadal periods from 1970 to 2010. I also highlight where rental tenure is highest in absolute terms, especially in the most recent decades. Visualizing change specifically says nothing of the concentrations of renters relative to the city as a whole.

In 1980, rental tenure was highest in 1980 in the downtown core and Capitol Hill, near the University of Washington, and at Northgate. These neighborhoods had a 75 percent share of renters. The majority of census tracts had seen an increase in the share of renters since ten years prior. Save for half a dozen tracts, the entire North End saw growth in rental tenure, most of it

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

above 20 percent compared to the 1970 figure. In fact, renters decreased as a percentage of all residents in only a handful of tracts mostly concentrated in Lower Queen Anne, Eastlake, Capitol Hill, and Madison Park.

The percentage was still on the rise in most tracts in 1990, though fewer fell into the highest bracket of growth. Those where rental tenure was at least 20 percent higher than the 1980 figure were still concentrated in the North End in neighborhoods like Crown Hill, Bitter Lake, Meadowbrook, Roosevelt, and Windermere. Four tracts adjacent to the city's southern boundary also had at least 20 percent growth in rental share. Once again many of the most central neighborhoods, such as Queen Anne, Belltown, Capitol Hill, Eastlake, Montlake, and Madison Park, saw a decrease in the percentage of renters. Tracts neighboring the University of Washington now boasted 75 percent or greater rental tenure, as did tracts in Fremont and Ballard.

From 1990 to 2000, downtown tracts on the waterfront fell out of the 75 percent or greater bracket for rental tenure, suggesting that construction of condominium towers in Belltown had increased the share of owner-occupied housing. In fact, in most corners of the city one finds tracts where renters decreased as a share of residents. The vast majority of tracts fell in the 80-100 percent and 100-120 percent classifications for change in rental tenure. At the higher end, Alki, Broadview, and Matthews Beach were the only neighborhoods with over 20 percent growth in renter tenure.

The previous section mentioned the visible relationship between light rail station construction and increases in total housing units. The map of change in rental tenure from 2000 to 2010 reveals that much of that residential development was rental housing. Most of the tracts with the greatest increases in rental housing during that period are in the Rainier Valley and Beacon Hill. As a result, some of these tracts became majority renter-occupied for the first time in 20 or 30 years. In addition, the cluster of downtown tracts where at least three of four units are renter occupied shrank as tracts in Lower Queen Anne and Eastlake saw a decrease in rental tenure. Taken in full, the 2010 data show 57 tracts where rentals outnumber owner-occupied units (43 percent of total tracts).

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

These tracts are well dispersed throughout the city but in general tend to be nearer to downtown or the University and more inland (i.e., away from the Lake or Sound and thus probably less likely to have a waterfront view). Apart from the University of Washington, other areas with predominantly majority renter-occupied housing include Capitol Hill south to Beacon Hill, the central part of West Seattle, and a swath from North Seattle Community College towards Lake City.

### **Poverty**

There are several ways to present data on poverty. The census tallies the number of residents living below the poverty level, so the most straightforward calculation for each decadal period is the percentage of the population in poverty. One can also calculate decadal changes in the population in poverty, both in absolute terms and relative to the population as a whole. The former, however, increases if the tract simply grows across all income levels, and the latter does if the non-impo- verished residents move elsewhere. Tracts with some of the highest counts of residents in poverty can appear to have become less impoverished, even though what should stand out is the high total count of residents below the poverty level. Likewise very affluent neighborhoods, of which Seattle has plenty, see huge jumps in the share of residents in poverty when the count increases only slightly because there are few residents below the poverty level to begin with. With this in mind, I discuss here where and to what the degree the number of residents living in poverty has changed from 1980 to 2011 with an emphasis on declining high-poverty tracts, as these could be indicative of gentrification. This data is shown in Figures 19 through 25.

In 1990, poverty levels were highest in two tracts in the International District and Pioneer Square. Only here were a majority of residents were living in poverty. Other tracts with at least 25 percent of residents below the poverty level were in Belltown, First Hill, South Lake Union, the student-dominated area adjacent to the University of Washington, High Point, and Holly Park. Most of the South End, however, was not only above the city average for residents in poverty in 1990 but saw an increase in this measure over the previous decade. The same was true for many tracts around Northgate.

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

No tract was majority in poverty in 2000, though the areas of highest poverty did not change from the previous decade. Though it remained one of the city's higher-poverty tracts, the Holly Park neighborhood saw more than a twofold reduction in the population in poverty as the count fell from 38 percent to 18 percent. In fact, the most substantial drops in poverty outside of the University of Washington area, which is skewed by its student population, were predominantly in South Seattle: Seward Park fell from 10 percent to less than 5 percent, South Park from 24 percent to 12 percent, and Dunlap from 25 percent to 17 percent. At the other end, North Seattle saw major rises in residents below the poverty line. Tracts at the Shoreline border saw some of the highest percentage changes in the poverty rate. One nearly tripled from 4.7 percent in 1990 to 14 percent in 2000, and another rose from 10 percent to 17 percent. Poverty also increased substantially in Licton Springs near North Seattle Community College (12 percent to 18 percent).

Two main patterns emerge from the 2011 poverty map. First, the only tracts north of the Montlake Cut with over 25 percent of residents living in poverty surround the University of Washington, and in the most recent decade this income bracket, most likely dominated by students, expanded towards Wallingford and Ravenna. The top two tracts in terms of percentage change in residents in poverty from 2000 to 2011 are in the University District. The population in poverty also more than doubled in Lake City, from under 9 percent to over 21 percent, and almost all the tracts in the North End where the poverty rate is 10-25 percent are north of 85th Street. Second, the entire east side of the West Seattle peninsula saw a stark reduction in the number of residents in poverty. In this area the share of people in poverty was on average almost half in 2011 what it was in 2000. Even larger reductions occurred elsewhere in the South End, specifically North Beacon Hill (17 percent in 2011 to 5.1 percent in 2000, a 71 percent reduction) and Mount Baker (16 percent to 6.5 percent, a 59 percent drop). Yet the eight southeasternmost tracts of Seattle—most of Columbia City and all of Brighton, South Beacon Hill, Dunlap, and Rainier Beach—experienced at least a 30 percent increase in the number of residents in poverty, one of them more than doubling.

### **Median home value**

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

GeoLytics publishes normalized data for median home value by tract only from 1990 on. Furthermore, a handful of tracts have no data for 1990 or 2000, making percentage change impossible to calculate. Apart from these shortcomings, the data on median home value illustrate where home prices have increased above the citywide average which, along with data on change in median rent, suggest gentrification could be taking root. Just as I presented median income data as quartiles to highlight tract-level changes relative to a citywide baseline, I am less concerned with absolute changes in median home value than with what neighborhoods have experienced the two- or threefold growth that reflects the substantial (re)investment and development associated with gentrification. That said, residents in an affluent neighborhood where median home value doubles are unlikely to be affected the same way that a \$125,000 household is when confronted with the same growth in home prices and corresponding property taxes.

From 1990 to 2000, median home value saw the greatest increases in Magnolia, Georgetown, the Industrial District, Eastlake, Queen Anne, and West Seattle (Figure 26). In these tracts, the median home value at least quadrupled in this decade. The median home value in the Lawton Park section of Magnolia experienced an impressive 419 percent rise in median home value during a period when home prices grew less than 100 percent citywide.

The following decade did see one tract with outstanding growth in median home value (Figure 27). In the waterfront Belltown tract, median home value grew from \$45,000 in 2000 to \$401,900 in 2011, a nearly ninefold increase due in large part to the few housing units this area had previously and the boom in high-end condominium development it saw through the early 2000s. Outside of this exceptional tract, though, the rest of the city saw less than threefold growth in median home value. The second-largest change occurred in a Central District tract, where median home value rose 141 percent during 2000-2011. Tracts in Georgetown, Columbia City, South Park, High Point, and Beacon Hill all experienced at least a doubling in median home value. In other words, South Seattle far and away saw the greatest increase in median home value. The only tracts outside of the South End where median home value doubled were in the Lawton Park and Sunset Hill neighborhoods, both of which have long contained some of the city's most expensive view properties.

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

### Median gross rent

While median home value reflects changes in the market for owner-occupied housing, median rent attests to where and how the affordability of rental housing has fluctuated. Since many of the residents most vulnerable to the negative consequences of gentrification are renters, neighborhoods where median rent has seen considerable growth are likely to have suffered disproportionately from displaced residents.

In 1990, median gross rent had doubled over the previous decade in 16 of 132 tracts (12 percent). Figure 28 shows that Sand Point, High Point, Belltown, and Broadview were the top four tracts in terms of change in median rent. Within these highest-growth tracts, however, rents varied substantially. In Broadview, rent grew from \$365 in 1980 to \$848 in 1990, while in the International District median gross rent rose from \$79 to \$166, the same percentage change but at a very different income level. Growth in median rent from 1980 to 1990 did not correlate strongly with median rent itself. Eight tracts saw a reduction in median rent of up to 25 percent.

From 1990 to 2000, growth in median gross rent accelerated. Just as it had with respect to median home value (Figure 29). Belltown saw the largest growth (571 percent) as rent increased from \$98 to \$658. Six other tracts tripled in median rent, from Georgetown and West Seattle in the south to Eastlake, Wallingford and Ballard in the north. Furthermore, the 15 tracts experiencing *the* least growth in rent from 1990 to 2000—between 15 percent and 40 percent growth—are predominantly affluent residential neighborhoods, many of them adjacent to Lake Washington or Puget Sound, such as Leschi, Madrona, Denny Blaine, Sand Point, North Beach, and Blue Ridge. One interpretation of this trend is that median rent grew most considerably in the more central “urban villages” closer to downtown jobs and with a mix of a residential and commercial uses and less in areas with higher-end single-family housing whose attractive characteristics—waterfront access and a view—had always boosted property values.

Figure 30 shows that, in 2010, median rent had doubled from 2000 in only four tracts city-wide: Downtown, Beacon Hill, the Central District, and Pioneer Square. Citywide, however, change in

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

median gross rent was more heterogeneous than median home value. The top 25 percent of tracts in terms of change in the median home value was concentrated in the South End, but tracts in the highest quartile of growth in median rent exist in roughly equal measure in each quadrant of the city. The visible spatial correlation noted in a previous section between new housing development, particularly rental housing, and the arrival of light rail through Southeast Seattle might have a counterpart in the map of median rent change from 2000 to 2010. Tracts in North and South Beacon Hill, Brighton, and Columbia City were in the highest quartile of growth, though others equally close to light rail stations saw much lower increases in median rent. Finally, a cluster of tracts in the lowest quartile of change in median rent change exists in North Seattle, perhaps signaling a period of stagnant investment in residential properties and commercial activity in this area.

### **Educational attainment**

Along with median income, educational attainment is another often used indicator of gentrification. This is typically measured as the percentage of residents with at least a Bachelor's degree, though some studies look specifically at changes in the share of residents with advanced degrees. GeoLytics data only includes a count of residents over the age of 25 with a Bachelor's degree or more, so parsing changes in educational attainment beyond that level is not possible. More recent census data, however, does parse out Bachelor's from graduate degrees, improving the resolution with which we can use educational attainment to identify gentrification in progress. Since it is *specifically* growth in the share of residents with advanced degrees, rather than the share itself, I tend to focus on decade over decade change and visualize the data as quartiles.

Figure 31 shows tract-level changes from 1970 to 1980 in the percentage of residents with at least a Bachelor's degree. There is a remarkable clustering within the highest quartile, where the share of this demographic was between two and six times larger in 1980 than ten years prior. These tracts are concentrated in the three clusters around West Seattle and Georgetown, Capitol Hill and Downtown, and Fremont to Crown Hill. The largest change in the share of Bachelor's holders were two adjacent tracts in Madison Valley and the Central District; both saw over sixfold

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

growth. Yet despite these changes, in 1980 there remained huge disparities in educational attainment in Seattle, and these regions remained some of the lowest in advanced degree holders. The highest quartile is almost entirely concentrated in a large cluster best described as bordering Lake Union and the Montlake Cut. Furthermore, almost all of the tracts in the lowest quartile—where less than 17 percent of residents have a Bachelor’s or more—are located in the southernmost tracts of the city.

From 1980 to 1990, educational attainment increased most in Georgetown, Belltown, South Lake Union, and the International District (Figure 32). Tracts in the highest quartile once again tended to cluster, especially in the northwest part of the city around Ballard, Crown Hill, and Northgate. The lowest quartile was dispersed in most neighborhoods except for the cluster of high growth tracts in the northwest part of the city. That said, the disparity in educational attainment was if anything more severe. Remarkably, despite two decades in the highest quartile for growth in the top education category, tracts in High Point, Riverview, Highland Park, and Georgetown remained in the lowest quartile for overall share of Bachelor’s degree holders. South Seattle as a whole fell lower in the ranks for educational attainment in 1990, as not a single highest-quartile tract and only three third-quartile tracts were south of downtown. The top quartile for Bachelor’s degree holders remained strongly clustered in Northeast Seattle.

Figures 33 and 34 show that these trends continued nearly unchanged throughout the next two decadal periods: large increases in South and Southwest Seattle in the share of residents with at least a Bachelor’s degree coupled with stubbornly persistent north-south disparities in overall percentage of degree holders. In other words, the South End was catching up, but the decades-long chasm in educational attainment narrowed only very slowly. To some degree, visualizing these data as quartiles almost ensures that these patterns emerge since historically affluent neighborhoods with the highest educational attainment are likely to remain in the top 25 percent of tracts even as the overall variation decreases. Quartiles obscure somewhat the steady rise in the minimum percentage with a Bachelor’s degree that the city experienced. In 1970, less than

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

half a percent of Georgetown residents met this criterion. In 1980, that same tract rose fourfold to two percent. South Park had the lowest share in 1990, but it was almost six percent—three times higher than the minimum ten years prior. By 2011, the Brighton tract with the smallest percentage in the city had 16 percent. The floor has been steadily rising. Still, 2011 census data that parses advanced degrees further reveals the spatial disparities in educational attainment. Not surprisingly, graduate and professional degrees are equally clustered in tracts adjacent to Lake Washington where waterfront access leads to some of the highest home values in the city.

Data from the most recent decadal period also illustrate where large changes in educational attainment suggest gentrification is likely in progress. Tracts in the highest quartile for growth in the share of degree holders have also seen some of the largest increases in median income and median home value or rent, and several are proximal to new transit infrastructure.

### **Age distribution**

Census data tabulates the number of residents per tract in several age brackets, two of which (ages 25 to 34 and 55 to 64) correspond well with the age groups the literature has found are most likely to gentrify a neighborhood. The younger demographic are often recent graduates of from college or hold advanced degrees. This age cohort is attracted to many of the amenities an urban lifestyle provides. They are also more likely to use alternative modes of transportation such as cycling or transit (Williams-Derry 2012). Though vehicle miles traveled (VMT) is on the decline across all age groups in the U.S., the trend has been led by people under 34, who drove 23 percent less in 2009 than in 2001 (Davis and Dutzik 2012). The older cohort of 55- to 64-year-old residents are often “empty nesters” who relocate from their large suburban home to somewhere better sized for two people, or recent retirees who, in their newfound free time, yearn for the denser mix of uses and activities urban living provides.

Figures 35 to 38 illustrate how the share of residents in these gentrifier age groups has changed in each decade. What matters is not where the share of residents aged 25-34 and 55-64 has simply increased, since this could be caused by other age groups leaving, but where these age

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

groups have grown faster than the overall population, indicating above average flows of gentrifiers into the neighborhood. In other words, each map presents the data according to the following formula:

$$\frac{[(\text{young}_n + \text{older}_n) / (\text{young}_{n-1} + \text{older}_{n-1})]}{[\text{population}_n / \text{population}_{n-1}]}$$

where young = number of residents in 25-34 age group in tract

older = number of residents in 55-64 age group in tract

n = decade

This approach controls for the overall rate of population growth in each tract, which causes all age groups to increase, and for the changes in other age brackets that affect the relative share of the gentrifier cohorts in question.

Over the past forty years, this measure has varied substantially. In some decades nearly every tract experienced above average growth in the 25 to 34 and 55 to 64 brackets, while in others these age groups grew ahead of the overall population in only a few tracts. This makes it difficult to choose informative classifications that are consistent across all decadal periods. One alternative is to standardize the number of tracts per classification with quartiles, but this obscures meaningful absolute changes. With this in mind, I adjust the classifications in each decadal period—something I have avoided thus far—in order to balance overall population context with the specific cutoffs worth noting. Furthermore, I combine the two age categories to simplify the analysis for each decade but parse them out for the 2000 to 2011 period for a closer evaluation.

From 1970 to 1980, 96 percent of Seattle tracts grew faster in the 25-34 and 55-64 age groups than in the population as a whole. In only five tracts was this not the case. In 22 tracts (17 percent of total) growth in these cohorts was one and a half times that of the overall population. These tracts were predominantly north of the Montlake Cut in Fremont, Phinney Ridge, Wallingford, and the Matthews Beach area. South of the Cut, Queen Anne, a Capitol Hill tract, and Seward Park also met this level of growth.

This period of exceptional growth in the gentrifier age brackets was more than counterbalanced in 1980-90. In this decade, a remarkable 83 percent of tracts saw below average growth

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

in the 25-34 and 55-64 age groups. The 23 tracts that did grow faster in these age ranges were distributed in a handful of clusters, the largest of which was in the center of the city from Lower Queen Anne through Downtown to the Central District. Indeed three of the four highest growing tracts in the 25-34 and 55-64 cohorts surrounded the central business district in Belltown and Yesler Terrace. (The fourth was the University of Washington, whose age data appears to be wildly variable year to year.)

The following decade saw a return to a more even distribution of growth in the 25-34 and 55-64 brackets. From 1970 to 1980 the median tract grew 36 percent faster than the population as a whole, then 10 percent slower from 1980 to 1990; by 2000, the median tract experienced a balanced 99 percent change. Roughly half of the city saw an increase in these age groups and half a decline, but tracts on the rise were visibly more centrally located than their counterparts. Nearly all tracts with at least 20 percent faster growth in ages 25-34 and 55-64 surround downtown in Belltown, Lower Queen Anne, Eastlake, Capitol Hill, and First Hill. (The large Industrial District tract meets this cutoff but contains, not surprisingly, primarily industrial uses. Georgetown is the only non-central tract at this level.) What's more, the remaining tracts experiencing above average growth in the 25-34 and 55-64 categories are closer to downtown than the tracts where these ages decline relative to the overall population. The further a tract is from downtown, in other words, the less likely that the share of residents in the gentrifier age brackets increased. This comports with the general consensus that a central location is a primary driver of, if not prerequisite for, gentrification.

For the period of 2000 to 2011, I look more closely at the 25-34 and 55-64 age groups in isolation. Taken together, the median tract grew 13 percent faster in these cohorts than the overall population, but parsed out one sees this growth was driven by the older demographic. The 25-34 age group saw below average growth in two thirds of tracts. Many of the tracts with the lowest rate of change of 25- to 34-year-olds relative to the overall population—a drop of at least 20 percent—also boast the highest median home values in the city. Above average growth in this cohort was

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

neighborhood as the black population in 1970. At that time, only one tract had a greater than ten percent share of Hispanic residents. Many tracts in Fremont, Wallingford, and Ravenna moved into the two to four percent Hispanic category by 1980, and the Hispanic share of the population increased throughout all of South Seattle. In 1990, Hispanic residents continued to increase relatively evenly across the city with a concentration in the Georgetown/South Park area. By 2000 that cluster expanded to include Delridge, High Point, and Beacon Hill, and in South Park well over a third of residents were Hispanic. In 2010, 19 tracts at a Hispanic population of at least ten percent, most of them in the South End neighborhoods of Beacon Hill, Rainier Valley, or West Seattle, though four tracts at the North End met this criterion as well. Perhaps most noteworthy is that only one was two percent Hispanic, while just twenty years earlier 33 tracts (25 percent of all tracts) had a lower share of Hispanic residents than this.

Finally, Figures 49 and 50 present the share of nonwhite residents by tract for the most recent two decennial censuses. The changes from 2000 to 2010 are very subtle. Southeast Seattle is majority nonwhite from the International District throughout all of Beacon Hill and Rainier Valley, and also in South Park and High Point. In 2010, however, three tracts in the Madison Valley and Leschi became majority white. Much of West Seattle and Capitol Hill also experienced considerable declines in its share of nonwhite residents. These trends further hint at gentrification taking root in these neighborhoods.

### **Gentrification from 2000 to 2010**

In her analysis of gentrification vulnerability in the Bay Area, Chapple (2009) examines tracts that have gentrified in the 1990s according to a specific definition: a low-income tract that experiences growth in median household income and educational attainment above the regional average. I apply a similar conception of gentrification to my analysis of neighborhood change and identify 18 tracts that gentrified from 2000 to 2010, shown in Figure 51. These tracts had median household income below 90 percent of the area median income (AMI) of \$45,736 in 2000 and in the

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

led by the Central District (51 percent), South Lake Union (41 percent), the International District (40 percent), and Ballard (30 percent). These neighborhoods are all walking distance to downtown, have a dense mix of uses and amenities, or both.

The older cohort of gentrifiers tells a different story: all but three tracts saw higher growth here than in the total population from 2000 to 2011. This primarily reflects the large baby boomer generation approaching retirement age. Their above-average growth was highest in Fremont and Phinney Ridge, where the number of 55- to 64-year-olds grew more than two and a half times faster than the overall population. In fact, all of the tracts where the 55-64 growth rate more than doubled that of the total population are clustered in a band from Sunset Hill in the west to View Ridge in the east. This cohort grew between one and a half and two times the population rate in tracts throughout the city, many clustered around First Hill, along the light rail line from Rainier Valley through Beacon Hill, and adjacent to Puget Sound. While the exceptional growth in this age demographic may appear to preclude any meaningful conclusions, another interpretation is that where such a large generation chooses to live provides a window into the amenities that attract current and soon-to-be retirees. In that vein, this age group increased considerably in residential neighborhoods outside of the central city, some of which have vibrant commercial centers, others that are almost exclusively single-family housing.

### **Race**

It is worth examining census data on race for two reasons. First, it highlights the stark spatial segregation Seattle experienced in the 1970s and 1980s, which to a large degree persists today. Second, several studies have identified racial, ethnic, or cultural diversity as attractive to potential gentrifiers. This section presents two measures, the share of black residents by tract and the share of Hispanic residents by tract, from 1970 to 2010 (Figures 39 to 48). Unlike the previous sections, I omit percentage change from the previous decade in favor for the raw share of black and Hispanic residents at each time period. Decadal changes focus on the small in absolute terms but relatively large growth in minority residents many predominantly white tracts have experienced in the last

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

forty years. This change is still visible in the following race maps, but the spatial disparities in black and Hispanic remain the salient features. Each of these maps has five classifications. For share of black residents, they are less than five percent, five to ten percent, ten to 20 percent, 20 to 40 percent, and greater than 40 percent. For share of Hispanic residents, they are less than 2 percent, 2 to 4 percent, 4 to 8 percent, and greater than 8 percent, except in 2010 when these classifications are doubled due to the growing Hispanic population.

The terminology used regarding race and ethnicity throughout this thesis comes from the Census itself. For many years, respondents selected amongst racial categories including White, Black, Asian, American Indian or Eskimo, Hawaiian and Pacific Islander, Other, and Two or More Races. In the 2000 Census, race and Hispanic ethnicity appeared as separate questions, and a respondent can self-identify as Hispanic regardless of the race or races he or she chooses. The following decade saw that question evolve to “Hispanic or Latino,” defined as a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race. Likewise the racial category of Black in 2010 became Black or African American. As a result of these fluid definitions, the maps and data presented here reflect the categories and terminology used by the U.S. Census Bureau in each respective decennial census. Given the complexities of race and neighborhood change, these categories are undoubtedly somewhat limited in their ability to reflect historical gentrification.

In 1970, eight tracts were over 40 percent black, all of them clustered in the Central District. Figure 39 shows the center of this cluster was two adjacent Madison Valley tracts where over 90 percent of residents were black. In almost three quarters of all Seattle tracts, less than five percent of residents were black. Every tract that was over ten percent black, of which there were only 27 (20 percent of all tracts), was located in Southeast Seattle except for two tracts in High Point. By 1980, the only noticeable changes were that the Rainier Valley had a higher share of black residents (most of the neighborhood between 20 and 40 percent) and that the only 92 tracts had less than five percent share of black residents compared to 105 ten years prior. For all of North Seattle,

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

however, nothing had changed. In 1990, the concentration of black residents in Southeast Seattle continued to disperse slowly towards adjacent tracts. Only five Central District tracts now had a 40 percent or greater share of black residents, though a tract in Columbia City joined them at this level. High Point moved into the 20 to 40 percent black category; this neighborhood had almost a third of residents below the poverty line in 1990 and remained predominantly low-income until Seattle Housing Authority redeveloped it into a mixed-income community in the early 2000s (High Point Neighborhood; Seattle Housing Authority). Four tracts in Northeast Seattle had between a five and ten percent share of black residents, but North Seattle as a whole remained overwhelmingly white. That did not change in 2000, though the area surrounding Northgate had the highest share of black residents north of downtown. For the first time ever, a majority of Seattle tracts (69 of 132) had at least a five percent share of black residents. The Central District continued to diversify; the two tracts that where nine in ten residents were black in 1970 fell to around 50 percent black by 2000. Southeast Seattle was solidly in the 20 to 40 percent black range.

In 2010, the distribution of black residents in Seattle looked significantly different than forty years earlier. Only one tract citywide, located in High Point, was 40 percent black. The Central District now had a considerably lower share of black residents. On average this region saw its black percentage fall by 30 to 40 percent. Furthermore, North Seattle now had five tracts where black residents were at least five percent of the total population; ten years prior there was just one. Figure 43 shows how tracts growing fastest in their black population from 2000 to 2010 are concentrated in the North End and pockets of West Seattle. From a neighborhood change perspective, these historical maps illustrate the process of gentrification that these predominantly minority neighborhoods in Southeast Seattle likely experienced throughout the 1990s and 2000s. Of course, this is due to both black residents gaining access to housing that red-lining prevented until outlawed by fair housing legislation in 1968 as well as gentrifiers (most of them white) reinvesting in lower-income urban neighborhoods (Frantilla).

Figure 44 shows that the Hispanic population was never as starkly concentrated in one

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

decade that followed increased more than the citywide means of 36 percent in median household income and 18 percent in the share of residents with at least a Bachelor's degree. These tracts are clustered in four locations: the West Seattle neighborhoods of High Point and South Delridge and South Park; North Beacon Hill; the central neighborhoods of Belltown, South Lake Union, Capitol Hill, and the International District; and Fremont and Ballard.

How did these 18 tracts change from 2000 to 2010 relative to the city overall? Here I evaluate these tracts on several variables compared to citywide averages, in each case weighting each tract based on the share of the total population it represents. In educational attainment, the gentrified tracts saw an average increase of 51 percent in the share of residents with a Bachelor's degree compared to a citywide mean of 18 percent. In South Lake Union, High Point, and South Park, Bachelor's holders expanded almost threefold. Median household income increased 35 percent in Seattle but 60 percent in these gentrified tracts, nearly doubling in Belltown. Housing development boomed in these neighborhoods as well. In 2010, 14 of 18 gentrified tracts had more units than ten years prior, true in only half of Seattle tracts overall. The average citywide was six percent growth in units, but in these 18 tracts that figure was 25 percent. The share of renters, however, fell almost across the board, barely rising one percent in just one Madison Valley tract. This suggests gentrifiers in this period were disproportionately moving into owner-occupied housing. Meanwhile the median rent grew in every gentrified tracts by an average of 67 percent, while the city saw 42 percent growth here. Home values too were 2.2 times greater in 2010 than 2000 for the gentrified tracts and 1.8 times greater in all of Seattle. The share of 25- to 34-year-olds increased in two thirds of the 18 tracts and averaged 11 percent higher in 2010; the average for all tracts was a six percent drop. The older age bracket of 55-64 saw a rise in all 18 gentrified tracts, but this is not surprising given its growth across the city. In fact, while the city averaged 63 percent growth here, these 18 tracts saw a mean rise of just 52 percent, and only Fremont was significantly ahead of the Seattle average with 121 percent growth in 55- to 64-year-olds. Finally, the share of black residents fell in 12 of 18 gentrified tracts but increased in six. The most significantly rise was in High Point,

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

whose 62 percent growth in the black percentage either contradicts the notion that gentrifiers are predominantly white or indicates that High Point is too far from downtown to be a candidate for gentrification in the first place. In the centrally located Minor neighborhood near Seattle University, however, the black share also rose by 13 percent, and in Ballard it grew 11 percent. Perhaps more interestingly, the nonwhite share fell in all but one gentrified tract. It remains unclear if and how race drives and responds to the forces of gentrification in Seattle. For many variables, though, the changes in the 18 gentrified tracts support the relationships posited in the literature. On average, housing units increased, renters declined, real estate prices rose, and young people grew as a share of the total population.

Several studies posit that gentrifiers are disproportionately singles or childless couples as opposed to families with children (Chapple 2009, Fouch 2013). Both the NCDB and ACS include variables on the number of nonfamily households and families with children under 18. From 2000 to 2011, Seattle tracts averaged one percent growth in the share of nonfamily households and a two percent drop in the share of families with children. Among the 18 gentrified tracts, change in nonfamily households was similarly low—just under three percent growth—but the share of families with children fell 23 percent, far ahead of the city mean and giving credence to the notion that gentrification is driven by childless households.

What factors in 2000 may have suggested a susceptibility to gentrification in these 18 tracts? Previous research has found the share of nonwhite residents positively correlated with gentrification (Chapple 2009). The 18 tracts that gentrified in Seattle had a wide range of nonwhite shares in 2000, from 11 percent in Fremont to 86 percent in the International District. On the surface, this runs counter to Chapple's finding in the Bay Area. But this variation may belie a noteworthy trend. In 2000, nonwhite residents were on average 29 percent of the population in all Seattle tracts, but in the 18 gentrified tracts the average nonwhite share was more than a third higher at 46 percent. Given that racial diversity varies considerably by tract in Seattle, one interpretation of this finding is that while the absolute nonwhite population probably does not *on its own* drive gentrification,

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

tracts that gentrify are more likely to have a higher percentage of minorities than others tracts *like it or near it*. In other words, Ballard and Fremont were nowhere close to majority minority in 2000—but their nonwhite share was higher than many adjacent tracts. Likewise tracts downtown and in Capitol Hill varied by nonwhite share but were some of the highest within their neighborhood on that measure.

Income diversity is another important factor according to Chapple (2009). There are two commonly used measures of diversity that have their roots in the field of ecology: the Simpson index and the Shannon index (Beals et al. 2000).

$$\text{Shannon index} = -\sum_{i=1}^R p_i \ln(p_i) \text{ and Simpson index} = \sum_{i=1}^R p_i^2$$

where  $p_i$  is the proportion of individuals in the  $i$ th category.

Both measures calculate the ratio of the number of individuals in one group to the number of individuals in the system and then sum these proportions. They differ in that the Shannon index takes the natural log of the relative abundance of each group while the Simpson index squares it, adding weight to less populous groups (e.g., rare species whose presence in even small numbers may disturb an ecosystem). The former is more appropriate here since scarcity has no outside bearing on income diversity. Using the Field Calculator in ArcMap, I determine the Shannon index for the city as a whole and in each gentrified tract in order to assess the distribution of the following six income groups. Note that census income brackets are not based on AMI and thus correspond only approximately with the prescribed income levels.

Seattle had a Shannon index of 3.77 in 2000. The highest figures—the most equal representation of the six income groups—were 4.11 in Crown Hill, 4.10 in Greenwood, and 4.10 Haller Lake (all North Seattle tracts). The lowest marks occurred in the International District (2.15), Pioneer Square (2.66), and Montlake (2.67). Within the 18 gentrified tracts, the Shannon index averaged 3.65, slightly below the Seattle mean, and ranged from the 2.15 International District tract to 4.06 in Fremont. Even eliminating the International District tract as a potential outlier given its aberrant very low-income population, the average gentrified tract has a Shannon index of 3.73, still below

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

the Seattle mean. This may indicate that income diversity is less attractive to gentrifiers in Seattle as has been demonstrated in other regions.

Gentrification may also be more likely to occur in areas with a high share of overburdened renters. This variable is of particular import since it alludes to the risk of displacement in gentrified tracts. In 2000, four of ten households paid more than 30 percent of their income on rent in Seattle. (Interestingly, the two tracts with the highest share of rent-burdened households are next to the University of Washington. The highest non-University adjacent tract is in Rainier Beach, where 63 percent of households are rent burdened.) At 43 percent, the average gentrified tract was not significantly higher in the share of rent-burdened households than the city as a whole. However, the range among gentrified tracts (31 to 54 percent) was much narrower than the city as a whole (12 to 69 percent).

Lastly, several housing variables are worth examining for their potential contribution to gentrification from 2000 to 2010. First, I determine whether a relationship existed between likelihood of gentrification and the share of multi-unit buildings (defined as having three or more units). Seattle had a 42 percent share of multi-unit buildings in 2000, ranging from a minimum of less than one percent in Broadview to over 99 percent in seven downtown tracts where no single-family houses or duplexes exist. Among the 18 gentrified tracts, however, the multi-unit share averaged 66 percent. At 23 percent, a Madison Valley tract exhibited the lowest percentage of buildings with three or more units among gentrified areas. Second, and related, a higher share of rental housing is positively associated with gentrification. In Seattle, gentrified tracts averaged a 73 percent share of renter-occupied housing in 2000 compared to 50 percent for the city as a whole. Third, the share of pre-war housing, a variable Chapple (2009) associates with gentrification risk, was no different in gentrified tracts (32 percent) from the city average (33 percent). Housing built in the last five years, however, which Chapple does not mention, had a twice as large average share in gentrified tracts (10 percent) than in all Seattle tracts (5 percent). Even housing built in just the nine months prior to the release of the 2000 census was more abundant in the gentrified tracts (2.5 percent)

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

than all Seattle tracts (1.6 percent), lending support to the notion that new housing development is correlated with gentrification, which anecdotal knowledge of the Seattle area confirms. Table 11 summarizes the trends identified within gentrifying tracts from 2000 to 2010.

Table 11: Trends identified in gentrifying tracts, 2000-2010	Gentrified tracts	Seattle average
Percent change, 2000-2010		
Median household income	60	35
Share of residents with a Bachelor's degree	51	18
Housing units	18	6.2
Rental share	-6.1	-1.8
Median gross rent	67	42
Median home value	119	77
Share of 25-34 age cohort	8.9	-5.8
Share of 55-64 age cohort	52	63
Share of black residents	-17	3.2
Share of family households with children	-23	-2.0
Factors associated with gentrification, 2000 (%)		
Share of non-white residents	46	29
Income diversity (Simpson index)	3.65	3.77
Share of residents over 30 percent of their income on rent	43	40
Share of multi-unit buildings	66	42
Share of renter-occupied housing	73	50
Share of pre-war housing	32	33
Share of housing built during 1995-2000	10	5

## Conclusion

The analysis of neighborhood change in Seattle over the last four decades reveals important demographic and socioeconomic trends. Though it remains overwhelmingly white (74 percent according to the 2010 census) Seattle is far less spatially segregated by race than it was in 1970 and 1980. Median household income has risen unevenly in the last twenty years, with the Beacon Hill/Rainier Valley and much of Northeast Seattle falling behind the highest-growth tracts in Eastlake, Queen Anne, Ballard, West Seattle, and Downtown. Since 2000 rental tenure has increased most rapidly in several Southeast Seattle tracts near the new light rail line, with increases in median gross rent here outpacing the city average as well.

Across the entire city, the cost of living has gone up. Although median household income

## 5 NEIGHBORHOOD CHANGE IN SEATTLE

rose 35 percent citywide and grew in all but five census tracts in the 2000s, it became more costly to rent or own a home in Seattle. Median rent increased 42 percent and was higher in 2010 than ten years prior in every tract but one. Home prices grew even more, up 77 percent in that decade, homeownership increasingly an option only for residents earning well above the area median income.

From 2000 to 2010 there were 18 lower-income tracts that experienced above-average growth in median household income and educational attainment, and they were more racially diverse than other tracts in the area, had higher shares of renters and multi-unit buildings, and coincided with areas of recent housing development. Along with the existing literature and factors contributing to gentrification, these Seattle-specific findings will inform the creation of a susceptibility index in the following chapter.

# 6 GENTRIFICATION SUSCEPTIBILITY

With a historical perspective in place, this chapter turns towards where gentrification is most likely to begin, continue, or accelerate in the future. I use a broad suite of factors drawn from literature on gentrification in general and previous GIS analyses in particular and in some instances adjust their relative weighting depending on the specific context of neighborhood change in Seattle.

## **Gentrifiable tracts**

The first step in this model is whether to identify specific gentrifiable tracts and, if so, on what criteria. Many studies remove from their model census tracts where median income is above the city or regional average—areas ostensibly too affluent to gentrify per se. The danger in this approach, however, is the exclusion of smaller census geography where median income is in fact lower and gentrification a risk. Since the most recent decennial census, released in 2010, does not contain economic data such as median income at the block or blockgroup level, we must defer to the American Community Survey five-year averages, which is only available with a reasonable margin of error at the tract level. To address the risk of omitting gentrifiable areas from the model, I use a different, broader approach, excluding only those tracts where either the share of households earning below 65 percent of AMI is less than 20 percent or the share of households earning above 120 percent of AMI is more than 67 percent. Much of the city remains eligible as a result, but since my model includes data at the parcel level, identifying specific blocks that could be vulnerable to gentrification, there is reason to avoid too much exclusion of *tracts a priori*. The purpose here, after all, is merely to eliminate truly affluent neighborhoods where gentrification cannot occur. This

## 6 GENTRIFICATION SUSCEPTIBILITY

results in the exclusion of 29 tracts (22 percent of total), shown in Figure 52, where median household income ranged from \$69,852 to \$145,221, none of which were identified as gentrifying from 2000 to 2010.

### **Methodology**

My assessment incorporates components from various previous studies of gentrification vulnerability. In terms of the general geospatial approach, I perform a weighted suitability analysis of 25 factors believed to make an area susceptible to gentrification similar to Chapple (2009), Gafvert (2011), and Fouch (2012). This involves gathering vector data on housing, built environment, location, and demographic characteristics, converting them to raster layers reclassified either as binary (e.g., 1 = gentrifiable, 0 = non-gentrifiable) or as a scale, and weighting and summing the raster layers into a composite susceptibility index. The results of any suitability analysis are sensitive to the indicators chosen, but gentrification is a particularly difficult phenomenon to measure (Wyly and Hammel 1999, p. 726). Several of the indicators I use derive from the data on past neighborhood change in Seattle presented in Chapter 5, an approach advanced by Chapple (2009) in the Bay Area. Others come from empirical evidence about the factors associated with gentrified neighborhoods (Meichert and Naroff 1987; Heidkamp and Lucas 2006; Kolko 2007; Aka 2010). Gentrification per se is not inherently problematic, but the displacement it often produces is. In this vein, I follow the methodology used by Bates (2013) in Portland and weight more heavily those variables that make certain populations more vulnerable to displacement, such as high rental tenure and communities of color.

However, unlike several previous studies, I focus specifically on where gentrification is likely to occur in the future as opposed to identifying where it is already well underway. Too often, the stages of gentrification are confounded, and factors contributing primarily to future risk (e.g., planned transit stations) are included alongside others that signal gentrification in progress (e.g., home value appreciation or increases in educational attainment). That's not to say gentrifying

## 6 GENTRIFICATION SUSCEPTIBILITY

neighborhoods are a lost cause, but anticipating displacement well in advance is particularly valuable, especially since the responses are rarely instantaneous. Certainly the recent past has a bearing on gentrification in the near future. If detectable, the beginnings of growth in median household income or other demographic changes are important warning signs that displacement may soon follow or accelerate. But due to the infrequency of reliable census data, extrapolating heavily from home value appreciation during 2000-2010 is unwarranted. Those neighborhoods have already gentrified.

The selection of weights and thresholds is consistently a source of disagreement and criticism in a suitability analysis. Some studies, such as Chapple (2009), perform a regression to determine the relative impact of certain variables on past gentrification and extrapolate those coefficients to the predictive model. Though based on empirical data, this method assumes previous drivers of gentrification persist today to the same degree. Others, like Gafvert (2011), measure the median weight that surveyed experts attribute to each factor. This risks misestimating or having to exclude variables on which there is disagreement. In truth, any procedure for choosing weights is inevitably subjective, reflecting an emphasis of either past trends, expert opinion, or the researcher's judgment. In the present study, I deviate little from the most robust previous analyses in terms of variable weighting. Certain factors receive greater weighting due to their emphasis in the literature or their particular importance in the Seattle context and lower weighting if their association with gentrification in Seattle is weaker.

The following sections briefly detail my rationale, data selection, and geoprocessing methods for each of the factors used. Using the Feature to Raster tool, each vector layer is eventually converted to a raster file that can be summed into the final index. I use a cell size of 100 feet, or roughly a quarter acre, for the final map as this scale keeps file sizes manageable but provides adequate resolution for block- or even parcel-level assessment. Table 12 shows the classifications and weights used for each factor. For each indicator, the maximum score is 4. Some are binary, scored as either 0 or 4, and others are ranked from 0 to 4. Most factors receive equal weighting,

## 6 GENTRIFICATION SUSCEPTIBILITY

but for instances where one is weighted more or less than that, I elaborate on my rationale.

### **Housing indicators**

#### *Concentration of pre-1940 housing*

Pre-war housing is not uncommon in Seattle, though in only a handful of tracts are the majority of homes built in this era. I calculate the percentage of housing in each tract built before 1940 and classify tracts over 50 percent as achieving this indicator.

#### *Concentration of historic buildings*

I select historic parcels from the City of Seattle parcel datalayer and use Feature to Point to create a point feature class for each historic structure. Then I calculate the point density within a quarter-mile neighborhood for this layer and reclassified based on quartiles. Since historic architecture is less of an attraction in Seattle compared to older cities on the East Coast, and because gentrification in recent years has been characterized by new residential development as opposed to property upgrades, I weight this factor at 0.5.

#### *Housing tenure*

According to several studies (Chapple 2009; Heidkamp and Lucas 2006), the higher the share of rental housing, the more likely a tract is to gentrify. Bates (2013) includes renters as one of the more vulnerable populations. Due to its prominence in the literature and previous studies and the direct relationship that exists between rental tenure and vulnerability to displacement, I weight this variable at 1.5. Figure 55 shows the percentage of renter-occupied units by tract, which I convert to raster and reclassify at 50 and 75 percent thresholds.

#### *Low dwelling value*

In 2011, Seattle had a median home value of \$453,000 and median gross rent (rent plus utilities) of \$1,003. To identify neighborhoods where a considerable share of the housing stock is below these city averages—areas where a developer could capitalize on undervalued real estate—I calculate the share of each tract that is below \$400,000 and \$1,000 in home value and rent, respectively,

## 6 GENTRIFICATION SUSCEPTIBILITY

and weight these two percentages according to the relative abundance of owner- and renter-occupied housing in the tract. This is shown in Figure 56. However, as Gafvert (2011) notes, at a certain point below-average housing prices can “prevent gentrification by deterring investment” (p. 56). Her expert survey produced widely ranging responses to the question of how low dwelling value affects gentrification. In the present study, I maintain it is still a worthwhile variable for two reasons. First, the study area is relatively small compared to regional analyses, and therefore spillover effects are more reasonable to expect in the next two decades almost anywhere in the city. Second, development in Seattle has progressed such that there are few truly disinvested areas remaining compared to Rust Belt cities like Cincinnati, so the deterrent effect of low dwelling value is probably minimized here.

### *Rent burden*

Figure 57 shows the share of households paying over 30 percent of their income on rent. Renters alone are more vulnerable than homeowners due to reduced control over their residence. If already struggling to make monthly rent payments, these households are particularly unlikely to be able to resist displacement should housing prices increase. Similar to housing tenure, high rent burden is a strong predictor of susceptibility to displacement, so this factor is weighted at 1.5.

### *Concentration of multi-family housing*

A higher share of multi-unit buildings means less investment is required for redevelopment and that the zoning already accommodates the type of housing prevalent in gentrified neighborhoods (Gafvert 2011). I measure the share of all housing units that have two or more units and reclassify according to whether multi- or single-family housing is the majority housing type.

### *Concentration of vacant parcels*

Vacant residential parcels create the potential for new development in a neighborhood, increasing the likelihood of gentrification (Gafvert 2011). Like low dwelling value, too high a concentration of vacant parcels can deter in-migrants and inhibit gentrification, but in Seattle, where

## 6 GENTRIFICATION SUSCEPTIBILITY

vacancy is rare and there is essentially no undeveloped land, this is not a concern. I select *Vacant (Single-family)* and *Vacant (Multi-family)* from the PRES\_USE\_D field of the King County parcel layer, which is current as of February 2012. Then I use Feature to Point and Point Density to produce a density raster for the concentration of vacant parcels within a quarter-mile neighborhood. I reclassify this raster according to natural breaks.

Gafvert (2011) and Fouch (2012) both use census data for this indicator, which measures vacant *units* as opposed to *parcels*. The purpose of this indicator is to identify areas where vacant land might entice infill development. Measuring vacancy at the parcel layer is better suited to that end than American Community Survey data tracking five-year averages for vacant units. Interestingly, the ACS data reports 7,584 vacant units, while the King County GIS parcel layer contains 8,165 vacant parcels. Because of uncertainty about the reliability of this data layer, however, I weight it at 0.5.

### *Foreclosure rate*

The Department of Housing and Urban Development (HUD) tracks the foreclosure rate across the United States and produces data at the tract level. Foreclosures decreases property values and, like low dwelling value, increases the likelihood of reinvestment. Unfortunately, the most recent data is from 2000, well before the subprime mortgage crisis sent a wave of foreclosures across the U.S. Figure 60 shows the percentage of foreclosed mortgages by tract. Given the age of this dataset and the low foreclosure rates at the time—less than four percent in every Seattle tract—I select only the top decile of tracts where above-average foreclosure rates in 2000 might be a proxy for high foreclosure rates during the housing crisis. Still, this is a bit of a causal leap, so I underweight this factor at 0.5.

## **Location indicators**

### *Proximity to park or open space*

Data for this layer came from the City of Seattle, but its parks and open space feature class

## 6 GENTRIFICATION SUSCEPTIBILITY

includes several features outside of the conventional conception of a park, such as tidelands, golf courses, and paved cycling or walking routes like the Burke Gilman Trail. To remove non-park features and avoid double counting others like bike routes, I manually eliminated these features from the layer. Due to the challenges of computing service areas along a network with polygon features, I used the Euclidean Distance tool and reclassified the raster at distances of 563, 1127, 1690, and 2253 feet.

### *Proximity to waterfront*

Since this layer comes from the King County hydrology dataset, I selected and removed features in the categories “Residential or industrial water impoundment” and “Sewage disposal pond,” neither of which are likely to attract anyone. I also removed the Duwamish River, which in Seattle is just an industrial estuary. I then ran Euclidean Distance and reclassified at 563, 1127, 1690, and 2253 feet.

### *Proximity to a college or university*

I selected by taxpayer from the parcel layer for the following schools: University of Washington, Seattle University, Seattle Pacific University, Cornish College of the Arts, Seattle Vocational Institute, Antioch University, Seattle Central Community College, South Seattle Community College, and North Seattle Community College. Then, similar to proximity to parks and the waterfront, I calculated Euclidean Distance at breaks of 563, 1127, 1690, and 2253 feet.

### *Proximity to community garden*

None of the previous studies of gentrification vulnerability to date have made use of the Network Analyst tool, which allows for the computation of service areas within a given distance of certain point locations along a network, though Kolko (2007) notes the superior of this approach. Unlike the Buffer tool, which uses Euclidean or as-the-crow-flies distances and ignores connectivity, Network Analyst produces more accurate visualizations of accessibility by measuring distance along the local street network. I use this approach for all locational indicators that come in the

## 6 GENTRIFICATION SUSCEPTIBILITY

form of point data. It is a superior method for measuring proximity whenever the amenity derives its value specifically from the ease of traveling there, though one drawback is that it cannot easily handle polygon shapefiles. Here I identify areas within an eighth-mile and quarter-mile distance of community gardens. Though this is certainly a valued neighborhood amenity, particularly in Seattle, I underweight this indicator at 0.5 as there is no explicit mention of them in the literature.

### *Transit access*

There are two main transit authorities operating in Seattle: Metro, which runs local and express buses throughout King County, and Sound Transit, which operates commuter buses and the Link light rail system throughout the larger Puget Sound region. I have taken two slightly different approaches for evaluating how these transit systems may contribute to gentrification.

Metro bus stops vary widely in the quality of transit access they provide. Some are served by over a dozen high-frequency routes; others are located in low-ridership areas and simply provide coverage to residents who depend on public transit (Walker 2011). The latter are far less likely to attract gentrifiers or incentive new development, because lack the level of service necessary to substantially reduce automobile dependence. That's why the LEED for Neighborhood Development rating system from the U.S. Green Building Council is careful to specify the number of transit trips a bus stop provides if a project is going to receive credit for transit accessibility (USGBC 2011, 27-28). Previous studies have not considered the quality of transit access a given location provides. To that end, I define a transit-rich area as located within a quarter-mile walk of bus stops that, in aggregate, have at least 320 weekday and 200 weekend trips. Within these areas, I reclassify at distances of an eighth and quarter mile. This factor is weighted at 0.5 since bus access is not as large a driver of neighborhood revitalization as light rail.

Since the Link network is far less extensive and has shorter headways than Metro, it is easier to calculate a pedestrian walkshed around each station. Here I improve on previous studies in two ways, first by using network rather than Euclidean distance, and second by stratifying by proximity. Studies typically treat all areas equally within a given distance—usually a half mile—of a transit

## 6 GENTRIFICATION SUSCEPTIBILITY

station. Yet parcels immediate adjacent to the station are at least marginally more likely to gentrify than those a quarter mile away. Gafvert (2011, p. 64) is the only one to use quarter-mile increments for a higher resolution of accessibility, though she extends her Euclidean buffers to 1.25 miles, further than most people will walk for transit (Walker 2011). I classify at network distances of an eighth, quarter, and half mile and weight them exponentially.

While Metro has undergone contentious changes to its service in the last few years, Link is expanding on a far greater scale. There are 13 stations currently in use from SeaTac Airport to Downtown Seattle and five under construction in that will open between 2015 and 2021. This presents an exciting opportunity to evaluate how future transit stations may attract reinvestment. Chapter 3 showed how the Southeast Seattle Link corridor has experienced some of the highest rates of housing development in the city. For this reason, I weight the areas surrounding future Link stations higher, though only slightly since development remains nascent around existing stations.

Finally, a streetcar network has expanded through South Lake Union and up First Hill to Broadway, though GIS data for these lines does not yet exist. I have geocoded the current and planned station locations and include them in the analysis. A long-range plan includes lines to Ballard, the University District, and West Seattle but remains in the conceptual phase at this point (SDOT 2008). The streetcar network is as of now rather limited, so I weight this indicator at 0.5 to reflect the relatively little mobility proximity to a station provides.

### *Location in an urban village*

The City of Seattle has an Urban Village Boundary layer that delineates commercial areas or neighborhood business districts that Gafvert (2011), among others, identifies as an amenity attractive to gentrifiers. This is also a suitable proxy for the type of dense, mixed-use developments that the LEED for Neighborhood Development rating system and the Smart Growth Network encourage (USGBC 2011; Smart Growth Network).

### *Neighborhood spillover effect*

Drawing on the findings of Kolko (2007), I select tracts where the median household income in

## 6 GENTRIFICATION SUSCEPTIBILITY

2011 was below 80 percent of AMI (\$49,485) that are adjacent to tracts where the median household income was greater than 120 percent of AMI (\$74,227). These areas are particularly vulnerable to what Kolko calls the neighborhood spillover effect and are more likely to gentrify given their adjacency to already gentrifying or affluent neighborhoods.

### **Demographic indicators**

#### *Heterogeneous racial composition*

Similar to how income diversity was calculated in Chapter 5, I use the Shannon index to measure racial diversity by tract, a characteristic previous studies have identified as desirable for gentrifiers (Chapple 2009). I convert the feature to a raster and reclassify based on quartiles, the highest two of which I use as an indicator of gentrification vulnerability. The Shannon index uses logarithms and thus can be calculated only for non-zero factors. As a result, I must evaluate this factor at the tract level where at least one individual of each race is present. Though experts surveyed in Gafvert's (2011) study were mixed on the effect of this variable, Figure 51 shows that gentrification was somewhat more likely to occur from 2000 to 2010 in tracts more racially heterogeneous than their immediate neighbors. This is also a prominent driver of gentrification in the literature and weight at 1.5 in the present study as a result.

#### *Concentration of minority residents*

Studies argue that a concentration of Hispanic (Kolko 2007), minority (Gafvert 2011), or otherwise non-white residents (Chapple 2009) is a community asset that attracts gentrifiers. Furthermore, Bates (2013) identifies communities of color (defined as all residents except non-Hispanic white) as less likely to be able to resist displacement. They are also associated with the "areas of long-term disinvestment...targeted by young people on the leading edge of gentrification" (Bates 2013, p. 28). I include all three of these factors but, at 0.5, weight them the than Shannon index, which provides a more holistic measure of racial and ethnic diversity. Though 2010 data on

## 6 GENTRIFICATION SUSCEPTIBILITY

race is available at the block level, the neighborhood characteristics that a household is likely to consider when choosing a residence are from a larger geographic area. Therefore for these race and ethnicity layers, I measure at the blockgroup level. In Seattle overall, just under 30 percent of all residents are non-white.

### *Educational attainment*

Bates (2013) also identifies an above-average share of residents without a college degree as an indicator of vulnerability to displacement. This factor in and of itself may not instigate gentrification; it is not an amenity or demand-side variable that attracts gentrifiers. But, along with high minority and renter populations, it increases the risk that incumbent residents are displaced, and this is a defining characteristic of gentrification. Citywide, just over 45 percent of Seattleites over 25 years old lack a college degree. Tracts with a higher share of this demographic are scored accordingly. Since it is strongly associated with displacement risk, I weight this factor at 1.5.

## **Findings and analysis**

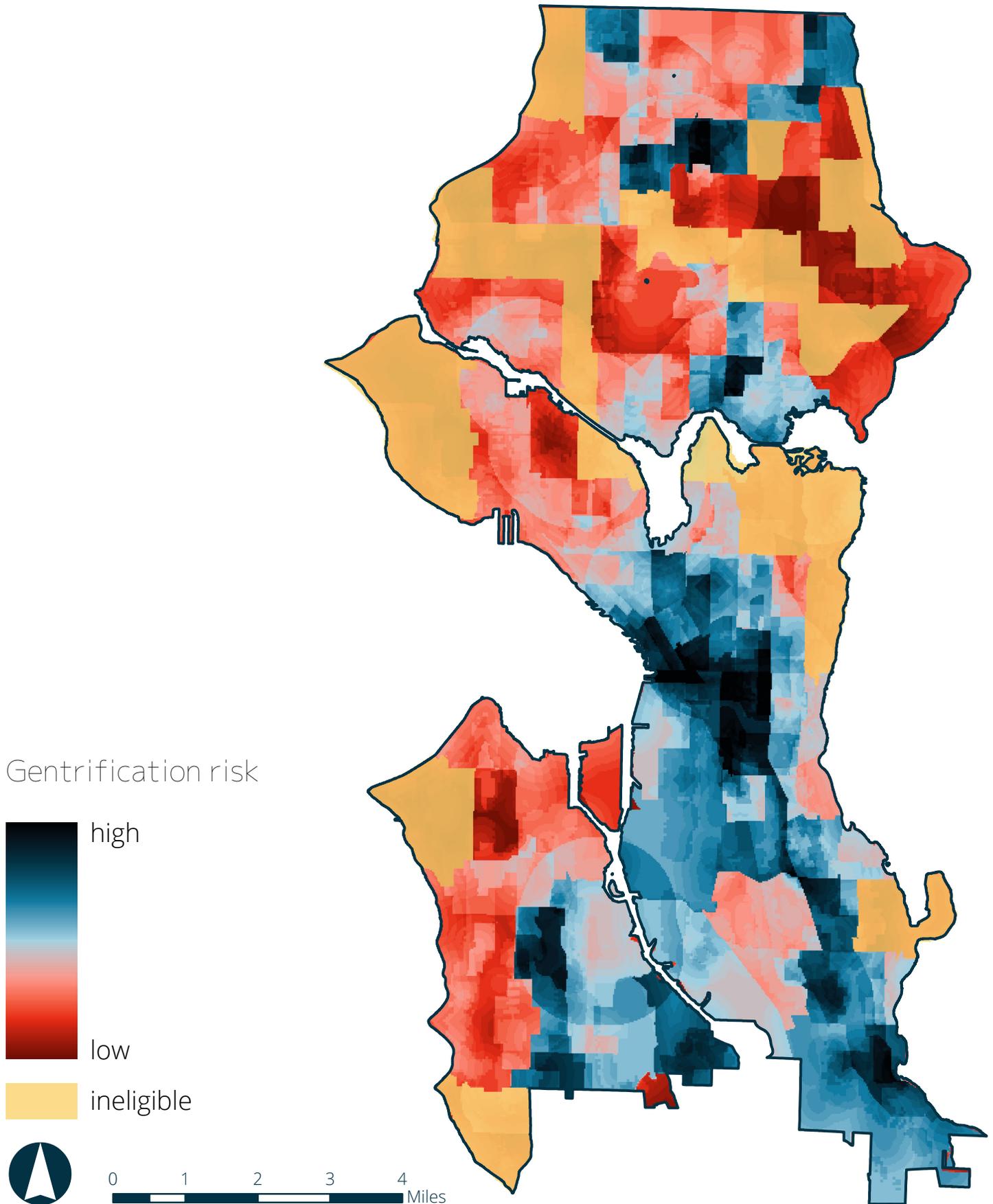
Once converted to raster data, each of the aforementioned factors was summed using the Raster Calculator tool according the weights in Table 12. Figure 3 shows the results of this weighted overlay in a composite gentrification susceptibility index with an overlay of tracts that are not considered eligible for gentrification. There are highly susceptible areas in both the north and south ends of the city. The most susceptible areas are in the south end are from First Hill through the Central District, High Point, Columbia City, Holly Park, and just north of Rainier Beach. At the north end, neighborhoods around North Seattle Community College and Northgate are at risk. The high scores found near the University of Washington probably ought to be viewed with caution given the student population there. Figure 4 highlights these most susceptible areas. I then summarize the index by neighborhood using the Zonal Statistics tool. Figure 5 displays the mean risk score for each neighborhood of Seattle. At this level of analysis, it is clear that the south end of Seattle is much more vulnerable overall than North Seattle, where a majority of neighborhoods have a

**Table 12: Factors included in weighted gentrification susceptibility index**

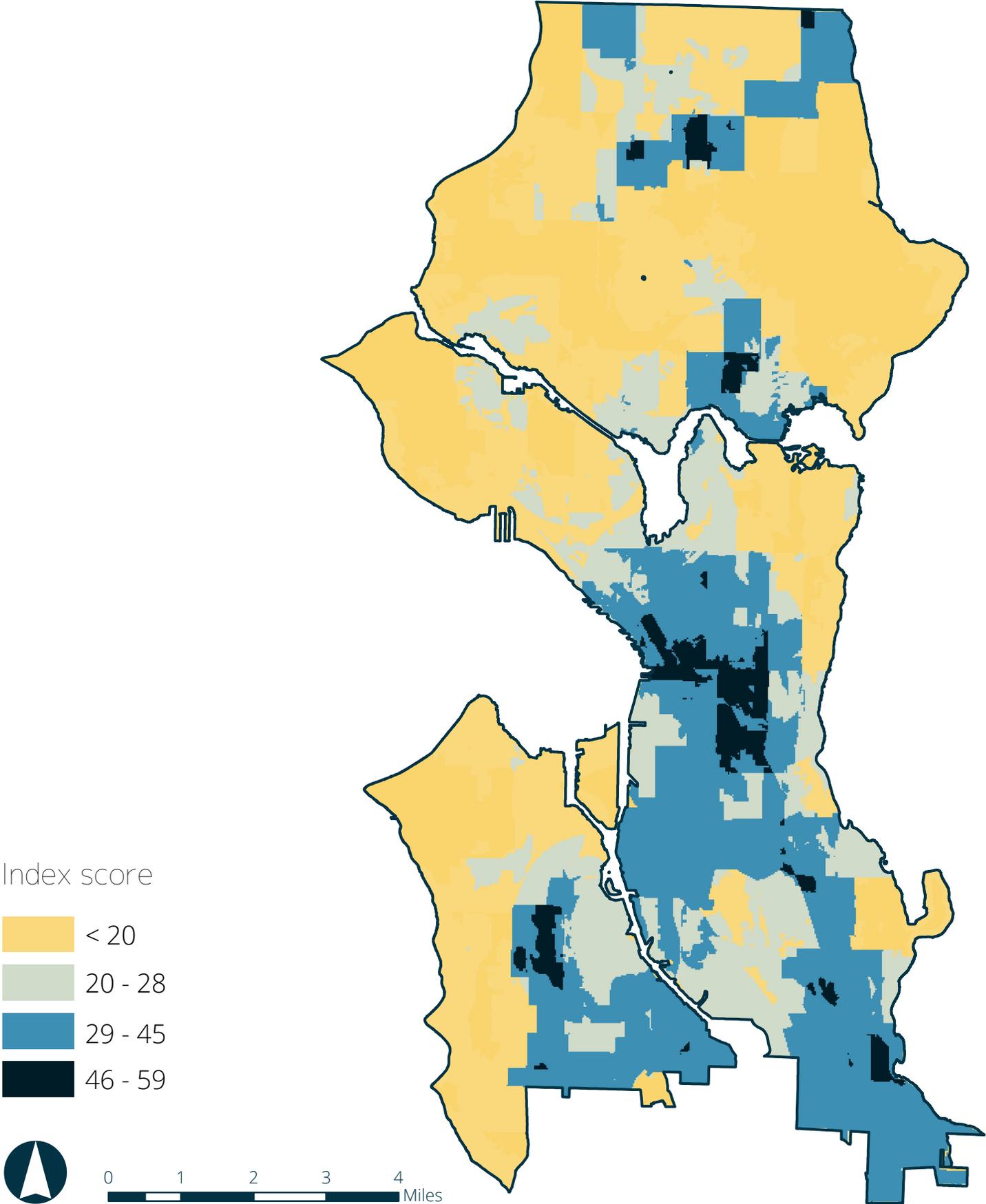
Factor		Description	Data source	Classifications	Weight	Reference	
1	Median household income	Only 2010 tracts where median income is within a certain range are defined as potentially able to gentrify.  This indicator limits the domain of the susceptibility index.	U.S. Census Bureau, 2010 Census	< 20% of households earn > 65% AMI OR > 66% of households earn > 120% AMI  ≥ 20% of households earn < 65% AMI OR ≤ 66% of households earn >120% AMI	0 (unable to gentrify)  1 (able to gentrify)	-  -	Heidkamp and Lucas (2006); Chapple (2009); Gafvert (2011)
<b>HOUSING AND BUILT ENVIRONMENT</b>							
2	Concentration of pre-1940 housing	Share of housing units built before 1940 by tract	2011 ACS 5-Year Estimate	< 30% 30-50% >50%	0 2 4	1	Melchert and Naroff (1987); Chapple (2009); Gafvert (2011); Kolko (2007)
3	Concentration of historic buildings	Density of historic buildings in surrounding quarter-mile neighborhood (quartiles)	King County GIS	lowest second third highest	0 1 2 4	0.5	Gafvert (2011);
4	Housing tenure	Share of occupied housing units that are renter occupied by tract	U.S. Census Bureau, 2010 Census	<50% 50-75% >75%	0 2 4	1.5	Chapple (2009); Heidkamp and Lucas (2006)
5	Low dwelling value	Share of owner-occupied housing below \$400,000 + share of rental housing below \$1000 rent/month, weighted by the relative share of each housing type in the tract	2011 ACS 5-Year Estimate	0-50% 50-60% 60-75% >75%	0 2 3 4	1	Melchert and Naroff (1987); Heidkamp and Lucas (2006); Chapple (2009); Aka (2010)
6	Rent burden	Share of renters paying over 30% income for housing by tract	U.S. Census Bureau, 2011 ACS	<30% 30-40% 40-50% 50-60% >60%	0 1 2 3 4	1.5	Gafvert (2011); Chapple (2009);
7	Concentration of multi-family housing	Share of buildings that have two or more units by tract	2011 ACS 5-Year Estimate	<50% ≥50%	0 4	1	Chapple (2009)
8	Concentration of vacant parcels	Vacant parcels in surrounding quarter-mile neighborhood (parcels/mi <sup>2</sup> )	King County GIS	<266 267-1025 >1025	0 2 4	0.5	Gafvert (2011); Fouch (2012)
9	Foreclosure rate	Share of foreclosed mortgages by tract (deciles, 2000 tracts)	HUD	0-9 10	0 4	0.5	Chapple (2009)
<b>LOCATION</b>							
10	Proximity to parks or open space	Within specified Euclidean distance of park or open space	City of Seattle	2253 ft. 1690 ft. 1127 ft. 563 ft.	1 2 3 4	1	Gafvert (2011); Chapple (2009)
11	Proximity to the waterfront	Within a specified Euclidean distance of a water body	King County GIS	2253 ft. 1690 ft. 1127 ft. 563 ft.	1 2 3 4	1	Heidkamp and Lucas (2006);
12	Proximity to a university or college	Within a specified Euclidean distance of a university or college	King County GIS	2253 ft. 1690 ft. 1127 ft. 563 ft.	1 2 3 4	1	Chapple (2009)

13	Proximity to a community garden	Within specified network distance of a community garden	City of Seattle	1/4 mile 1/8 mile	2 4	0.5	
14	Proximity to high-frequency bus service	Within quarter-mile network distance of bus stops where service in aggregate meets specified thresholds	King County GIS	less than 320 weekday or 200 weekend trips  at least 320 weekday and 200 weekend trips	0  4	0.5	Chapple (2009); USGBC (2011)
15	Proximity to current Link station	Within specified network distance of a current Link station	King County GIS	1/2 mile 1/4 mile 1/8 mile	1 3 4	1	Chapple (2009)
16	Proximity to future Link stations	Within specified network distance of a future Link station	King County GIS	1/2 mile 1/4 mile 1/8 mile	1 3 4	1.5	Chapple (2009)
17	Proximity to streetcar station	Within specified network distance of a current, planned, or under construction streetcar station	author calculation	1/4 mile 1/8 mile	2 4	0.5	Chapple (2009)
18	Location in "Urban Village"	Located within boundaries of an urban village or neighborhood business district	City of Seattle	within urban village outside urban village	0 4	1	
19	Proximity to already-gentrified or affluent neighborhood	Median household income is less than 80% AMI and adjacent tract has median household income of greater than 120% AMI	U.S. Census Bureau, 2010 Census	not adjacent to high-income tract  adjacent to high-income tract	0  4	1	Kolko (2007)
<b>DEMOGRAPHIC</b>							
20	Diverse racial composition	Shannon index for racial diversity by tract (quartiles)	U.S. Census Bureau, 2010 Census	lowest second third highest	0 0 2 4	1.5	Gafvert (2011); Chapple (2009)
21	Hispanic population	Share of Hispanic residents by tract	U.S. Census Bureau, 2010 Census	<15% ≥15%	0 4	0.5	Gafvert (2011)
22	Black population	Share of black residents by tract	U.S. Census Bureau, 2010 Census	<20% ≥20%	0 4	0.5	Kolko (2007)
23	Communities of color	Share of non-white residents by tract	U.S. Census Bureau, 2010 Census	<50% ≥50%	0 4	0.5	Chapple (2009)
24	Low educational attainment	Below city average for population without Bachelor's degree by tract	U.S. Census Bureau, 2010 Census	<45.3% ≥45.3%	0 4	1.5	Bates (2013)

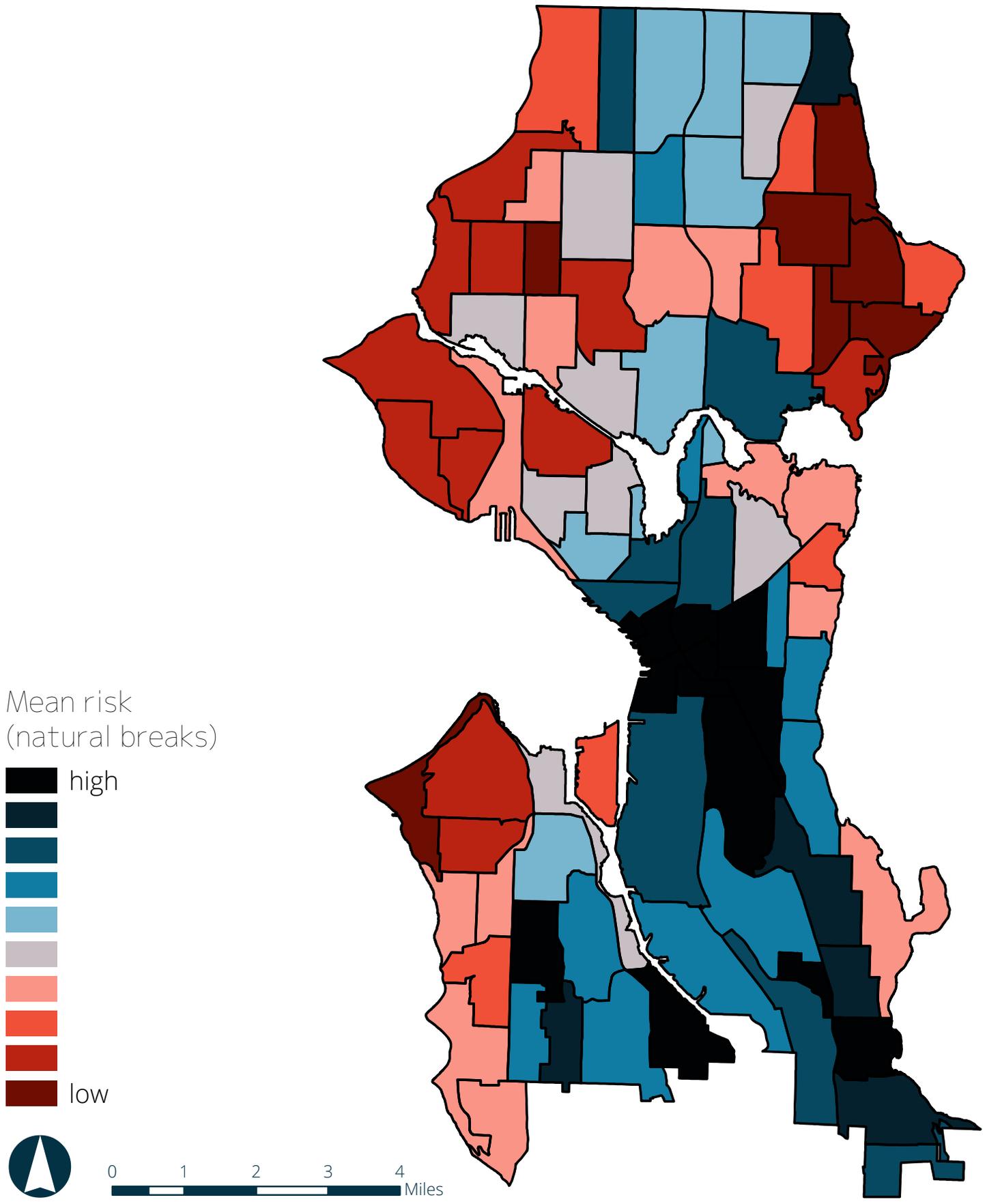
**Figure 3:** Composite gentrification susceptibility index



**Figure 4:** Areas of highest susceptibility to gentrification



**Figure 5:** Gentrification susceptibility by neighborhood



## 6 GENTRIFICATION SUSCEPTIBILITY

median income well above the city average. Still, there are clusters near the Maple Leaf and Lake City neighborhoods with some of the highest scores on the susceptibility index in the entire city.

These results are, on the whole, not surprising. The least susceptible areas according to the index are concentrated in neighborhoods that are already quite affluent. Many neighborhoods most vulnerable to gentrification, such as the Central District and Rainier Valley, were historically lower income, are located close to downtown, and have a high percentage of renters. Likewise areas close to either the existing light rail line through Southeast Seattle or stations under construction in the University District and Northgate are likely to experience high residential development. Given the current concentration of lower-income and high-foreign born populations in these areas, gentrification risk is significant.

A fine resolution raster approach such as this enables policymakers to identify certain particularly susceptible blocks and neighborhoods and monitor changes occurring there. Several of the other models discussed share this goal, but the present study incorporates a more comprehensive set of indicators than most existing efforts to identify at-risk neighborhoods. For example, Gafvert (2011) omits factors where surveyed experts disagree about the direction and magnitude of its effect on gentrification despite empirical research indicating their importance. Including more factors than some previous models reduces chance that any single variable has an outsized impact on the final index. The present study is also more balanced than several other models, drawing on a relatively equal weighting of housing, location, and demographic variables. Further, this study is the first to focus explicitly on factors that suggest probable future gentrification as opposed to indicators of recent or current gentrification, making it more useful for efforts to mitigate displacement. Finally, I make several improvements in geospatial processing, such as the use of network rather than Euclidean distance and the inclusion of novel measures for diversity and low dwelling value.

These are meaningful lessons for researchers looking to predict gentrification risk using GIS, but ultimately this model is tailored to Seattle and its particular context of neighborhood change. Any future effort to model gentrification risk ought to follow this approach. Table 13 answers the

## 6 GENTRIFICATION SUSCEPTIBILITY

same questions as Table 10 but for the present study. Rather than simply replicate this or any other suite of factors for different metropolitan area, I recommend future research also begin with historical data to determine what variables have correlated most strongly with gentrification, a method first advanced by Chapple (2009). Then, the present study should serve as a comprehensive guide for the factors most often associated with gentrification in the literature. Inevitably, certain indicators will not apply in other locales. Proximity to the waterfront, for example, is a very significant driver of real estate prices in Seattle but may be largely meaningless in a city without prominent water features. Additionally, as noted in the literature review, the impact of race on gentrification risk is not straightforward. Some researchers posit that racial heterogeneity is an amenity gentrifiers seek. Racially homogenous neighborhoods, the argument goes, are unattractive to gentrifiers or have already gentrified. As a result, many models, including the present study, include this variable as a indicator of gentrification susceptibility. Yet the literature on displacement overwhelmingly indicates that nonwhite residents are more likely to be negatively affected by gentrification. And the way race contributes to and is affected by patterns of neighborhood change in Seattle is likely quite different from, say, Atlanta or Washington, D.C.

With this in mind, the elegant model presented by Bates (2013) suggests there is value in a simpler approach with fewer indicators. Though the present study is comprehensive in its assessment of susceptibility and highlights small geographic areas particularly likely to gentrify, to some it may seem overly complex. In contrast, Bates first examines in broad strokes where a vulnerable population and accelerating housing market coincide. This precipitates a more precise “drill-down” analysis to understand more about the real estate, demographic, and socioeconomic dynamics at work. For policymakers in search of a detailed portrait of gentrification risk citywide, the model proposed in this thesis is a powerful synthesis of existing literature and previous research on gentrification indicators. But it may be cumbersome to update it regularly as conditions change and new data arrives; to that end, Bates presents a useful and more flexible tool that may better facilitate ongoing monitoring of at-risk neighborhoods.

**Table 13: Description of geospatial approach to measuring gentrification vulnerability**

How are gentrifiable neighborhoods defined? Does the model cover the entire city or only those areas?	How are the stages of gentrification characterized?	How are indicators chosen?	What data is available and used in the model?	How are relative weights determined?	Is the model tailored to the particular context of the study area?
<p>To avoid inadvertently omitting certain census tracts that, despite high average income, may contain lower-income, gentrifiable blocks, the model covers the entire city. Only tracts where the share of lower-income households is extremely low or high-income households is so overwhelming—in other words, tracts that are demonstrably already gentrified—are defined as not gentrifiable. A transparent overlay identifies these areas, but their theoretical susceptibility score remains faintly visible.</p>	<p>This study seeks to identify areas where gentrification is likely to take root or accelerate in the future. The indicators are selected with this goal in mind, as opposed to identifying neighborhoods where gentrification is already underway.</p>	<p>Most indicators derive from the existing literature on gentrification drivers. I also draw on previous models of gentrification susceptibility to assemble a comprehensive and balanced set of factors.</p>	<p>The model uses data from the decennial U.S. Census and American Community Survey, built environment and transportation data from the City of Seattle and King County, and unique datalayers generated by the author.</p>	<p>I deviate as little as possible from previous research in determining the relative weighting of each indicator. In general, factors more heavily represented in the literature are weighted at 1.5, those with less theoretical grounding or a weaker association with gentrification underweighted at 0.5.</p>	<p>Yes. A survey of past neighborhood change illustrates which factors have been most strongly associated with gentrifying neighborhoods in Seattle specifically, and certain indicators are included and/or emphasized in the model because of their particular relevance here, such as proximity to the waterfront and to future Link stations.</p>

## 6 GENTRIFICATION SUSCEPTIBILITY

The index also has the potential to help policymakers think about and learn from areas that are not particularly susceptible to gentrification. These places might be stable high-income areas, where displacement risk is minimal because households are affluent, or stable low-income areas lacking the conditions that attract gentrifiers. However imminent the threat of displacement in rapidly gentrifying neighborhoods, other persistently low-income neighborhoods may also benefit from additional services. Further, these are likely to be areas to which displaced households move. In sum, there are important policy implications not only for neighborhoods identified as highly vulnerable to gentrification but for those at the bottom of the susceptibility index as well. The present model is a useful starting point for this discussion.

### **Limitations**

No matter the rigor with which indicators are chosen, there are certain inherent limitations to a suitability analysis such as this one. First, the quality of geospatial data can vary widely. In the present study, datasets from the City of Seattle and King County are all current as of 2012, though in other jurisdictions this might not be the case. The HUD foreclosure data, for example, is quite outdated and invites question as to whether this indicator is worth including at all. When it comes to census data, timing matters. For several important indicators, 2010 decennial census data is not available yet, forcing me to use the American Community Survey data despite its larger margins of error. This lack of consistency is a potential source of error overall but is also easily rectified when complete long-form census data from 2010 becomes available. Furthermore, simply by virtue of writing this thesis in the summer of 2013 meant missing out on the forthcoming update to the Neighborhood Change Database from GeoLytics, Inc. that will normalize historic census data to the 2010 tract geography.

Second, data availability is a major determinant of how comprehensive a suite of factors one can assemble. Some municipalities publish detailed tax data that is easily converted into a geospatial format, allowing for parcel-level analysis of property tax increases, housing improvements,

## 6 GENTRIFICATION SUSCEPTIBILITY

and other assessment variables. The boundaries of historic neighborhoods, tax abatement or tax-increment financing zones, or neighborhood business districts may already exist as geospatial data, or they may need to be created by the researcher.

Third, overlay mapping has long been criticized for an overuse of assumptions. The selection of weights has a direct impact on the results of the analysis. Even slight adjustments to the thresholds of a given indicator can make a neighborhood appear substantially more or less vulnerable to the specified outcome. Gafvert (2011) demonstrates how a survey of local housing and development experts can reduce the arbitrariness of choosing factor weights, though this process is certainly not free from bias and presents the challenge of dealing with conflicting opinion, which for Gafvert meant eliminating half of the indicators from her analysis. It may be wiser to think of weights not as irrational one-time choices but as a scale one can continually revisit in order to visualize different scenarios.

Finally, the potential vulnerability identified in the index is valid only insofar as the conditions that created this map continue. Gentrification is more likely here given current trends—but trends change. Should the planned Link extension to Northgate somehow unravel, those neighborhoods may be substantially less attractive to gentrifiers. Passage of a housing levy that leads to new affordable units in vulnerable neighborhoods could mitigate the displacement risk depicted in Figure 3. Not only can factor weights be adjusted according to different values, but the model itself can be regularly updated as new data becomes available, as Bates (2013, p. 27) encourages.

There are other useful indicators of susceptibility to displacement. Expiring affordability clauses for subsidized housing is a major contributor. In gentrifying areas, units are often converted to market rate when affordability clauses expire. Chapple (2009, p. 12) demonstrates how the potential subsidized housing loss can be mapped using data from the U.S. Department of Housing and Urban Development. Additionally, the Center for Neighborhood Technology (2012) computes an index of affordability that incorporates the transportation costs associated with a given location. Not only is this more comprehensive measure useful as a gauge of vulnerability to displacement,

## 6 GENTRIFICATION SUSCEPTIBILITY

but it also illustrates the difficulty lower-income households often have finding affordable housing in a gentrifying region when forced to move far from the city center, where rents are lower but commutes longer and more costly.

# 7 CONCLUSION

This thesis has sought to inventory existing approaches for identify neighborhoods vulnerable to gentrification and propose an improved methodology for the city of Seattle. Part of this process was an exploration of how Seattle neighborhoods have changed over the past four decades. Of particular note were the lower-income census tracts that gentrified from 2000 to 2010 and the factors associated with that change, such as a high population of renters, above-average racial diversity, and recent housing development. The following chapter detailed the creation of a susceptibility index that attempts to predict where gentrification is likely to occur or accelerate if the current conditions persist. The neighborhoods of First Hill, the Central District, Columbia City, High Point, and Northgate are some of the most vulnerable to gentrification and displacement.

This approach synthesizes the work of previous researchers, many of whom had not seen their contributions applied to a GIS model, and improves certain methodological components that can increase the reliability of the index. Identification, however, is only the beginning. In truth, the purpose of this thesis is to aid policymakers in anticipating where displacement is likely and intervening to mitigate it. Kim (2011) provides an excellent compendium of options to this end. Kennedy and Leonard (2001a) urge local officials to review how development policies may contribute to gentrification. They caution that “sound public investment in combination with a strong local economy...leads not to the equitable development...hoped for, but rather to displacement and the loss of community character” (33). Given Seattle’s ongoing investments in transit infrastructure and the empirical evidence that future transit access is a driver of gentrification (Chapple 2009), this is a warning Seattle officials would do well to consider. Every city requires a unique set of solutions, but as an example Mertz (2008) advises the City of Atlanta to incorporate inclusionary zoning, community land trusts, and rent control policies in anticipation of gentrification caused by the BeltLine, a

## 7 CONCLUSION

transit and greenway loop under construction.

The breadth of tools contained in the literature only reinforces the need for understanding the local context when exploring the drivers of economic disinvestment, revitalization, and gentrification. This is particularly true with geospatial analyses. A citywide study inevitably glosses over the block- or even parcel-level nuances that produce what we see on the ground. Still, as data quality and quantity continue to improve through new technology, and given the spatial nature of so many drivers of gentrification, there is reason to continue exploring how GIS can help policymakers make sense of the dynamic processes of neighborhood change.

# WORKS CITED

Agyeman, J 2013, *Introducing Just Sustainabilities: Policy, Planning, and Practice*, London: Zed Books.

Badger, E 2013, "The suburbanization of poverty," *Atlantic Cities*, 20 May, viewed 18 June 2013, <http://www.theatlanticcities.com/jobs-and-economy/2013/05/suburbanization-poverty/5633/>.

Balk, G 2013, "Can aPodments save Capitol Hill?" *Seattle Times*, 24 April, viewed 18 June 2013, <http://blogs.seattletimes.com/fyi-guy/2013/04/24/can-apodments-save-capitol-hill/>.

Barnett, E 2013a, "Proposals to increase affordable housing requirement in SLU move forward," *Publicola*, 19 May, viewed 18 June 2013, <http://www.seattletimes.com/news-and-profiles/publicola/articles/mike-obrien-second-try-march-2013>.

— 2013b, "Council discusses competing South Lake Union proposals," *Publicola*, 26 May, viewed 18 June 2013, <http://www.seattletimes.com/news-and-profiles/publicola/articles/council-discusses-competing-south-lake-union-proposals-march-2013>.

Bates, LK 2013, "Gentrification and displacement study: implementing an equitable inclusive development strategy in the context of gentrification," City of Portland Bureau of Planning and Sustainability, viewed 23 June 2013, <http://www.portlandoregon.gov/bps/article/454027>.

Beals, M, Gross, L, & Harrel, S 2000, "Diversity indices: Shannon's *H* and *E*," viewed 18 June 2013, <http://www.tiem.utk.edu/~gross/bioed/bealsmodules/shannonDI.html>.

Beauregard, RA 1986, "The chaos and complexity of gentrification," in N. Smith & P. Williams (ed.), *Gentrification of the City*, London: Allen & Unwin.

Benfield, K 2011, "11 US cities honored as 'walk-friendly': Seattle ranks first" *Switchboard*, 4 May, viewed 18 June 2013, [http://switchboard.nrdc.org/blogs/kbenfield/11\\_us\\_cities\\_honored\\_as\\_walk-f.html](http://switchboard.nrdc.org/blogs/kbenfield/11_us_cities_honored_as_walk-f.html).

Berger, K 2013, "South Lake Union: the bulldozing of Seattle's past?" *Crosscut*, 9 January, viewed 18 June 2013, <http://crosscut.com/2013/01/09/mossback/112381/future-history-south-lake-union/>.

Brown University n.d., "Boundary adjustments with national U.S. census tract," US2010, viewed 18 June 2013, <http://www.s4.brown.edu/us2010/Researcher/BoundaryAdjustments.htm>.

Brugman, J 1997, "Is there a method in our measurement? The use of indicators in local sustainable development planning," *Local Environment*, vol. 2, no.1, pp. 59–72.

Can, A 1998, "GIS and spatial analysis of housing and mortgage markets," *Journal of Housing Research*, vol. 9, no. 1, pp. 61–86.

Center for Neighborhood Technology 2012, "H+T index," viewed 18 June 2013, <http://htaindex.cnt.org/downloads/HTMethods.2011.pdf>.

Chapple, K 2009, "Mapping susceptibility to gentrification: the early warning toolkit," Center for Community Innovation," viewed 18 June 2013, <http://communityinnovation.berkeley.edu/reports/Gentrification-Report.pdf>.

City of Seattle 2012, "Housing levy impact: 2011 report of accomplishments," viewed 18 June 2013, [http://www.Seattle.gov/housing/levy/docs/2011\\_annual\\_report.pdf](http://www.Seattle.gov/housing/levy/docs/2011_annual_report.pdf).

City of Seattle GIS n.d., "GIS WEB: data," viewed 18 June 2013, <http://www.Seattle.gov/GIS/docs/data.htm>.

City of Seattle Office of Economic Development (OED) 2012a, "Public and private investments in South Lake Union," viewed 18 June 2013, [http://www.Seattle.gov/EconomicDevelopment/pdf\\_files/SLU%20Public%20Private%20Report%20Final%202012\\_0703\\_small.pdf](http://www.Seattle.gov/EconomicDevelopment/pdf_files/SLU%20Public%20Private%20Report%20Final%202012_0703_small.pdf).

— 2012b, "Economic indicators dashboard," viewed 18 June 2013, <http://www.Seattle.gov/EconomicDevelopment/indicators/images/Economic.Indicators.2012.October.pdf>.

City of Seattle Office of Sustainability and Environment (OSE) 2013, "Seattle climate action plan," viewed 18 June 2013, [http://www.Seattle.gov/environment/documents/Seattle\\_2013\\_CAP\\_for\\_web.pdf](http://www.Seattle.gov/environment/documents/Seattle_2013_CAP_for_web.pdf).

Copeland, J 2013, "South Lake Union: city ought to fight for affordable housing," *Crosscut*, 12 April, viewed 18 June 2013, <http://crosscut.com/2013/04/12/seattle-city-hall/113856/south-lake-union/>.

Corbett, J n.d. "Ian McHarg: Overlay maps and the evaluation of social and environmental costs of land use change," Center for Spatially Integrated Social Science, viewed 18 June 2013, <http://www.csiss.org/classics/content/23>.

Davidson, M and Lees, L 2005, "New-build 'gentrification' and London's riverside renaissance," *Environment and Planning A*, vol. 37, no. 7, pp. 1165–1190.

Davis, B & Dutzik, T 2012, "Transportation and the new generation: why young people are driving less and what it means for transportation policy," *Frontier Group*, viewed 18 June 2013, <http://www.frontiergroup.org/sites/default/files/reports/Transportation%20&%20the%20New%20Generation%20vUS.pdf>.

Feit, J 2009, "Seattle displacement coalition vs. futurewise. Left vs. left," *Publicola*, 25 January, viewed 10 May 2013, <http://www.seattlemet.com/news-and-profiles/publicola/articles/seattle-displacement-coalition-vs-futurewise-left-vs-left>.

Fouch, NT 2012, "Planning for gentrification: a geographic analysis of gentrification susceptibility in the city of Asheville, NC," masters thesis, Clemson University, viewed 18 June 2013, [http://etd.lib.clemson.edu/documents/1349104293/Fouch\\_clemson\\_0050M\\_11837.pdf](http://etd.lib.clemson.edu/documents/1349104293/Fouch_clemson_0050M_11837.pdf).

Fox, JV 2011, "City Council votes to continue million-dollar developer giveaway, Fox says," *Seattle Post Globe*, 1 March, viewed 18 June 2013, <http://seattlepostglobe.org/2011/03/01/commentary-city-council-votes-to-continue-million-dollar-developer-giveaway-fox-says>.

Fox, JV & Coulter C 2012, "Supply and demand in the real world," *Madison Park Times*, 6 June, viewed 18 June 2013, <http://madisonparktimes.com/main.asp?SectionID=9&subsectionID=252&articleID=28514>.

Frantilla, A n.d., "The Seattle open housing campaign, 1959-1968," Seattle Municipal Archives, viewed 18 June 2013, <http://www.Seattle.gov/cityarchives/Exhibits/Openhouse/narrative.htm>.

Freeman, L 2005, "Displacement or succession? Residential mobility in gentrifying neighborhoods," *Urban Affairs Review*, vol. 40, no. 4, pp. 463-491.

Friedman, N & Fenit N 2013, "Tualatin, Oregon City and Beaverton see fastest-growing metro-area poverty rates since 2000," *The Oregonian*, 21 May, viewed 18 June 2013, [http://www.oregonlive.com/tualatin/index.ssf/2013/05/tualatin\\_oregon\\_city\\_and\\_beave.html](http://www.oregonlive.com/tualatin/index.ssf/2013/05/tualatin_oregon_city_and_beave.html).

Gafvert, R 2011, "Mapping the path of gentrification: an analysis of gentrification susceptibility in Cincinnati, Ohio," masters thesis, University of Cincinnati, viewed 18 June 2013, <http://etd.ohiolink.edu/send-pdf.cgi/Gafvert%20Rebecca%20C.pdf?ucin1314114199>.

Galster, G, & Peacock, S 1986, "Urban gentrification: evaluating alternative indicators," *Social Indicators Research*, vol. 18, no. 3, pp. 321-337.

Glass, R 1964, *London: Aspects of Change*, London: MacGibbon & Kee.

GeoLytics, Inc. 2000, "Neighborhood Change Database," East Brunswick, NJ.

Hammel, D and Wylie, EK 1996, "A model for identifying gentrified areas with census data," *Urban Geography*, vol. 17, pp. 248-268.

Hamnet, C 1984, "Gentrification and residential location theory: a review and assessment," *Geography and the Urban Environment: Progress in Research and Applications*, vol. 6, pp. 283-319.

— 1991, "The blind men and the elephant: the explanation of gentrification," *Transactions of the Institute of British Geographers*, vol. 16, no. 2, pp. 173-189.

Heidkamp, CP, & Lucas S 2006, "Finding the gentrification frontier using census data: the case of Portland, Maine," *Urban Geography*, vol. 27, no. 2, pp. 101-125.

Helms, AC 2003, "Understanding gentrification: an empirical analysis of the determinants of urban housing renovation," *Journal of Urban Economics*, vol. 54, no. 3, pp. 474–98.

High Point Neighborhood n.d., "High Point then and now," viewed 18 June 2013, [http://www.highpointneighborhood.org/?page\\_id=5](http://www.highpointneighborhood.org/?page_id=5).

Holden, D 2013, "The Fight Against Small Apartments," *The Stranger*, 8 May, viewed 18 June 2013, <http://www.thestranger.com/Seattle/the-fight-against-small-apartments/Content?oid=16701155>.

Hoole, J 2011, "The Rainier Valley's diversity myth," City of Seattle Department of Neighborhoods: Historic Preservation Program, viewed 18 June 2013, <http://www.Seattle.gov/neighborhoods/preservation/southeastseattle/pdf/SE%20Essay%20-%20The%20Diversity%20Myth.pdf>.

Jonjak, M 2013, "The Rent Hike," *The Stranger*, 30 January 2013, viewed 18 June 2013, <http://www.thestranger.com/Seattle/the-rent-hike/Content?oid=15876932>.

Kennedy, M & Leonard, P 2001a, "Dealing with neighborhood change: a primer on gentrification and policy choices," The Brookings Institution Center for Urban and Metropolitan Policy, viewed 18 June 2013, <http://www.brookings.edu/~media/research/files/reports/2001/4/metropolitanpolicy/gentrification>.

Kennedy, M & Leonard, P 2001b, "Gentrification: practice and politics," The LISC Center for Homeownership, viewed 18 June 2013, [http://www.lisc.org/files/901\\_file\\_asset\\_upload\\_file304\\_540.pdf](http://www.lisc.org/files/901_file_asset_upload_file304_540.pdf).

Kim, E 2012, "Mitigating displacement due to gentrification: tools for Portland, Oregon," masters thesis, Tufts University Department of Urban and Environmental Policy and Planning.

King County GIS, "King County GIS data portal," viewed 18 June 2013, <http://www5.kingcounty.gov/gisdataportal/>.

Kneebone, E & Berube, A 2013, *Confronting Suburban Poverty in America*, Washington, D.C.: Brookings Press.

Kneebone, E 2012, "The changing geography of metropolitan poverty," *Atlantic Cities*, 20 September, viewed 18 June 2013, <http://www.theatlanticcities.com/politics/2012/09/changing-geography-metropolitan-poverty/3348/>.

Kolko, J 2007, "The determinants of gentrification," Public Policy Institute of California, viewed 18 June 2013, [http://papers.ssrn.com/sol3/Delivery.cfm/SSRN\\_ID1072148\\_code236676.pdf?abstractid=985714&mirid=1](http://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID1072148_code236676.pdf?abstractid=985714&mirid=1).

— 2009, "Job location, neighborhood change, and gentrification," Public Policy Institute of California, viewed 18 June 2013, [http://www.frbsf.org/economic-research/files/Gentrification\\_JedKolko.pdf](http://www.frbsf.org/economic-research/files/Gentrification_JedKolko.pdf).

Konrad, A 2012, "America's 50 Best Cities," *Bloomberg Businessweek*, 28 September, viewed 18 June 2013, <http://images.businessweek.com/slideshows/2012-09-26/americas-50-best-cities#slide50>.

Lazarus, M, Erickson, P, Chandler, C, Daudon, M, Donegan, S, Gallivan, & F, Ang-Olson, J 2011, "Getting to zero: A pathway to a carbon neutral Seattle," City of Seattle Office of Sustainability and Environment (OSE), viewed 18 June 2013, [http://www.Seattle.gov/environment/documents/CN\\_Seattle\\_Report\\_May\\_2011.pdf](http://www.Seattle.gov/environment/documents/CN_Seattle_Report_May_2011.pdf).

Levy, L 2009, "Mapping gentrification in Pilsen: community empowerment through GIS technology," *Creating Knowledge: The LA&S Student Research Journal*, vol. 2, pp. 36–39.

Ley, D 1986, "Alternative explanations for inner-city gentrification: A Canadian assessment," *Annals of the Association of American Geographers*, vol. 76, no. 4, pp. 521–535.

— 1987, "Reply: The rent gap revisited," *Annals of the Association of American Geographers*, vol. 77, no. 3, 465–8.

London, B & Palen, J 1984, *Gentrification, Displacement and Neighborhood Revitalization*. Albany, N.Y: State University Press of New York.

Malczewski, J 2004, "GIS-based land-use suitability analysis: a critical overview," *Progress in Planning*, vol. 62, pp. 3–65.

Manjoo, F 2012, "San Francisco can become a world capital. First it needs to get over itself," *Pandodaily*, 1 December, viewed 18 June 2013, <http://pandodaily.com/2012/12/01/san-francisco-can-become-a-world-capital-first-it-needs-to-get-over-itself/>.

McGee, Jr HW 2007a, "Seattle's Central District, 1990–2006: integration or displacement?" *The Urban Lawyer*, vol. 37, p. 169–256.

— 2007b, "Gentrification, integration or displacement?: the Seattle story," viewed 18 June 2013, <http://www.blackpast.org/?q=perspectives/gentrification-integration-or-displacement-seattle-story>.

Melchert, D & Naroff, JL 1987, "Central city revitalization: A predictive model," *AREUEA Journal*, vol. 1, no. 15, pp. 664–683.

Mertz, KE 2008, "Equitable development tools to mitigate residential displacement due to gentrification: case studies of three Atlanta neighborhoods," masters thesis, University of Florida, viewed 18 June 2013, [http://etd.fcla.edu/UF/UFE0024084/mertz\\_k.pdf](http://etd.fcla.edu/UF/UFE0024084/mertz_k.pdf).

Meyer, J 2013, "Spared by climate change: the 10 best cities to ride out the times," *Grist*, 24 May, viewed 18 June 2013, <http://grist.org/cities/spared-by-climate-change-the-10-best-cities-to-ride-out-hot-times/>.

Morgan, M 1995, *Skid Road: An Informal Portrait of Seattle*, Seattle: University of Washington Press.

Morrill, R 2007, "Gentrification, class, and growth management in Seattle, 1990-2000," in GM Pomeroy & GM Webster, (ed.), *Global perspectives on urbanization*, Lanham, MD: University Press of America.

Nelson, KP 1988, *Gentrification and Distressed Cities: An Assessment of Trends in Intrametropolitan Migration*, Madison: The University of Wisconsin Press.

Nesbitt, AJ 2005, "A model of gentrification: monitoring community change in selected neighborhoods of St. Petersburg, Florida using the analytic hierarchy process," masters thesis, University of Florida, viewed 18 June 2013, <http://ufdc.ufl.edu/UFE0010582/00001>.

O'Donnell, AJ 2004, *In the City of Neighborhoods: Seattle's History of Community Activism and Non-Profit Survival Guide*, Lincoln, NE: iUniverse, Inc.

Owen, D 2013, *Green Metropolis: Why Living Smaller, Living Closer, and Driving Less Are the Keys to Sustainability*, New York: Riverhead Trade.

Pennington, H and Pastor, M 2013, "Seattle's economic growth masks losses in homegrown population," *Seattle Times*, 22 June, viewed 23 June 2013, [http://seattletimes.com/html/opinion/2021243280\\_hilarypenningtonmanuelpastoropedxml.html](http://seattletimes.com/html/opinion/2021243280_hilarypenningtonmanuelpastoropedxml.html).

Perkins, DD, Larsen, C, Brown, BB 2009, "Mapping urban revitalization: using GIS spatial analysis to evaluate a new housing policy," *Journal of Prevention & Intervention in the Community*, vol. 37, no. 1, pp. 48–65.

Quon Hober, MS, Van Egeren, LA, Pierce, SJ, & Foster-Fishman, PG 2009, "GIS applications for community-based research and action: mapping change in a community-building initiative," *Journal of Prevention & Intervention in the Community*, vol. 37, no. 1, pp. 5–20.

Revised Code of Washington, 1981, "Controls on rent for residential structures — Prohibited — Exceptions," 35.21.830, viewed 18 June 2013, <http://apps.leg.wa.gov/rcw/default.aspx?cite=35.21.830>.

Sassen, S 1991, *The Global City: New York, London and Tokyo*, Princeton, NJ: Princeton University Press.

Seattle Department of Transportation (SDOT) 2008, "Seattle streetcar network development report," viewed 18 June 2013, <http://www.seattlestreetcar.org/about/docs/StreetcarNetworkReportMay2008rev.pdf>.

Seattle Housing Authority, "Redevelopment plan—High Point," viewed 18 June 2013, <http://www.seattlehousing.org/redevelopment/high-point/plan/>.

Seattle Planning Commission 2007, "Incentive zoning in Seattle: enhancing livability and housing affordability," viewed 18 June 2013, [http://www.Seattle.gov/planningcommission/docs/SPC\\_IncZon.pdf](http://www.Seattle.gov/planningcommission/docs/SPC_IncZon.pdf).

- Seattle Streetcar 2012a, "Broadway street extension," viewed 18 June 2013, <http://www.seattlestreetcar.org/docs/bx/Broadway%20Extension%20Overview.pdf>.
- 2012b, "SLU streetcar map," viewed 18 June 2013 <http://www.seattlestreetcar.org/docs/SLU%20Streetcar%20Station%20Map2012.pdf>.
- Shaw, K 2008, "Gentrification: what it is, why it is, and what can be done about it," *Geography Compass*, vol. 2, pp. 1–32.
- Slater, T 2011, "Gentrification of the city," in G Bridge & S Watson (ed.), *The New Blackwell Companion to the City*, Hoboken: Wiley-Blackwell.
- Smart Growth Network 2006, "This is smart growth," Smart Growth Network, viewed 18 June 2013, [http://www.smartgrowthonlineaudio.org/pdf/TISG\\_2006\\_8-5x11.pdf](http://www.smartgrowthonlineaudio.org/pdf/TISG_2006_8-5x11.pdf).
- Smith, N 1979, "Toward a theory of gentrification: a back to the city movement by capital, not people," *Journal of the American Planning Association*, vol. 45, no. 4, pp. 538-548.
- 1987, "Gentrification and the rent gap," *Annals of the Association of American Geographers*, vol. 77, no. 3, pp. 462–465.
- 1996, *The New Urban Frontier: Gentrification and the Revanchist City*, London: Routledge.
- Smith, N, & Williams, P 1986, "Alternatives to orthodoxy: invitation to a debate," in N Smith & P Williams (ed.), *Gentrification of the City*, London: Allen & Unwin.
- Soja, EW 2010, *Seeking Spatial Justice*, Minneapolis: University of Minnesota Press.
- Sound Transit 2013, "Data downloads," viewed 18 June 2013, <http://www.soundtransit.org/Developer-resources/Data-downloads/Download-Data>.
- Thompson, C 2009, "The 15 most sustainable U.S. cities," *Grist*, 17 July, viewed 18 June 2013, <http://grist.org/article/2009-07-16-sustainable-green-us-cities/full/>
- Torrens, PM, & Atsushi N 2007, "Modeling gentrification dynamics: a hybrid approach," *Computers, Environment, and Urban Systems*, vol. 31, pp. 337–361.
- U.S. Green Building Council (USGBC) 2011, "LEED 2009 for neighborhood development rating system."
- Walker, J 2011, *Human Transit*, Washington, D.C.: Island Press.
- Watson, J 2012, "Hot spots: benchmarking global city competitiveness," Economic Intelligence Unit.
- Williams-Derry, C 2012, "Young people are driving less," *Sightline*, 5 April, viewed 18 June, <http://daily.sightline.org/2012/04/05/young-people-are-driving-less/>.

Wyly, EK, & Hammel, DJ 1998, "Modeling the context and contingency of gentrification," *Journal of Urban Affairs*, vol. 28, no. 3, pp. 303–326.

— 1999, "Islands of decay and renewal: housing policy and the resurgence of gentrification," *Housing Policy Debate*, vol. 10, no. 4, 711–771.

# APPENDIX A: NEIGHBORHOOD CHANGE MAPS

Figure 6: Change in median household income by tract

# 1970-1980

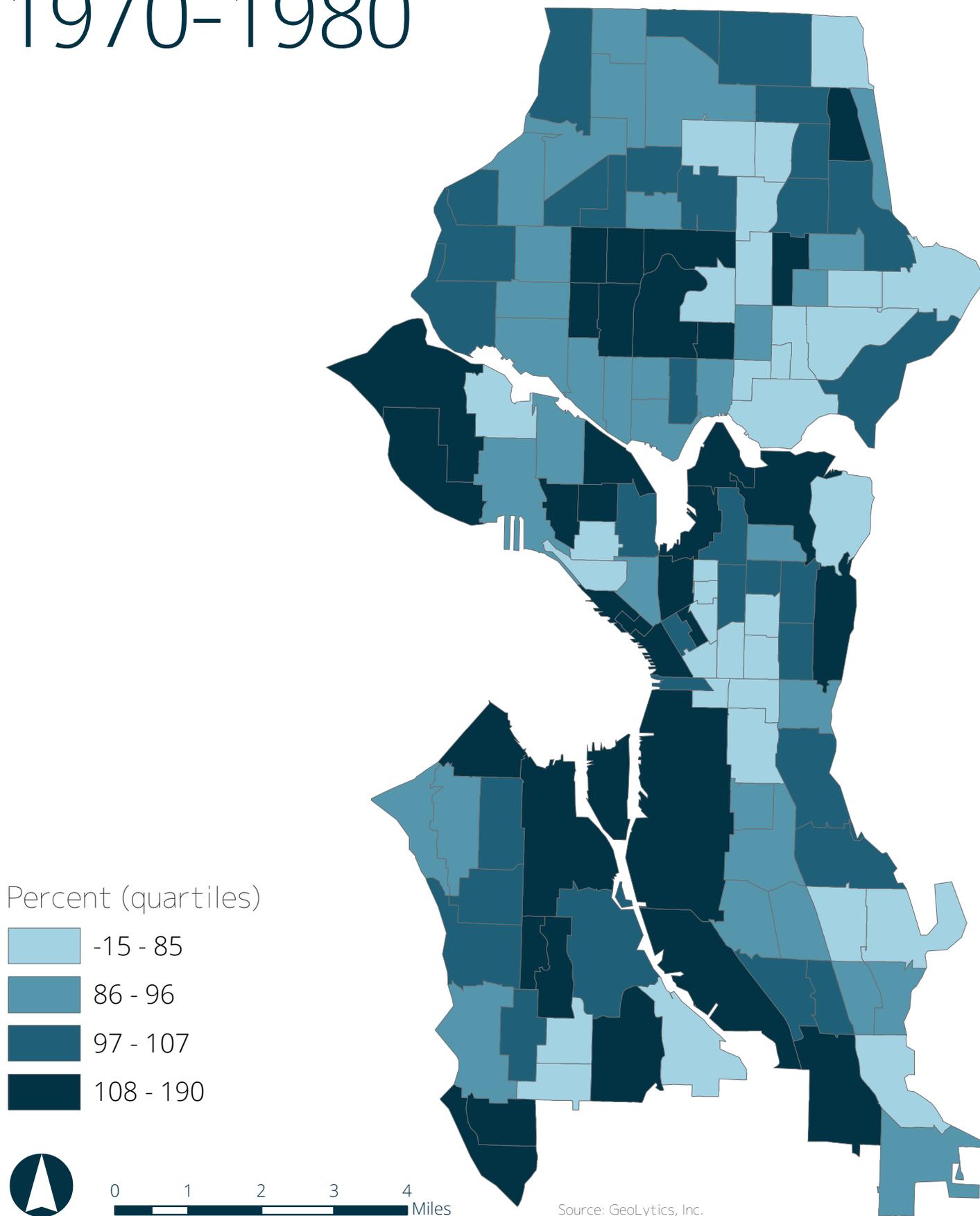
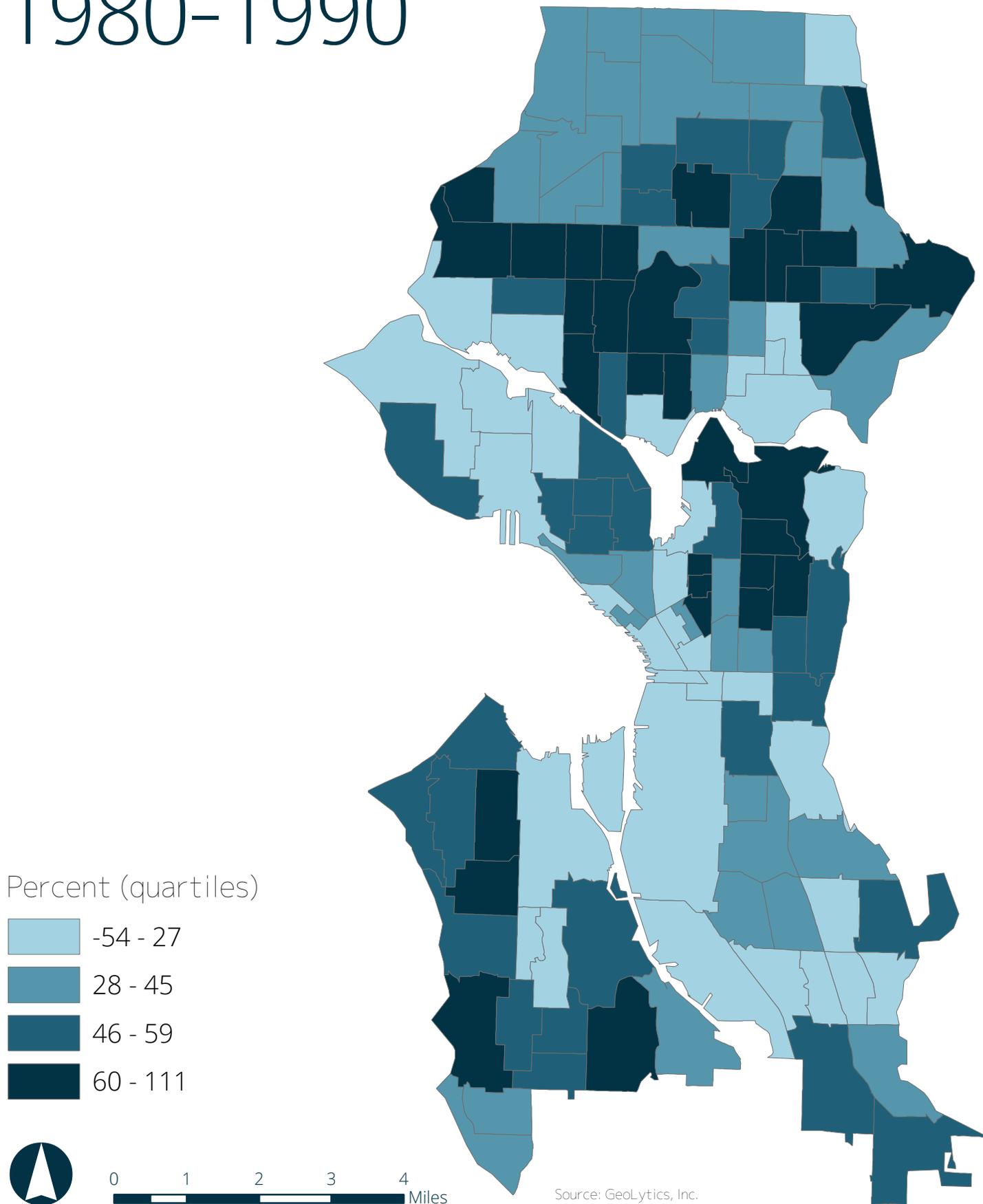


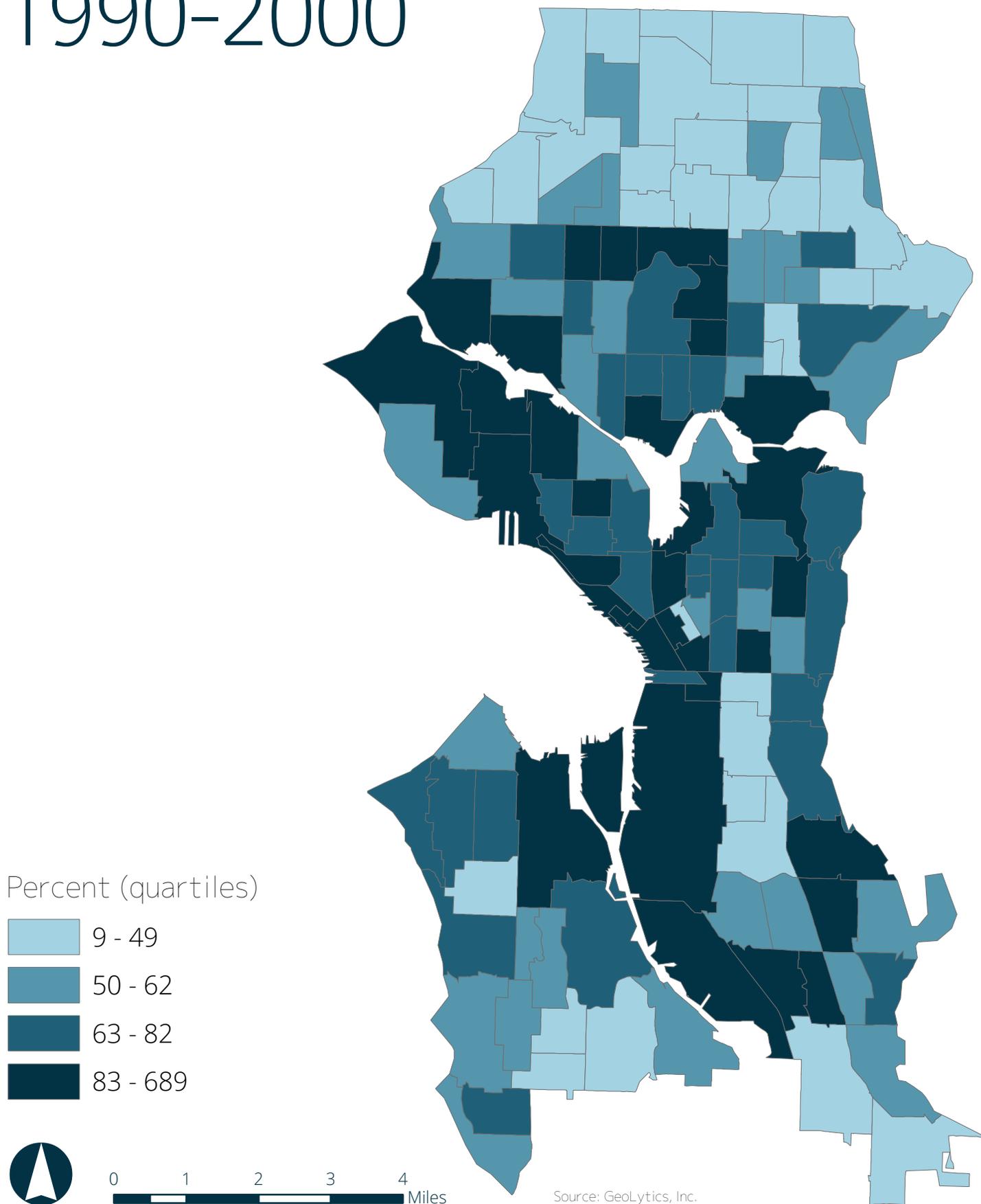
Figure 7: Change in median household income by tract

# 1980-1990



**Figure 8:** Change in median household income by tract

# 1990-2000



**Figure 9:** Change in median household income by tract  
2000-2011

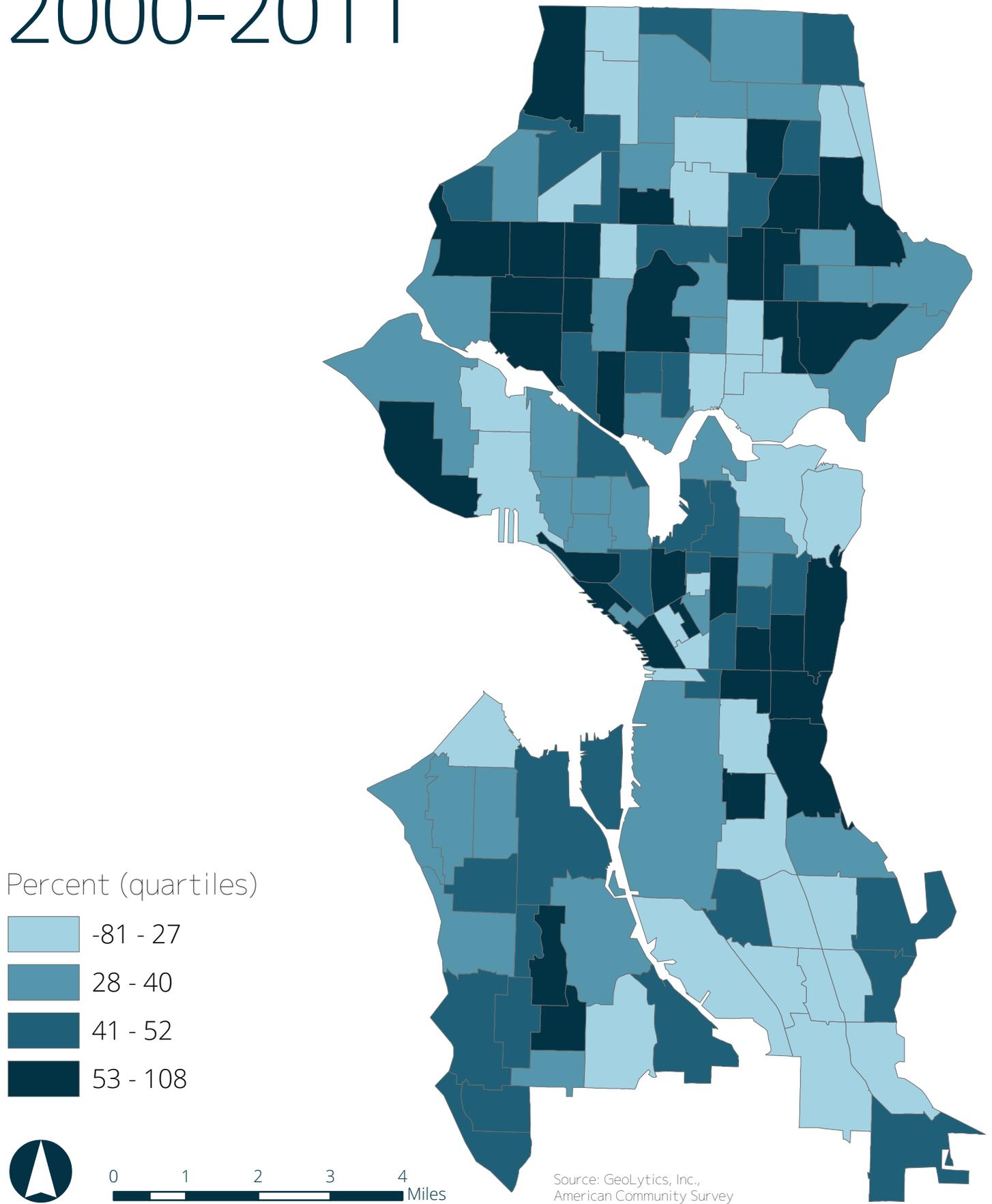


Figure 10: Change in total housing units by tract

1970-1980

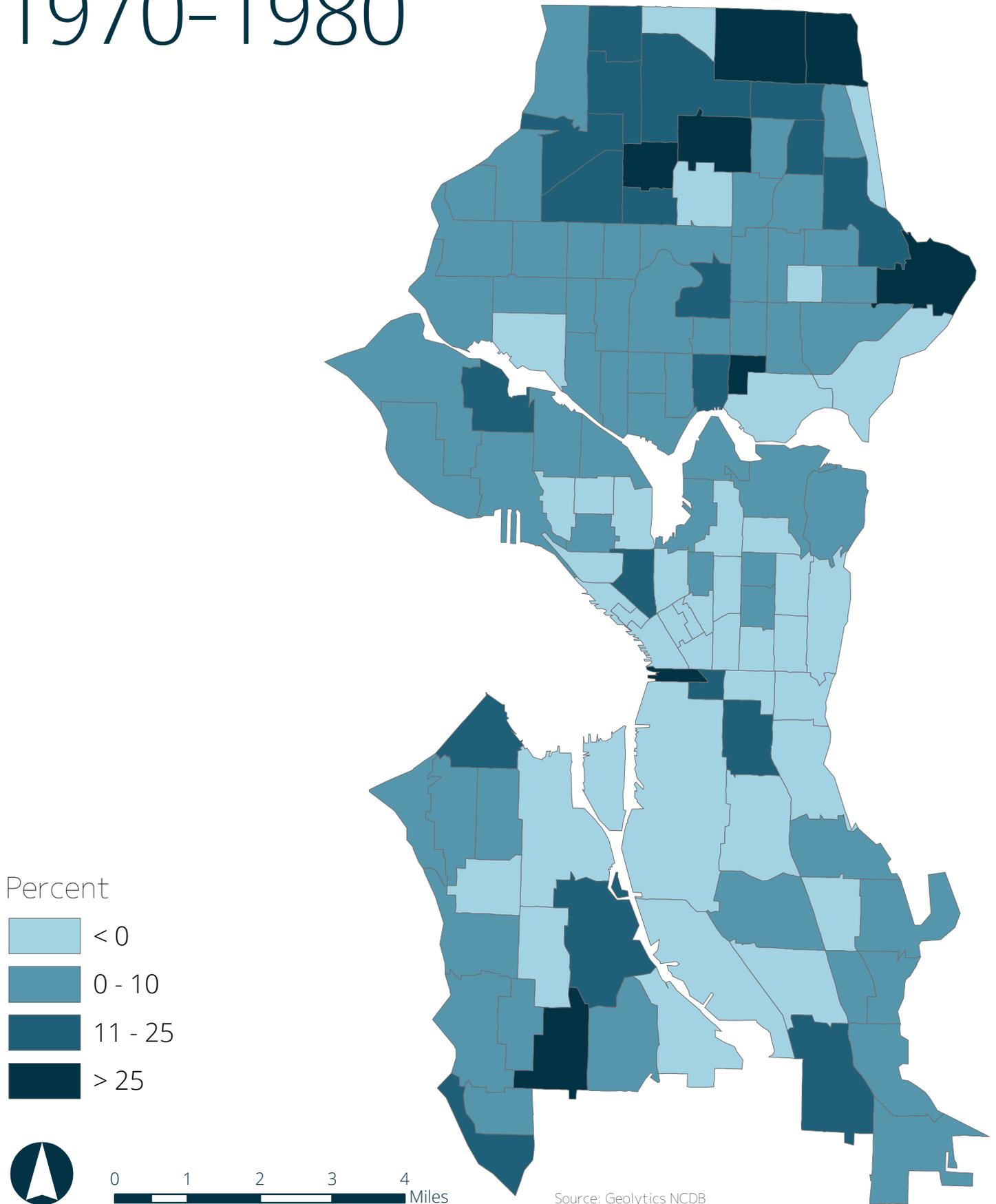


Figure 11: Change in total housing units by tract

# 1980-1990

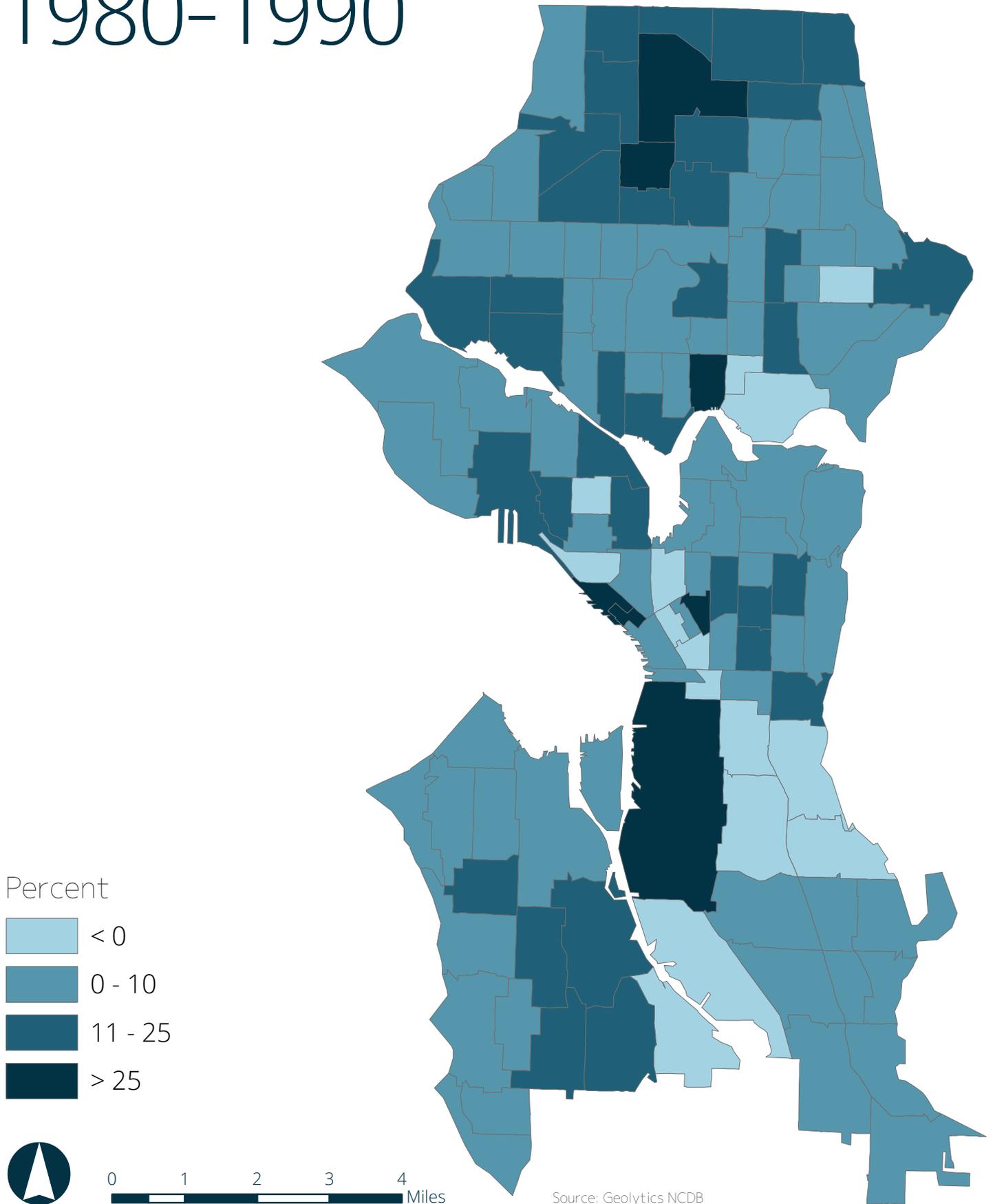


Figure 12: Change in total housing units by tract

# 1990-2000

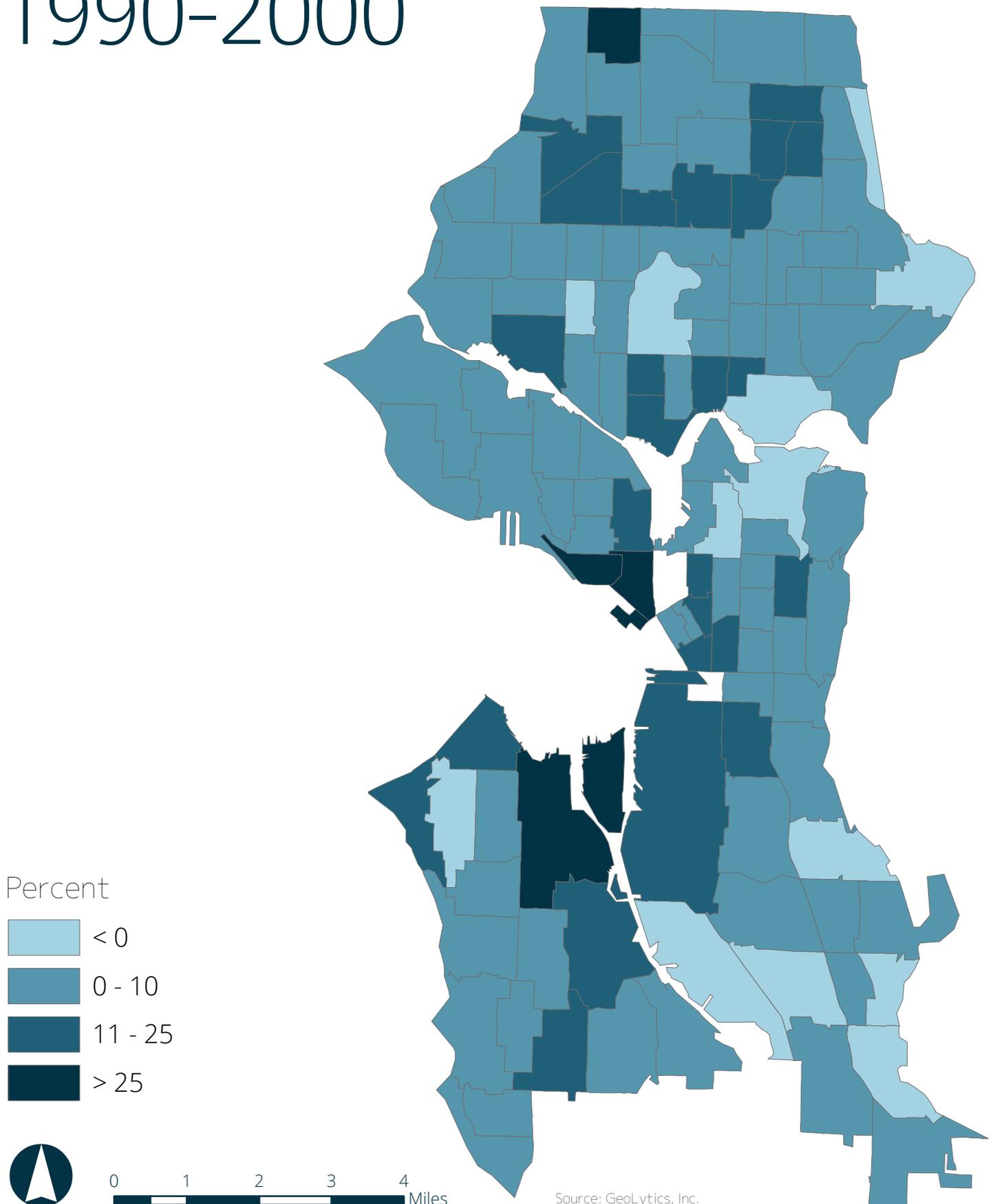


Figure 13: Change in total housing units by tract

# 2000-2010

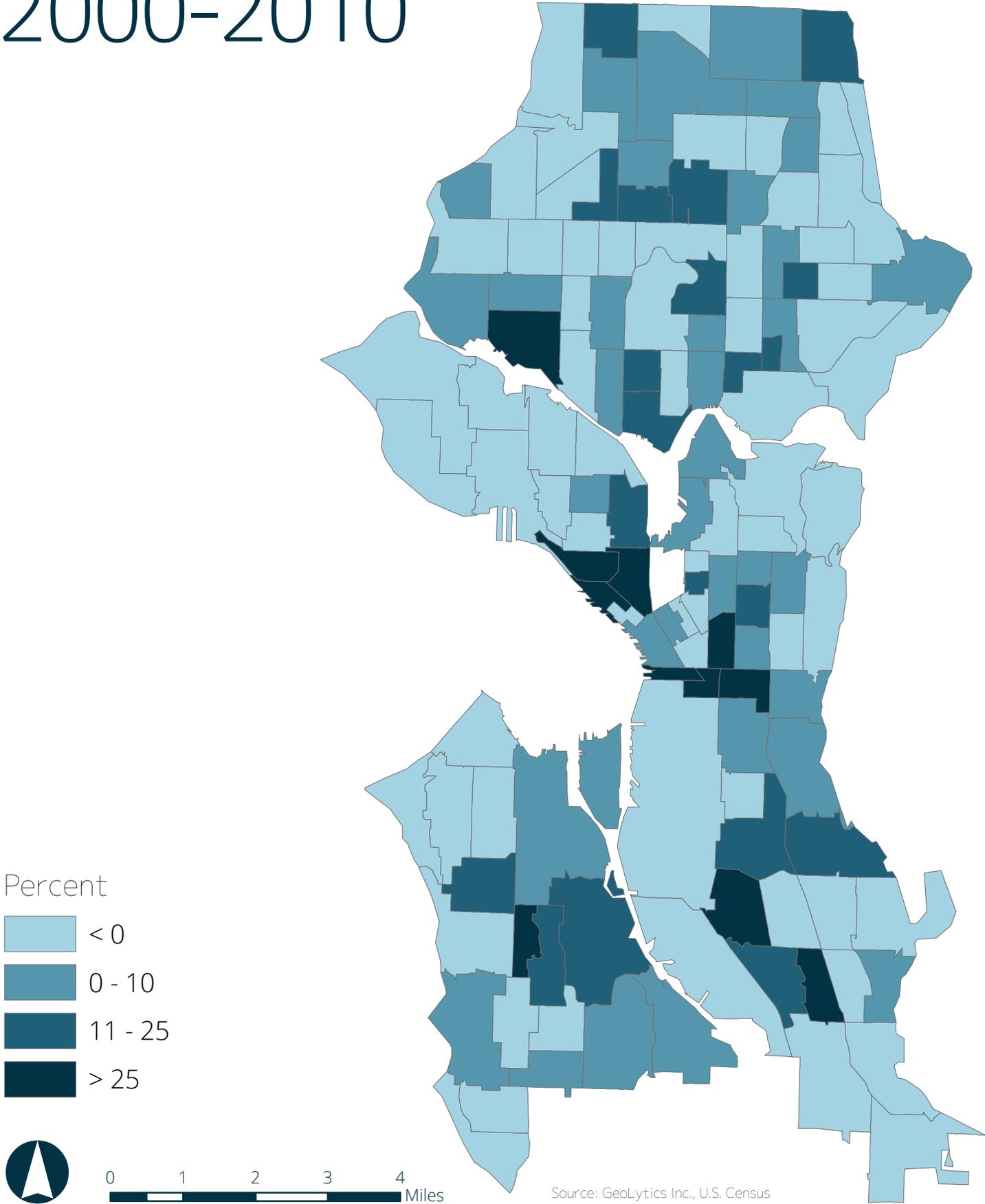


Figure 14: Rental share by tract

1980

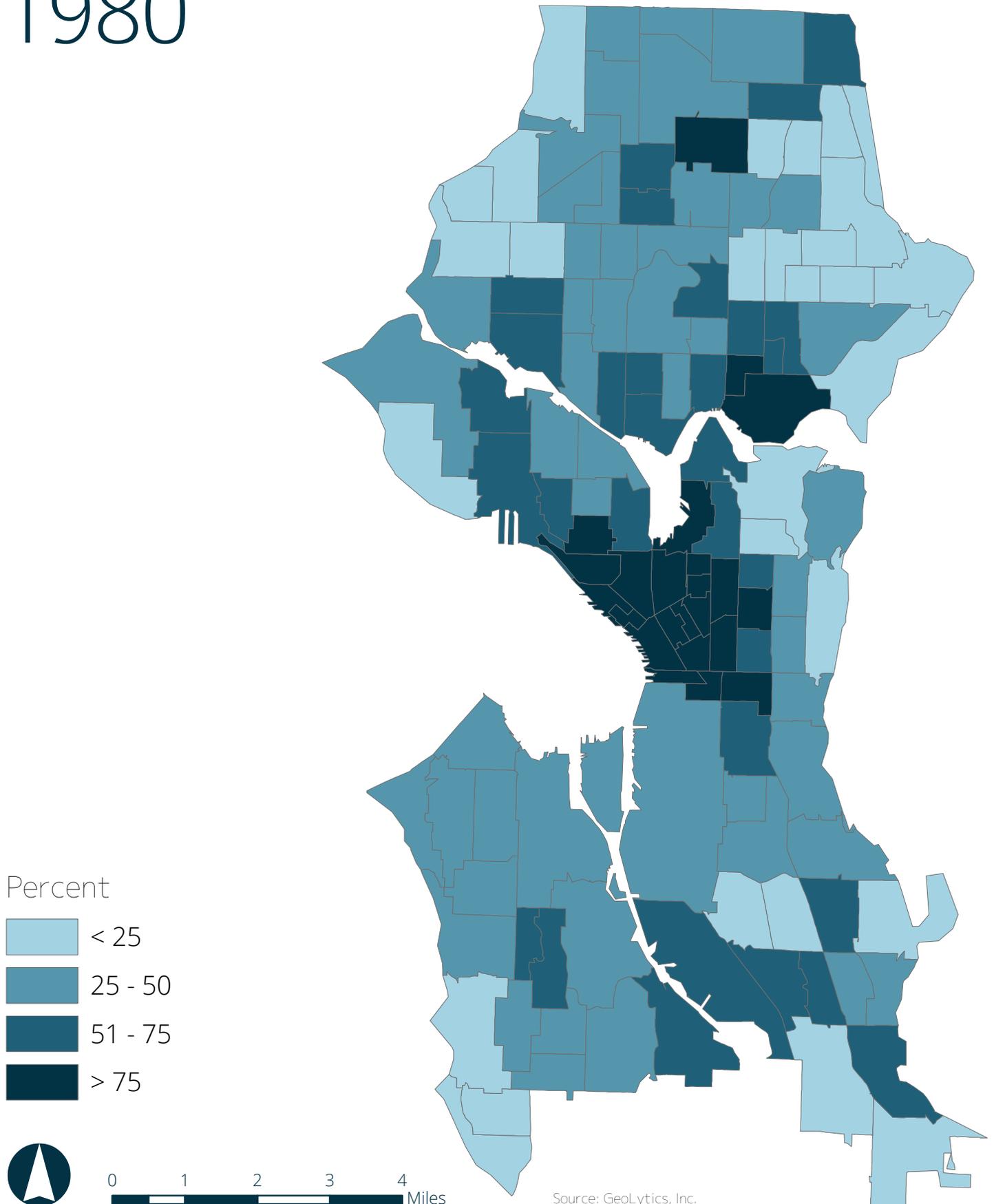


Figure 15: Rental share by tract

1990

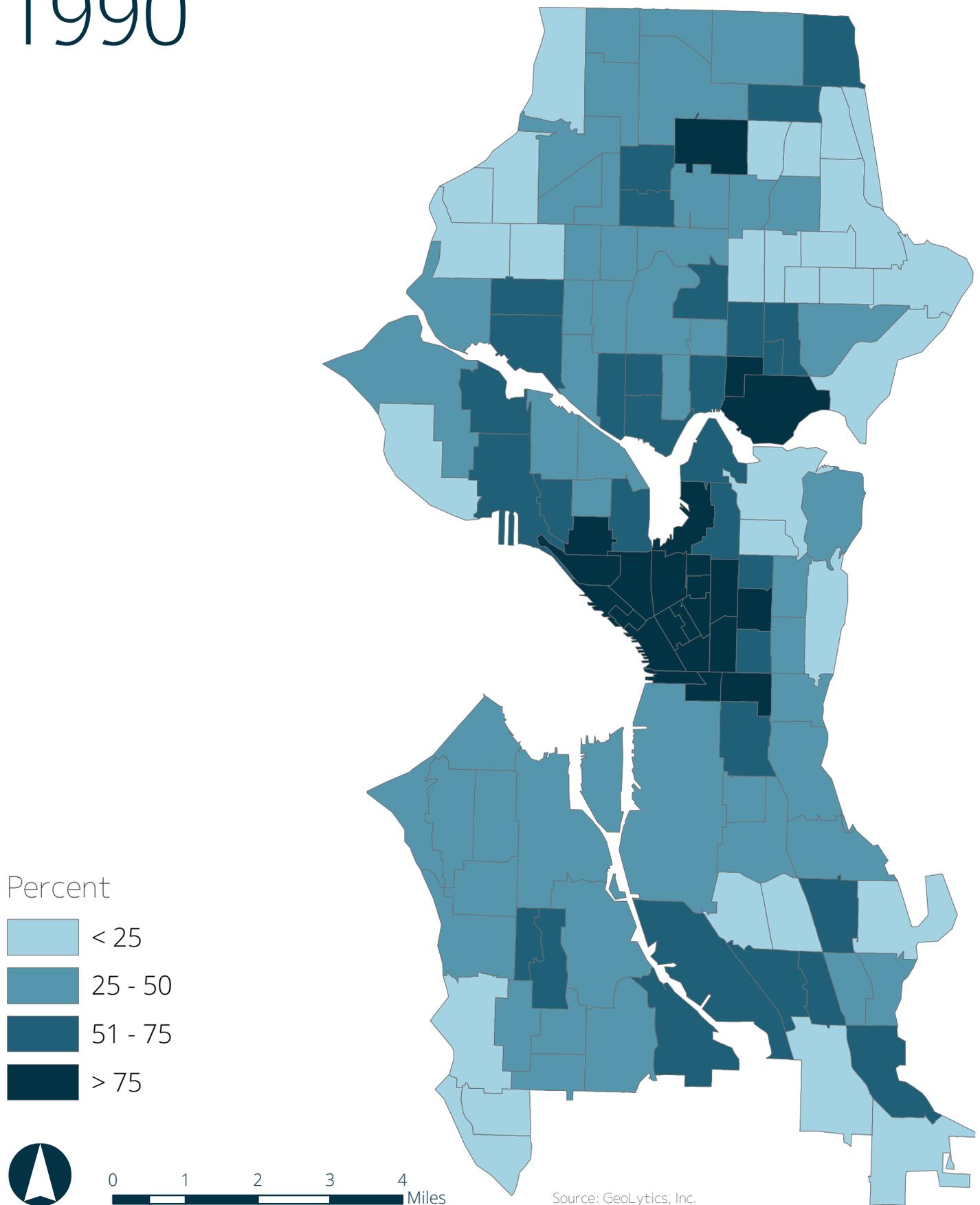


Figure 16: Rental share by tract

2000

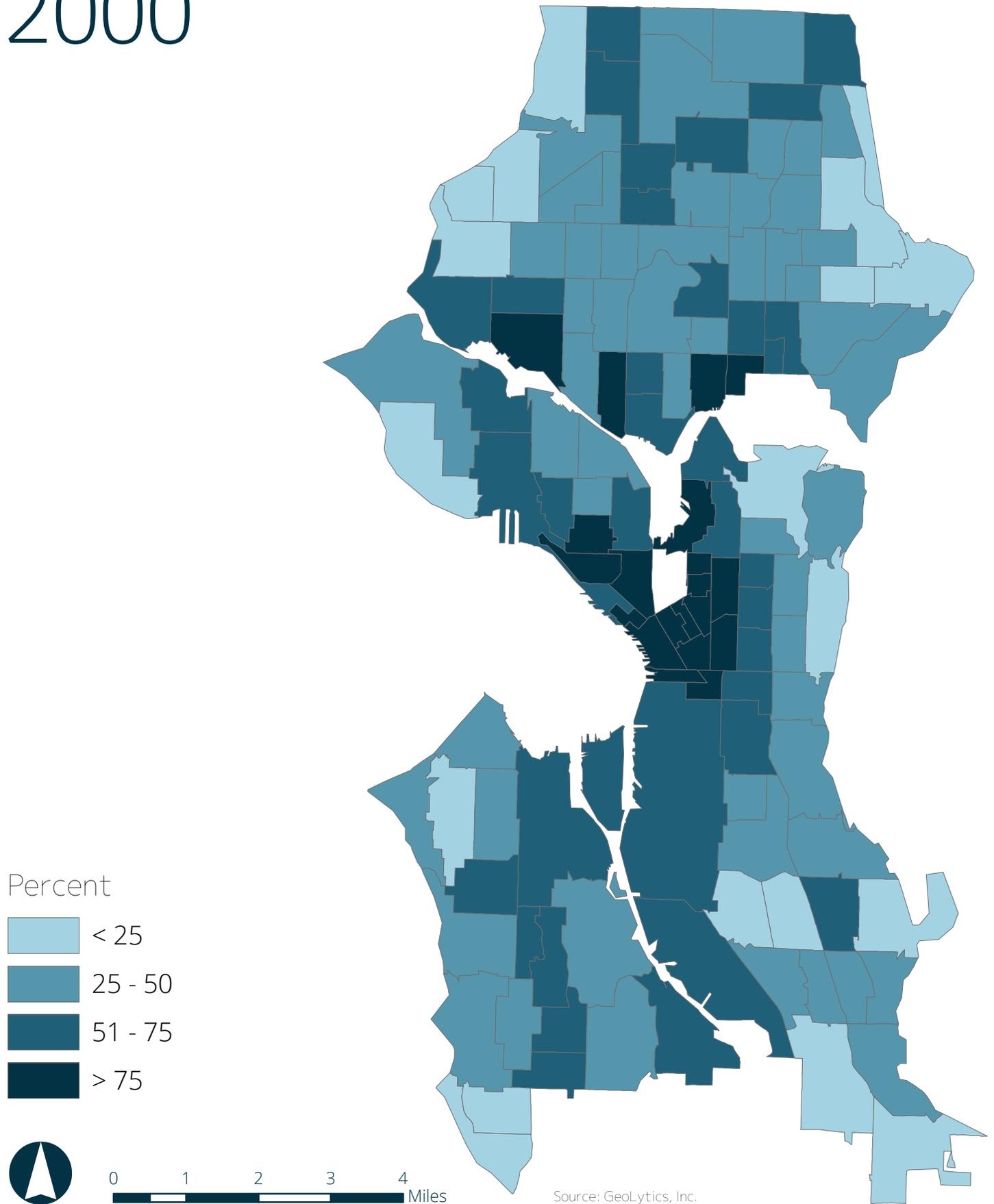


Figure 17: Rental share by tract

# 2010

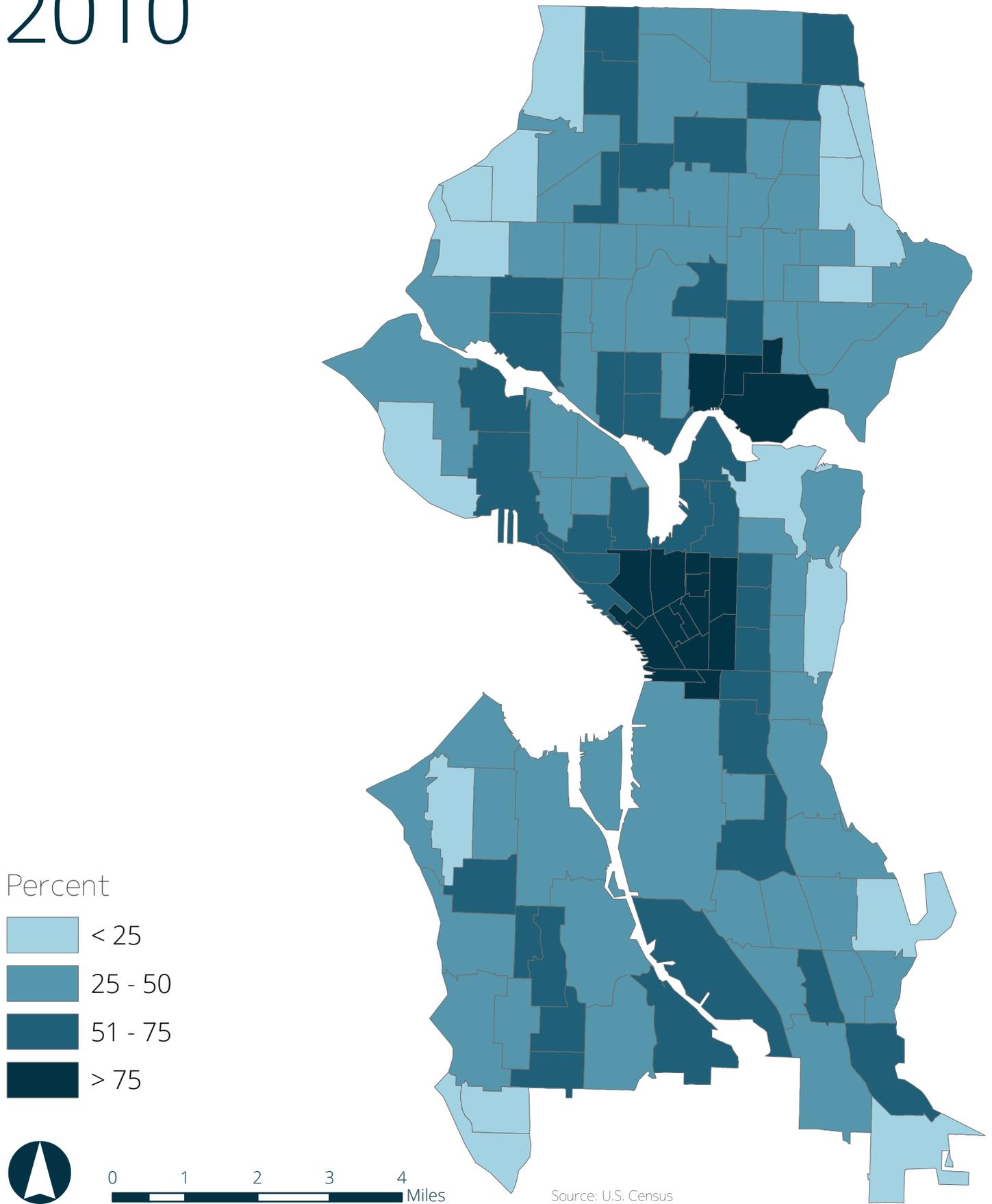


Figure 18: Change in rental share by tract

# 1970-1980

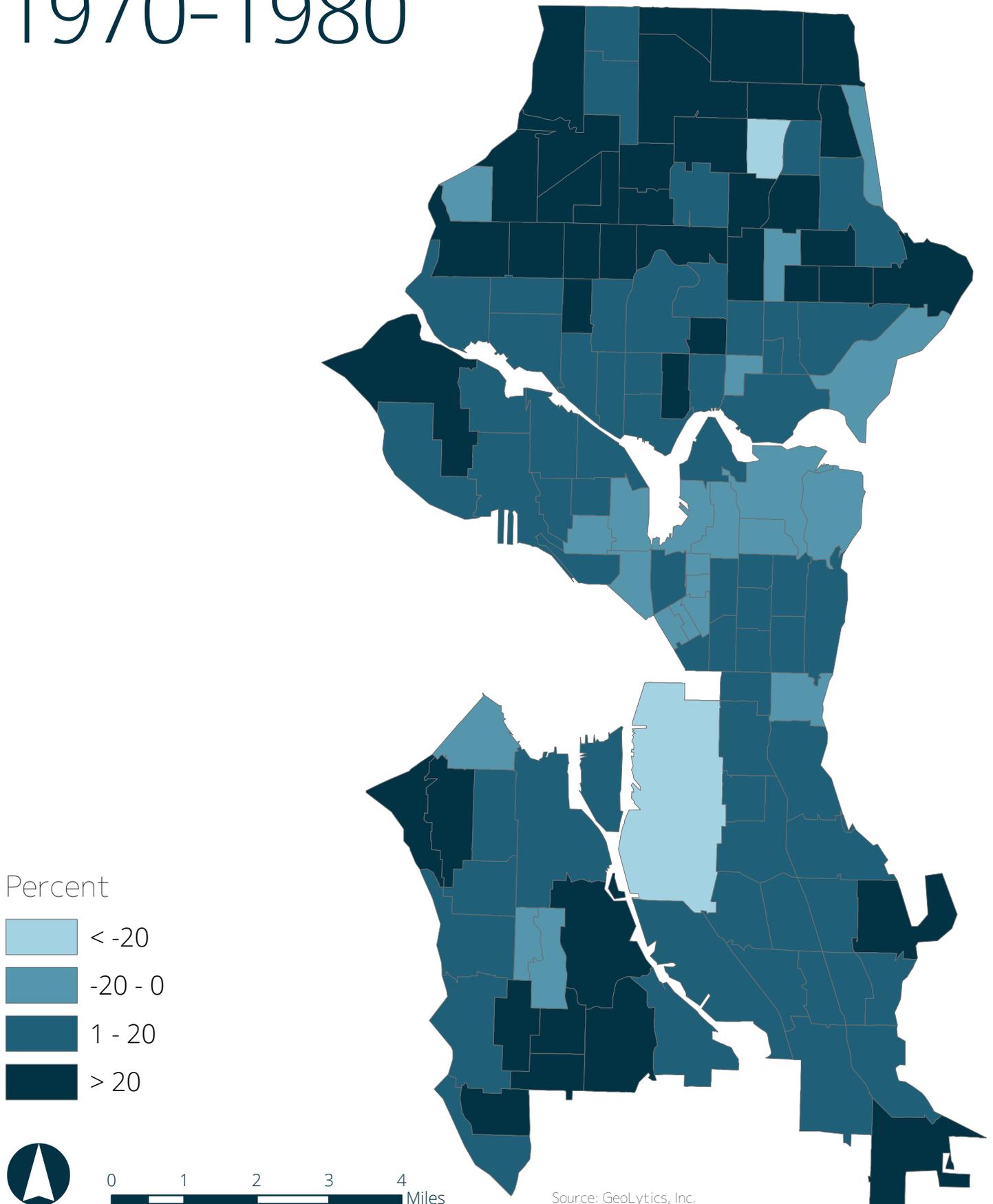


Figure 19: Change in rental share by tract

# 1980-1990

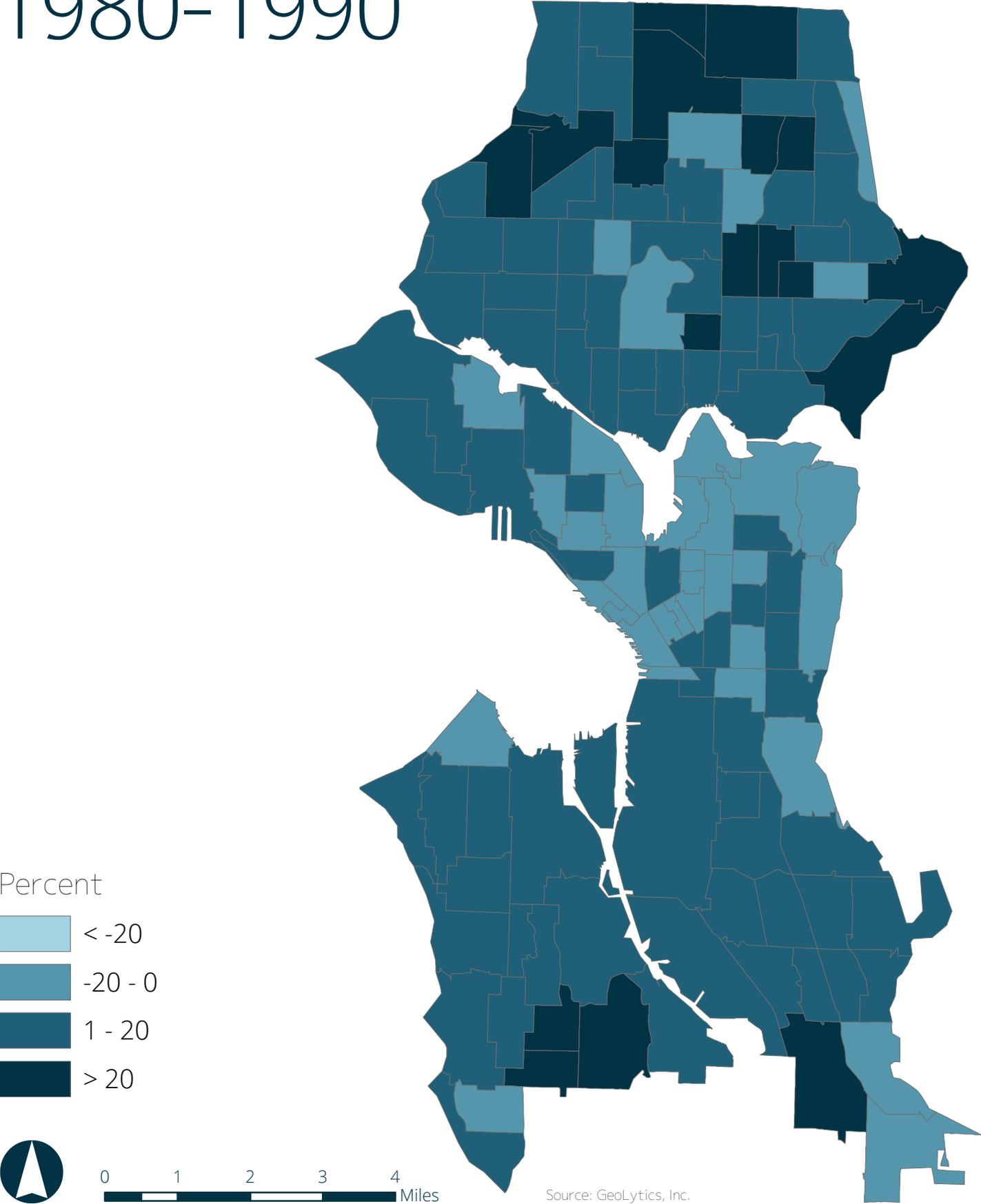


Figure 20: Change in rental share by tract

# 1990-2000

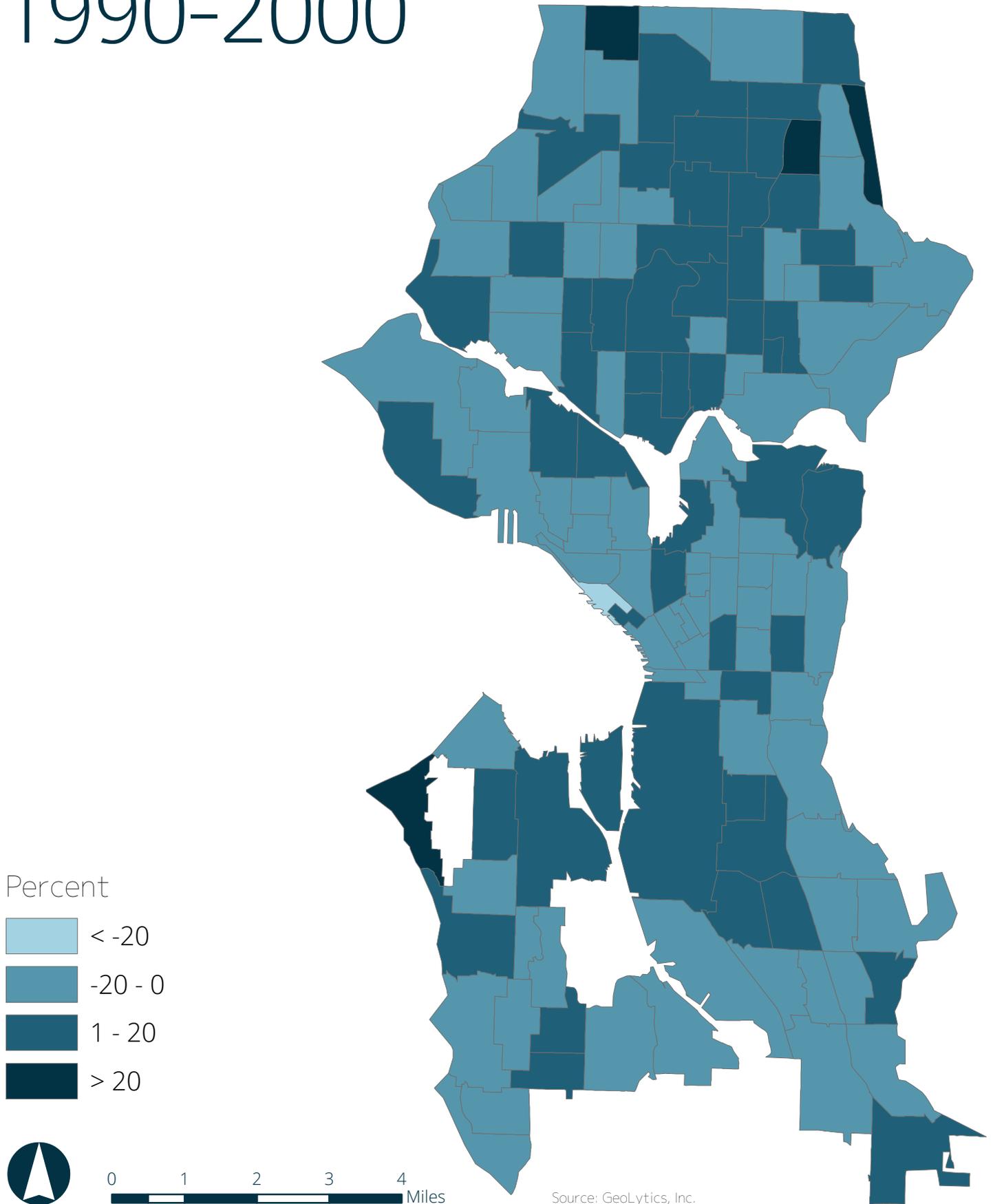


Figure 21: Change in rental share by tract

# 2000-2010

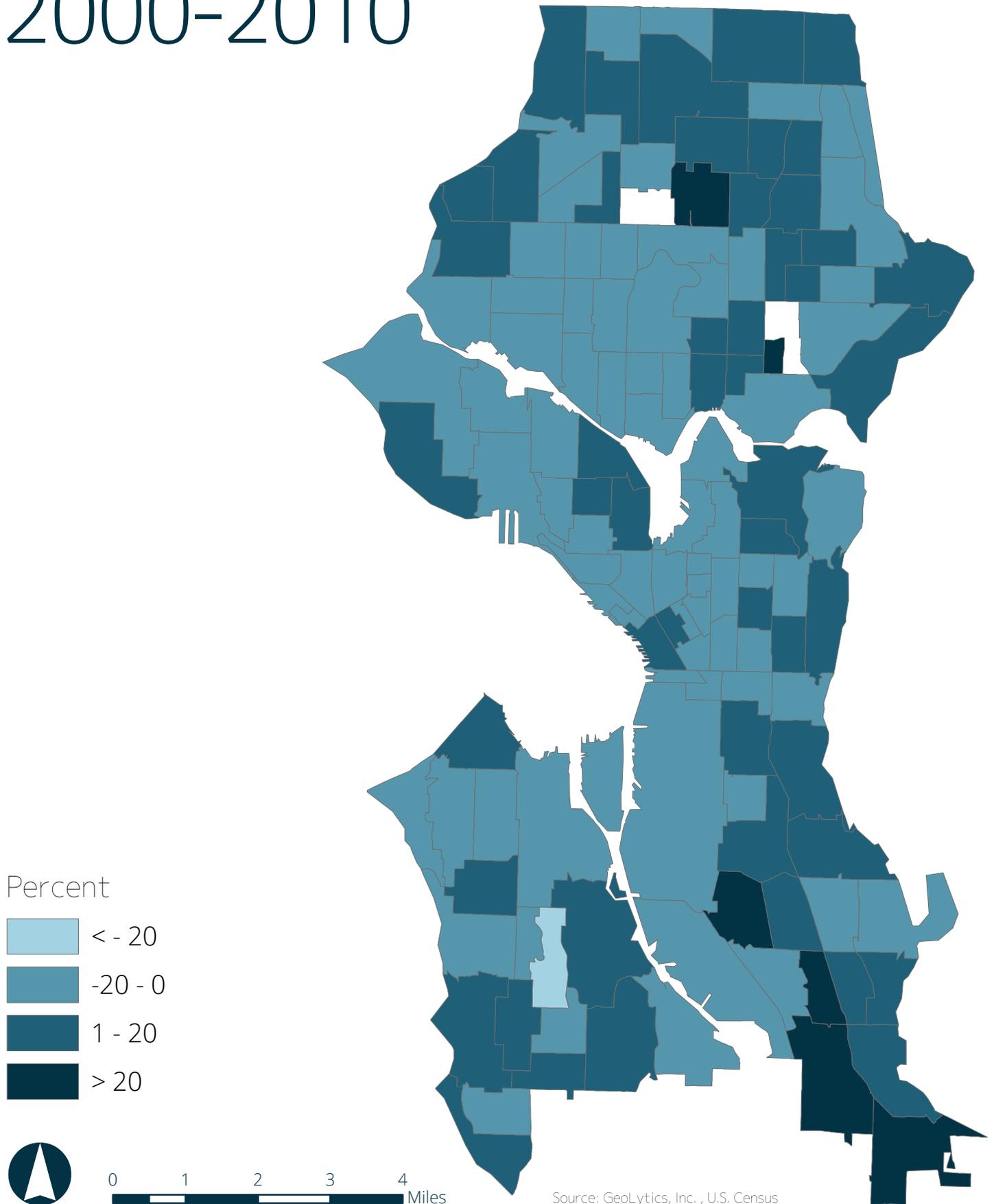


Figure 22: Residents in poverty by tract

1980

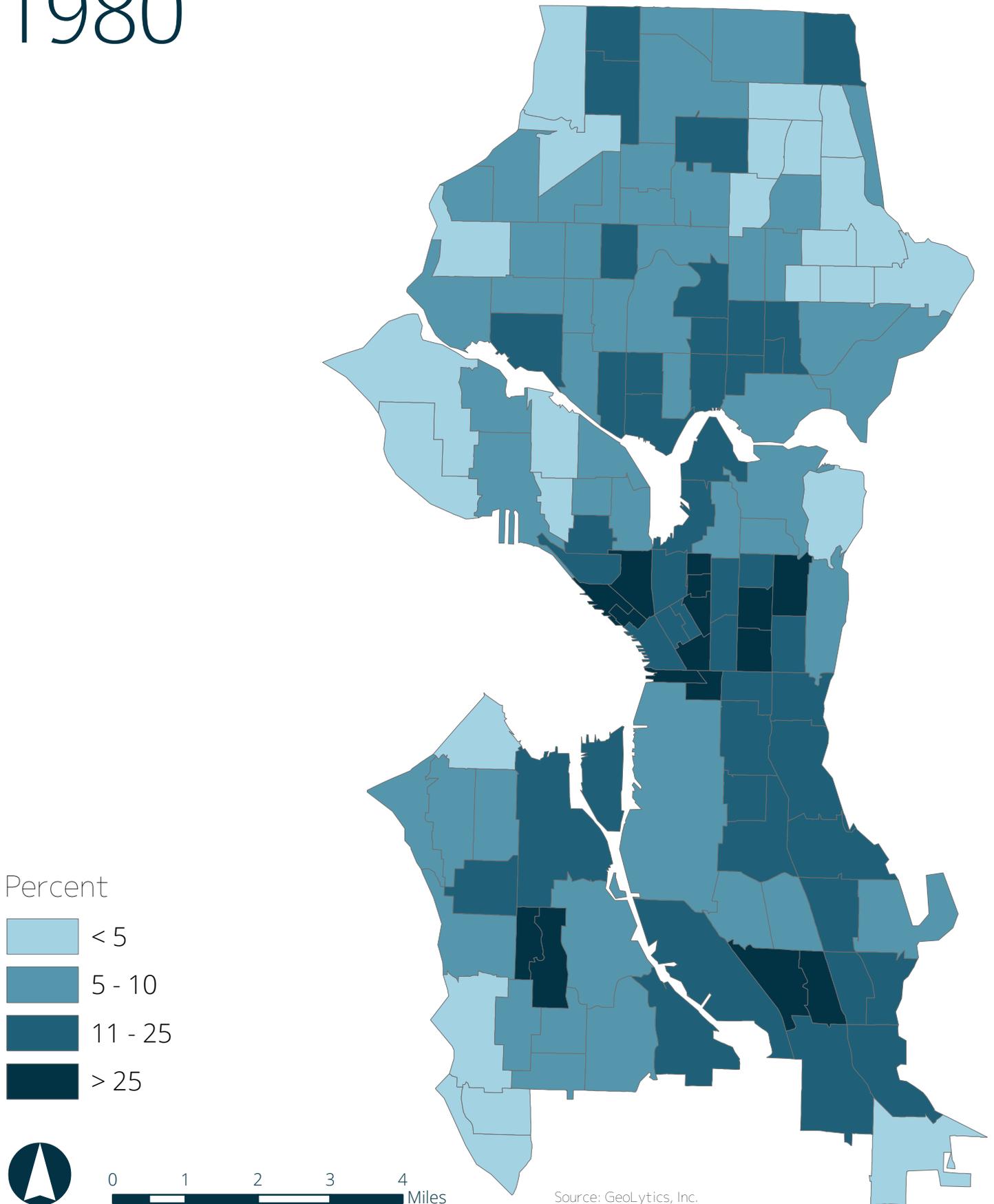


Figure 23: Residents in poverty by tract

1990

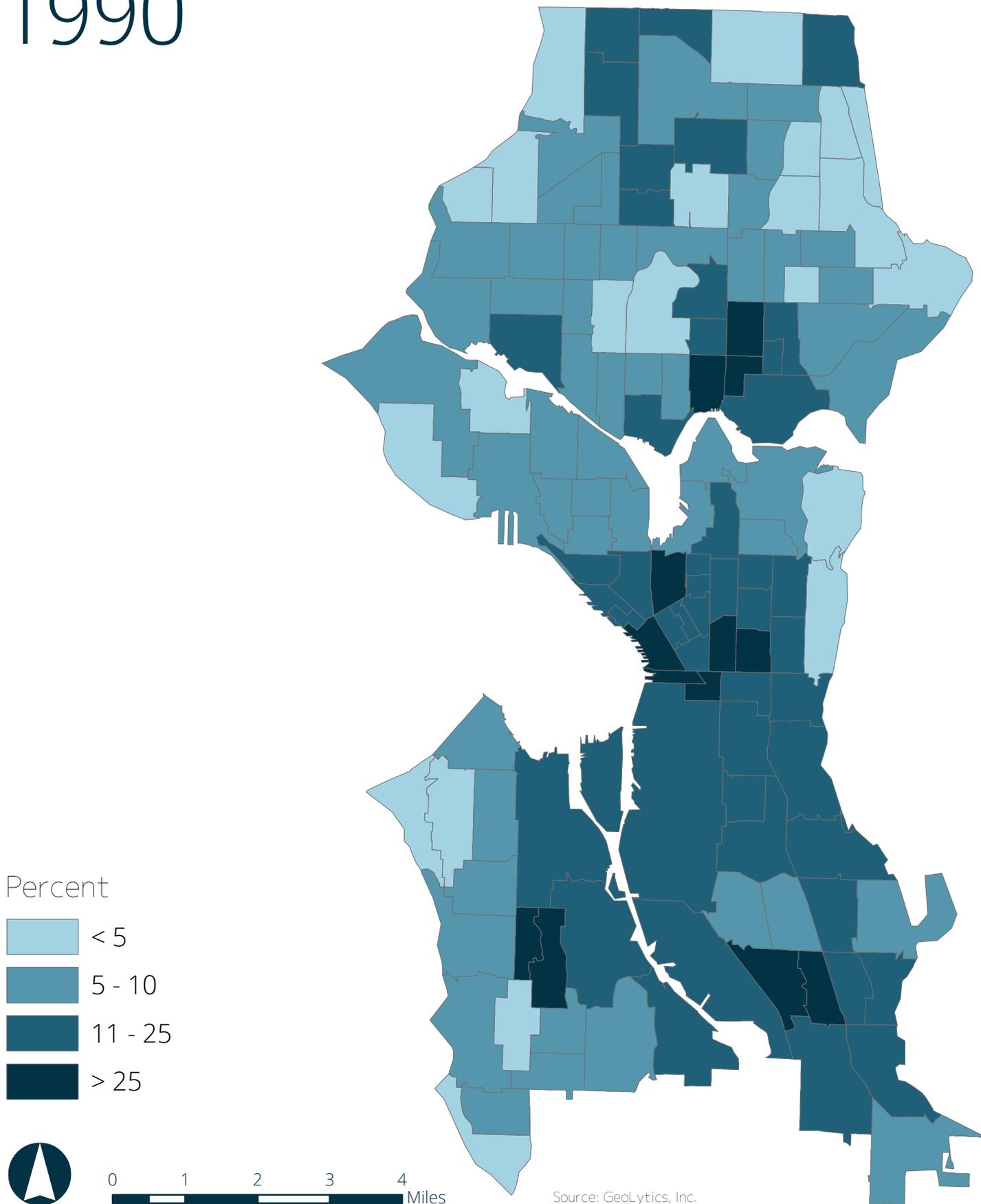


Figure 24: Residents in poverty by tract

2000

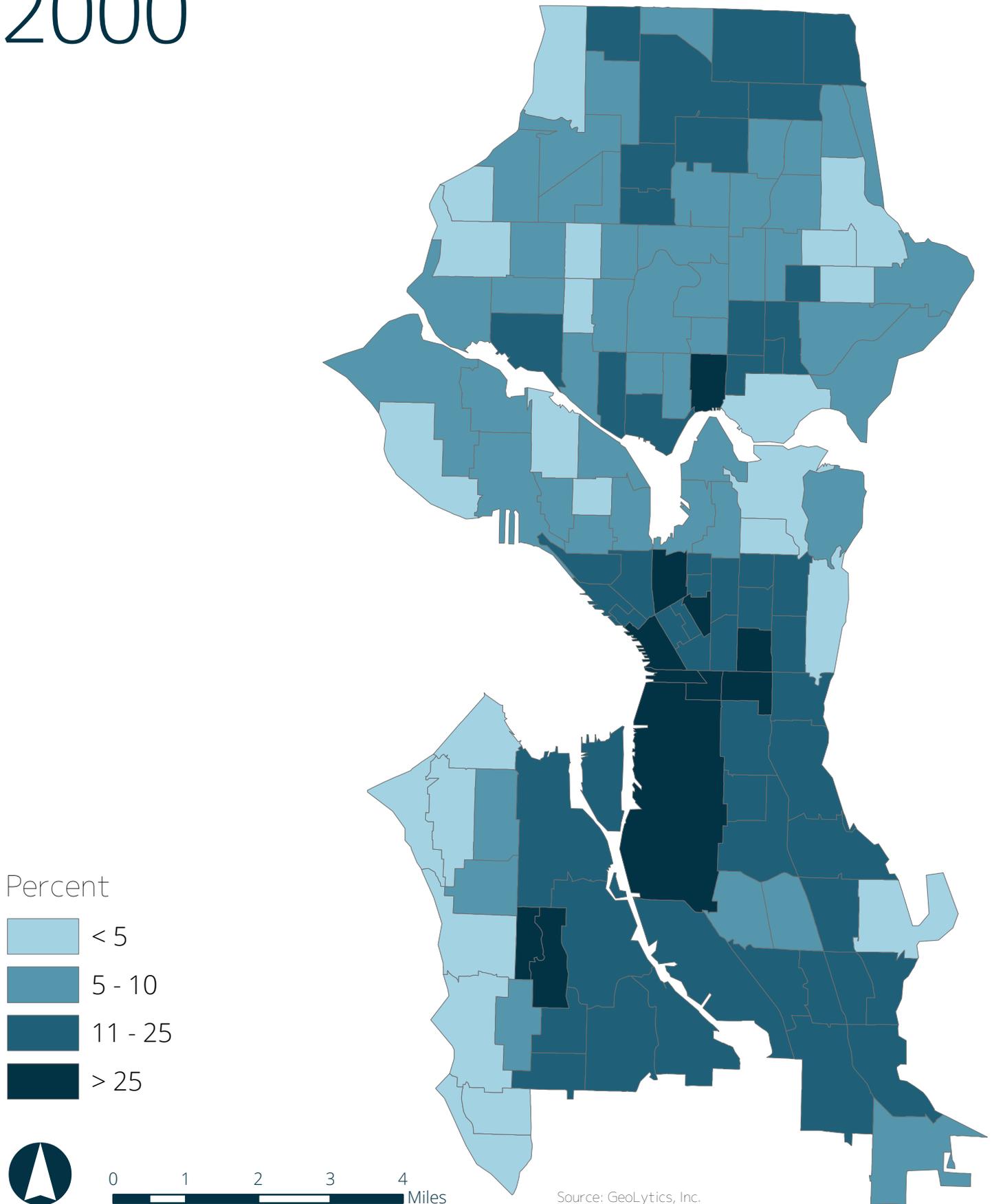
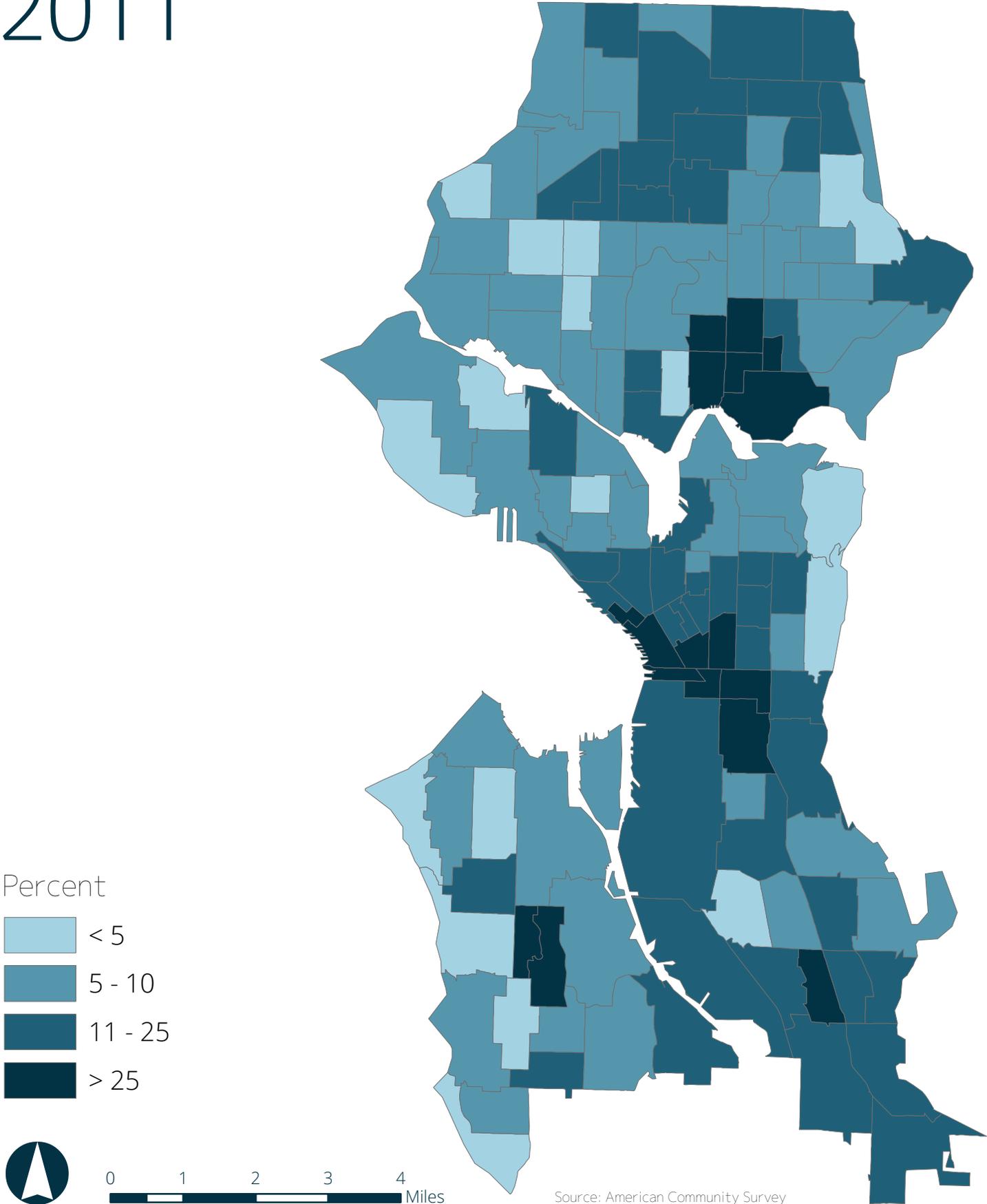
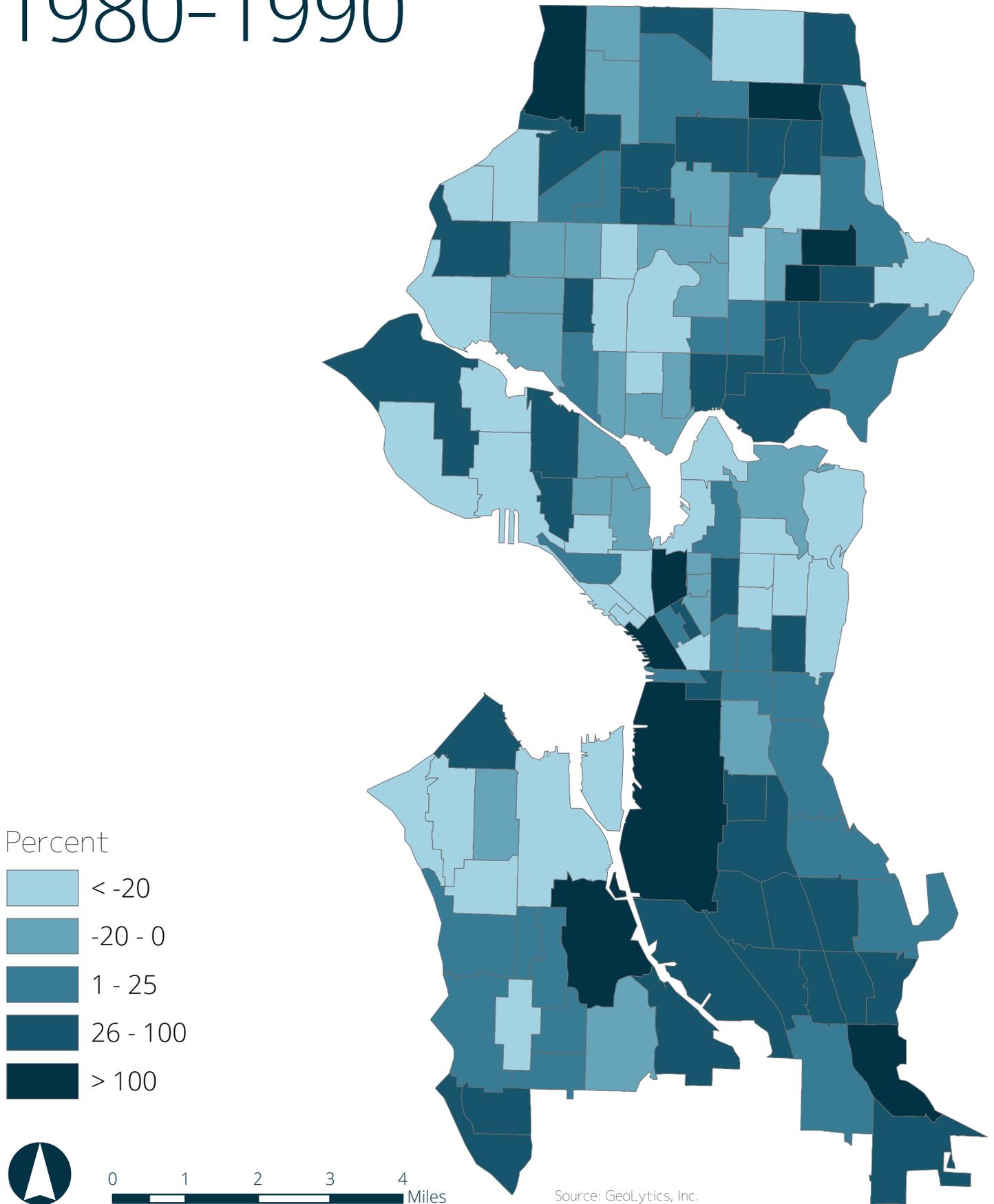


Figure 25: Residents in poverty by tract

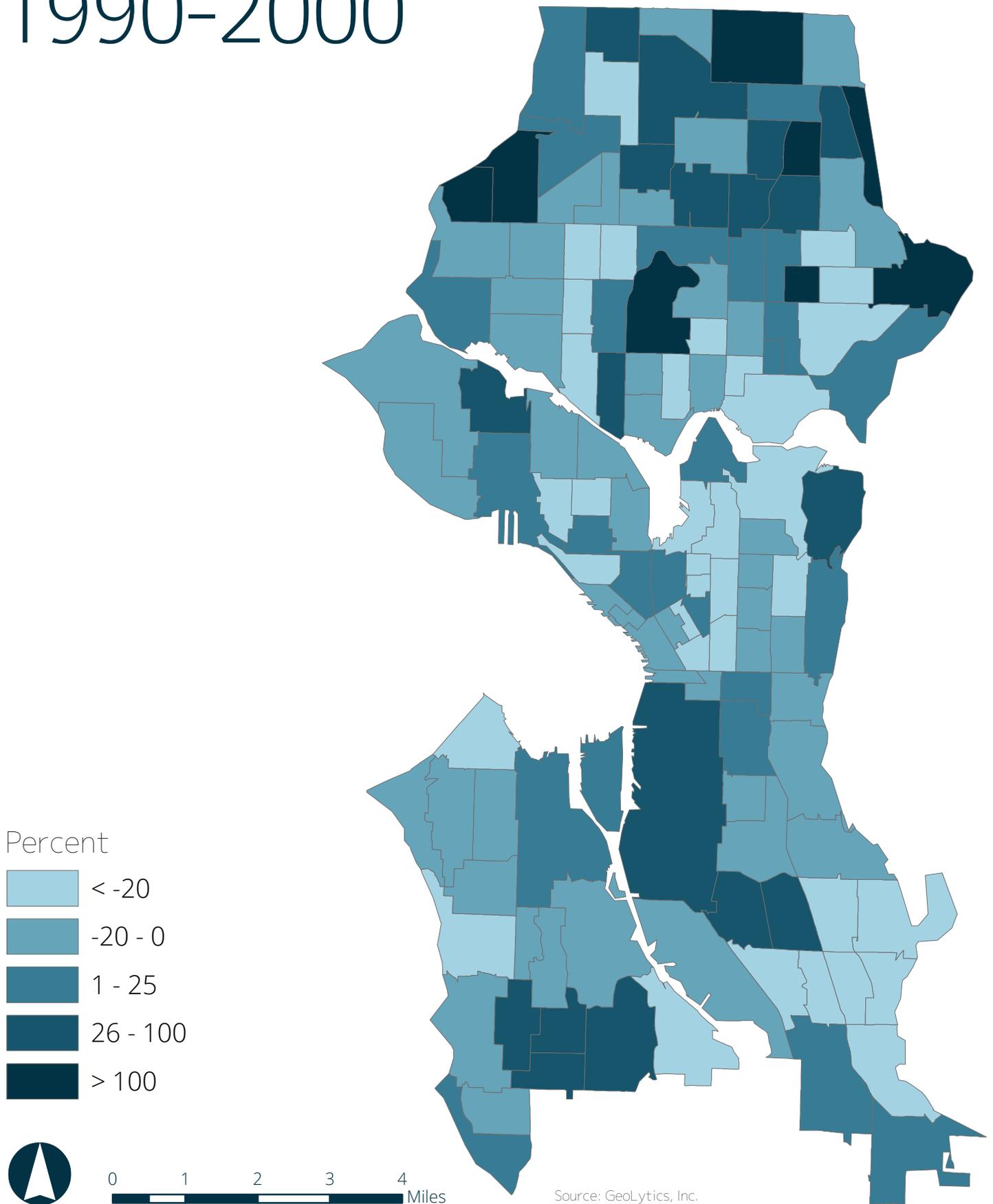
2011



**Figure 26:** Change in share of residents in poverty by tract  
1980-1990



**Figure 27:** Change in share of residents in poverty by tract  
1990-2000



**Figure 28:** Change in share of residents in poverty by tract  
2000-2011

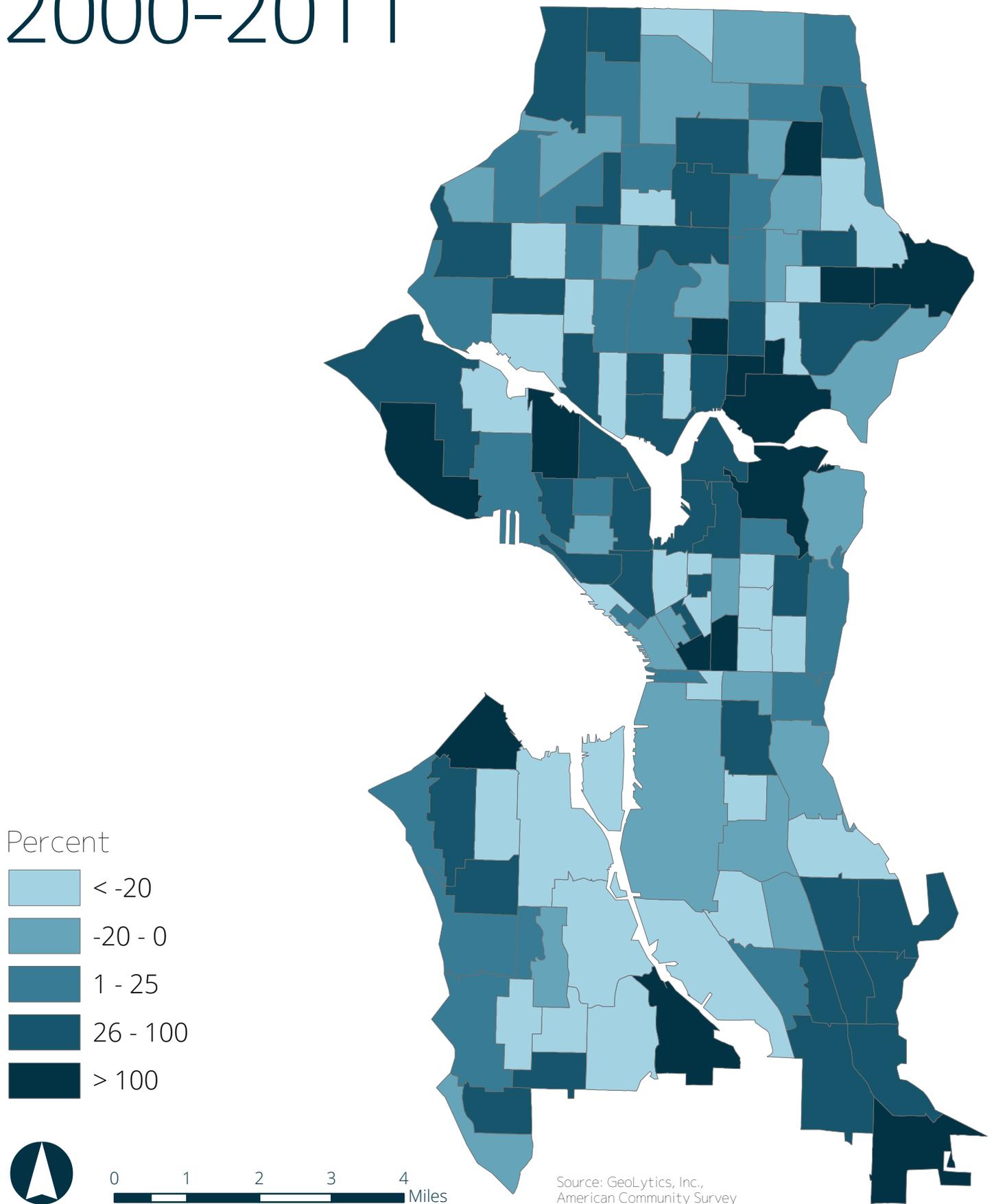


Figure 29: Change in median home value by tract

# 1990-2000

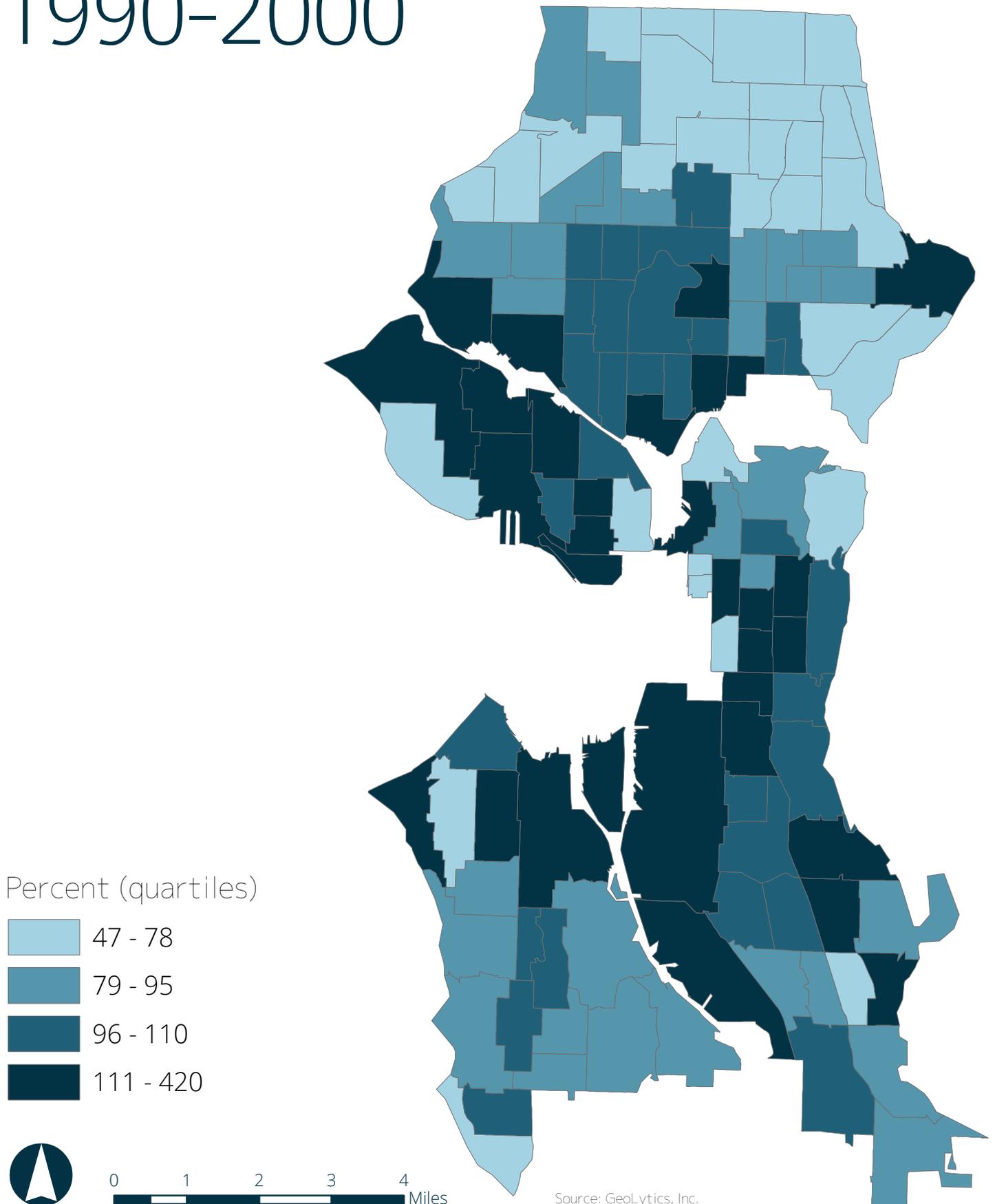


Figure 30: Change in median home value by tract

# 2000-2011

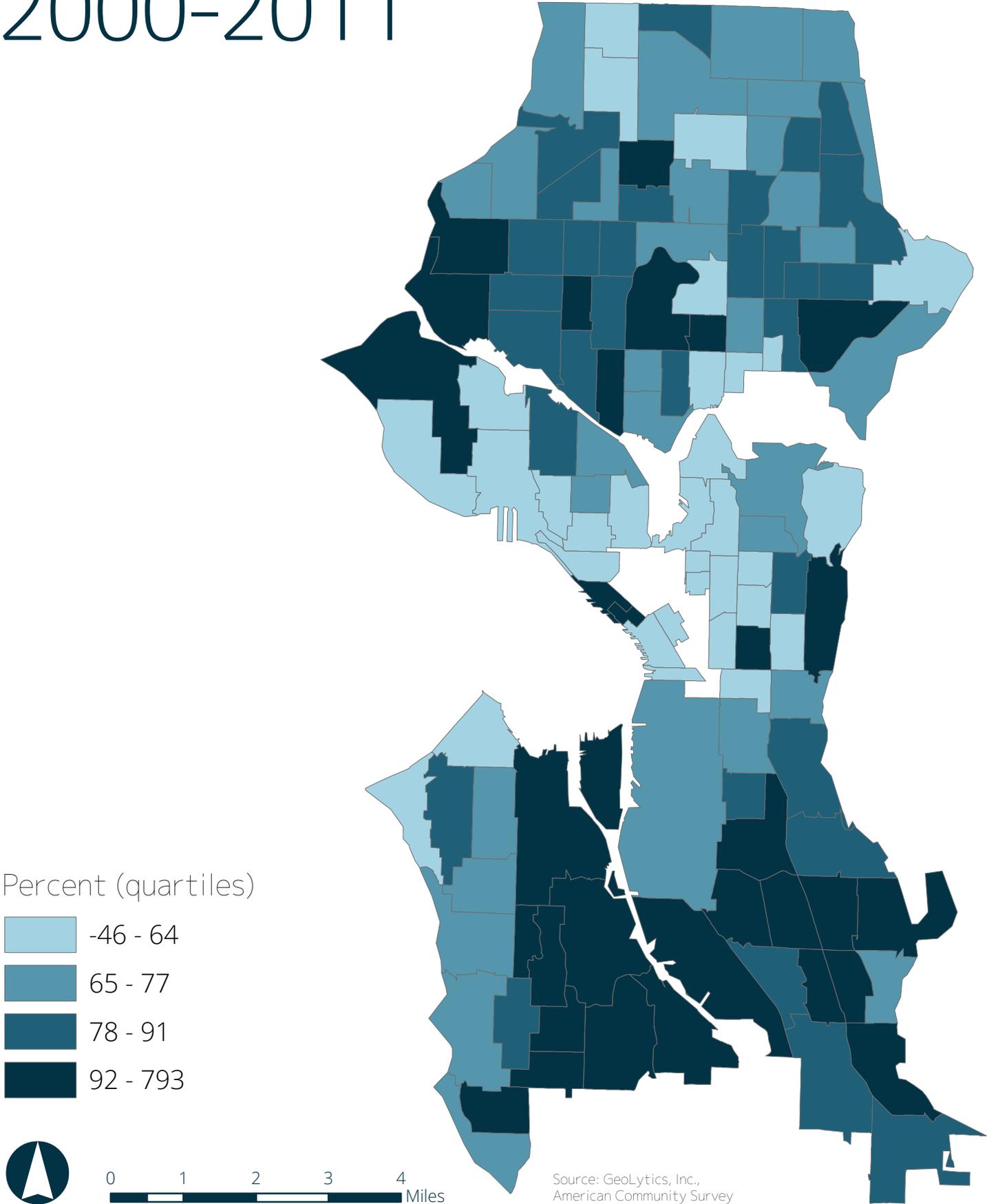


Figure 31: Change in median gross rent by tract

1980-1990

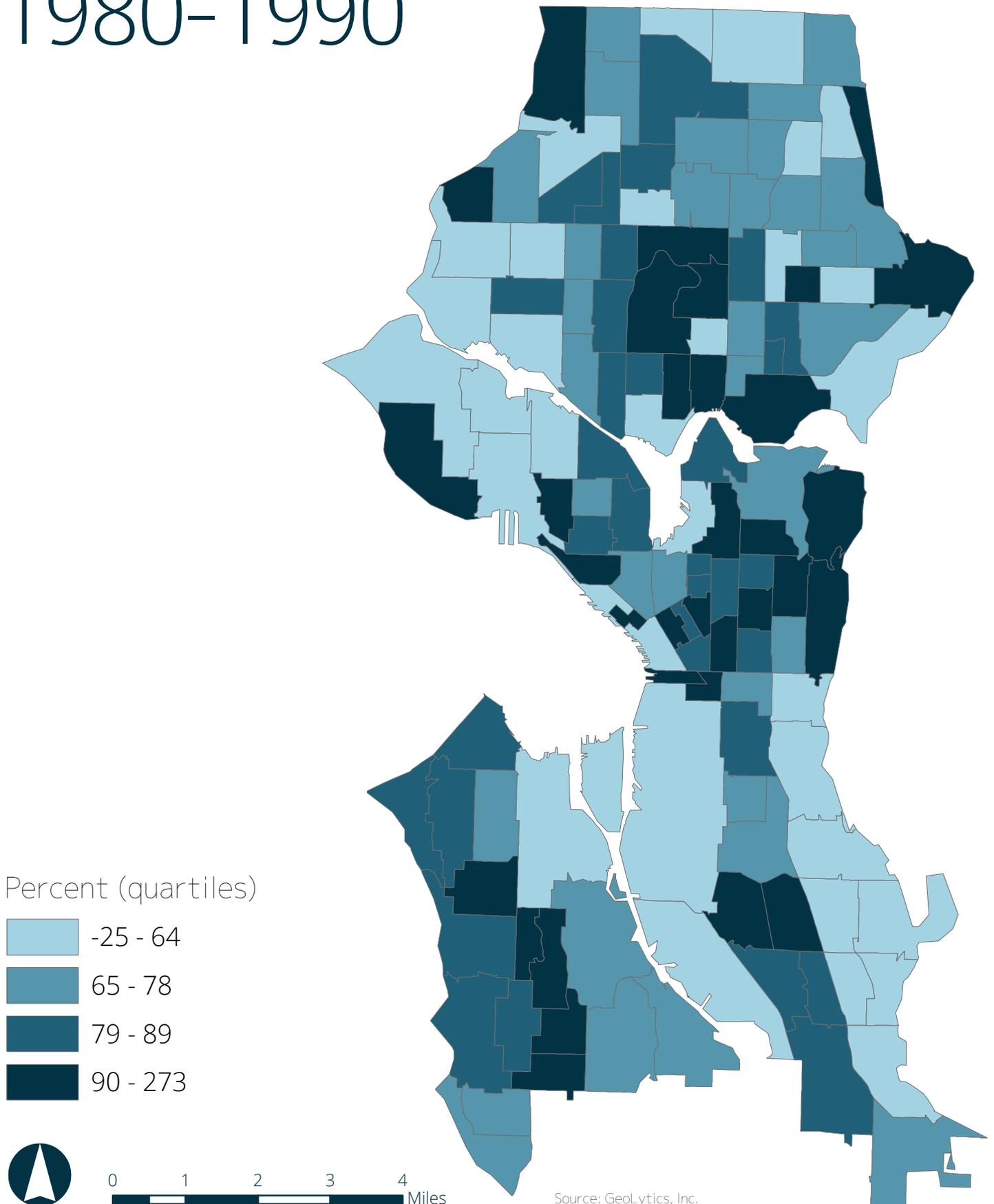


Figure 32: Change in median gross rent by tract

1990-2000

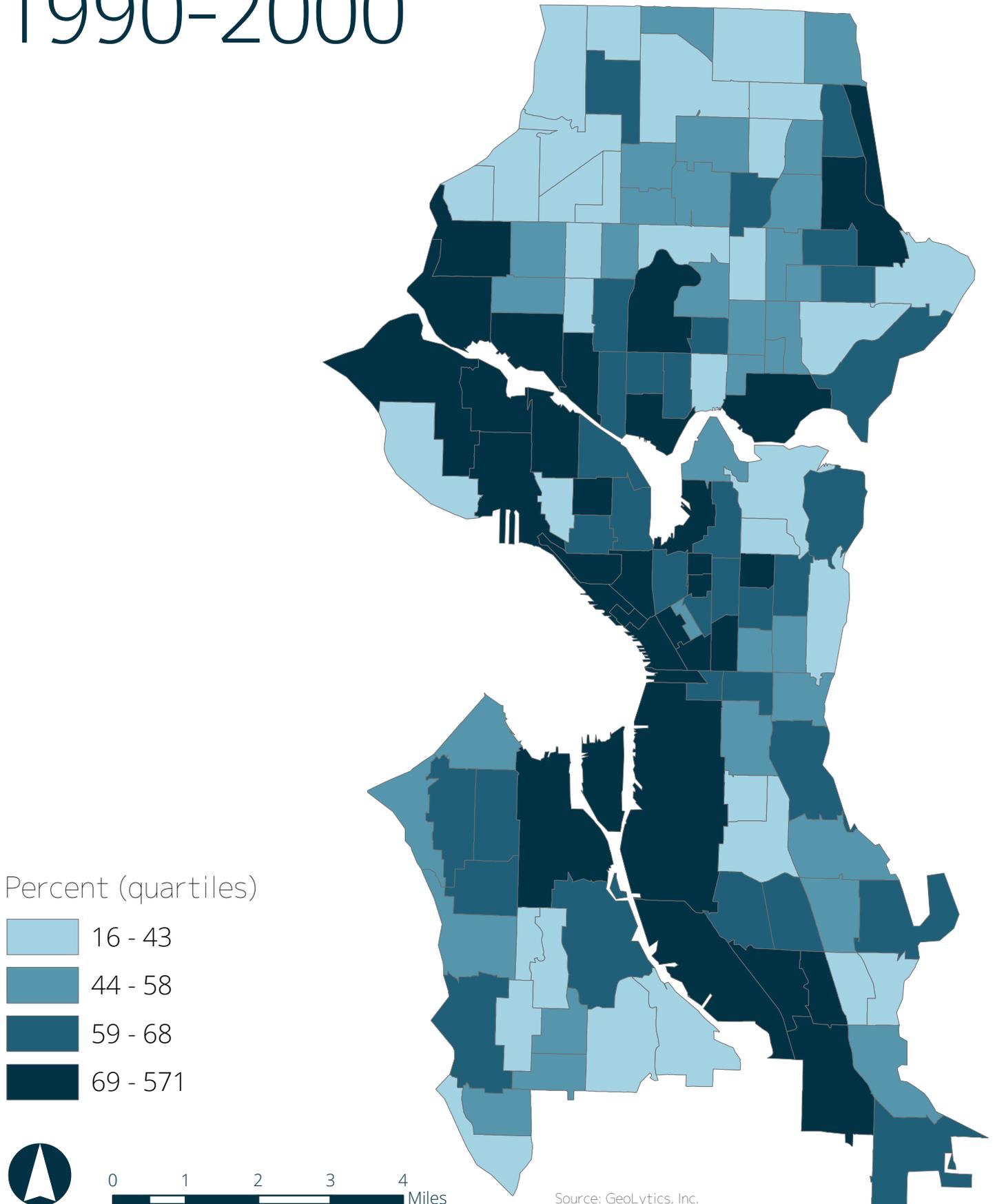
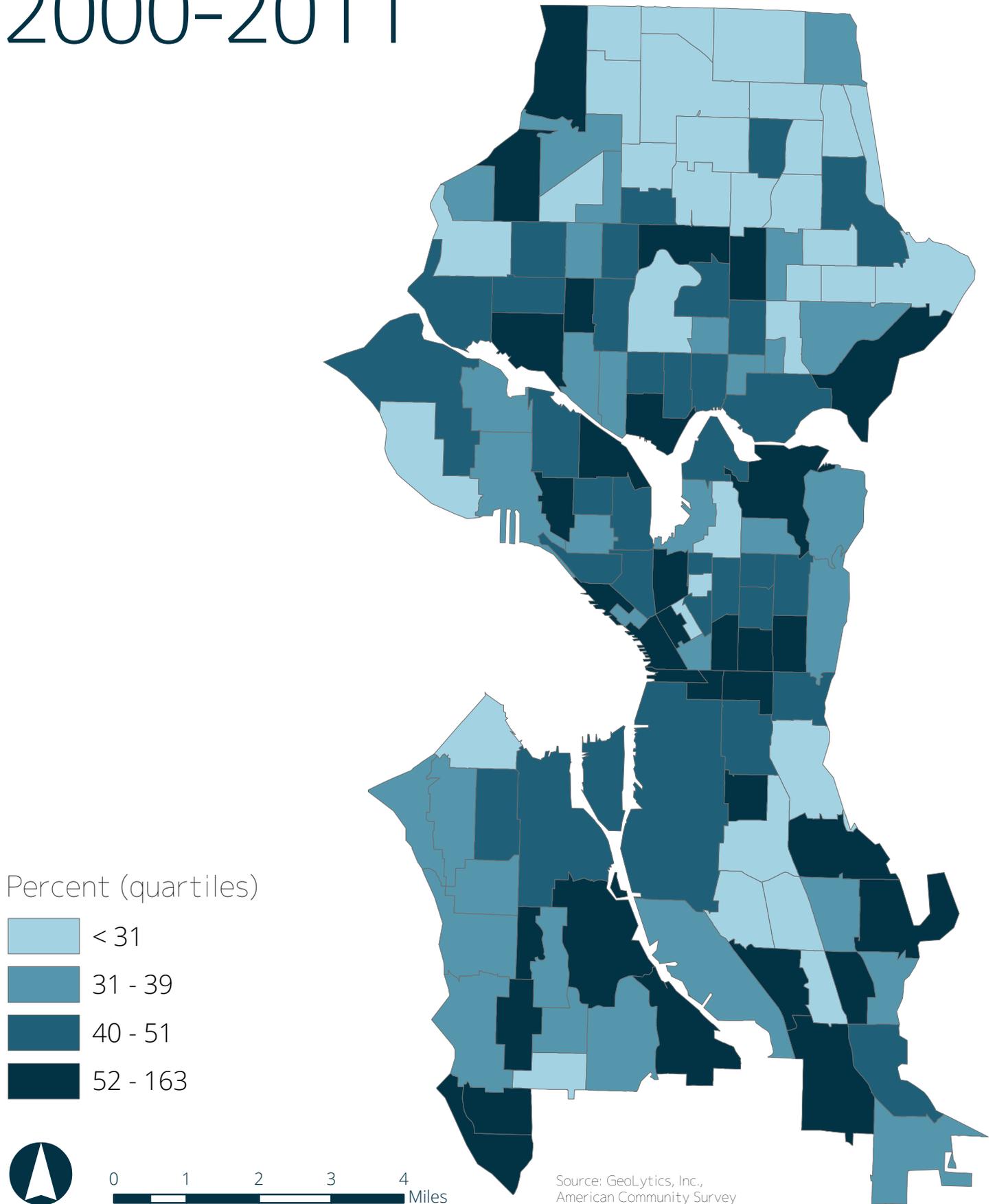


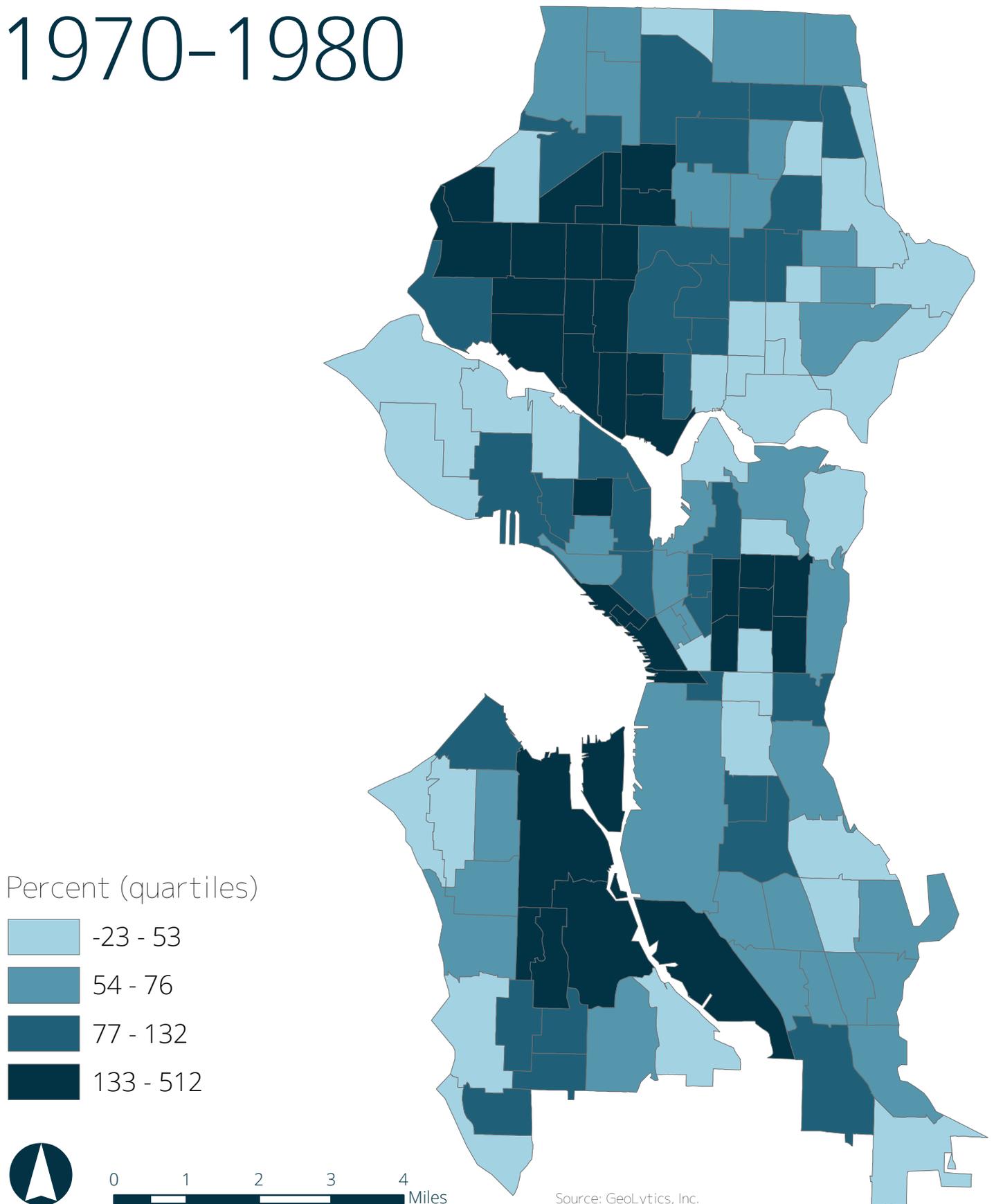
Figure 33: Change in median gross rent by tract

# 2000-2011



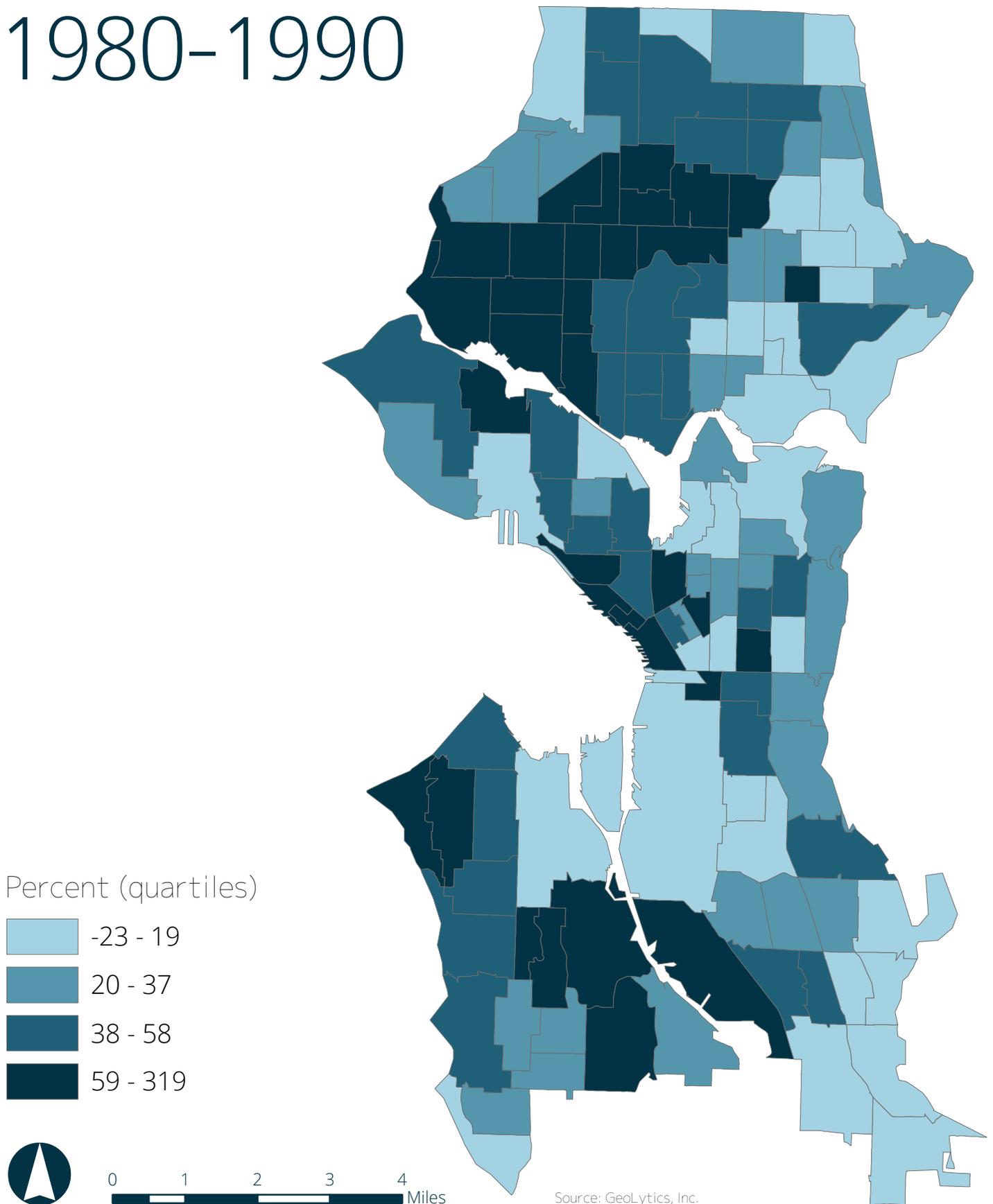
**Figure 34:** Change in share of residents with a Bachelor's degree by tract

1970-1980



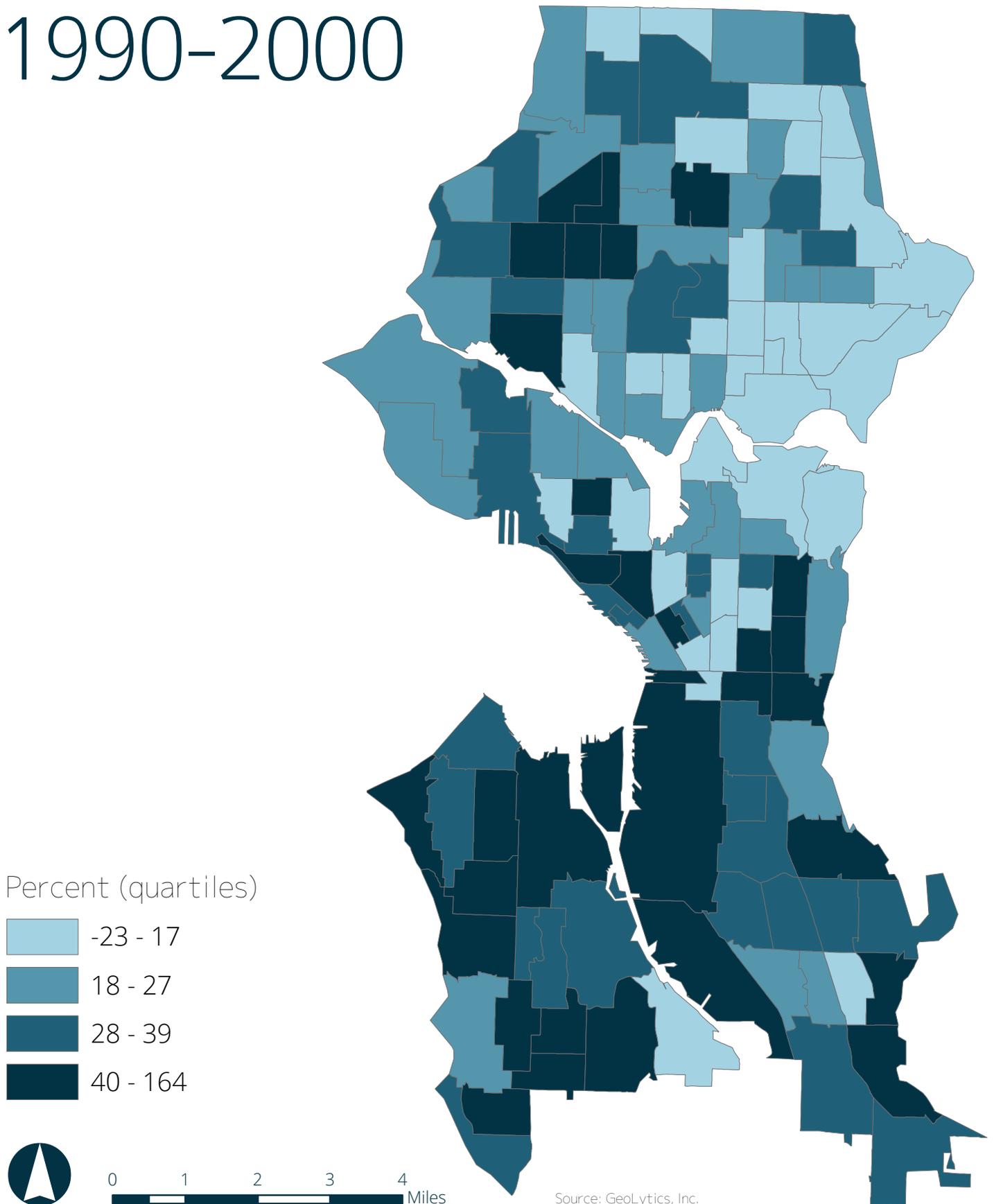
**Figure 35:** Change in share of residents with a Bachelor's degree by tract

# 1980-1990



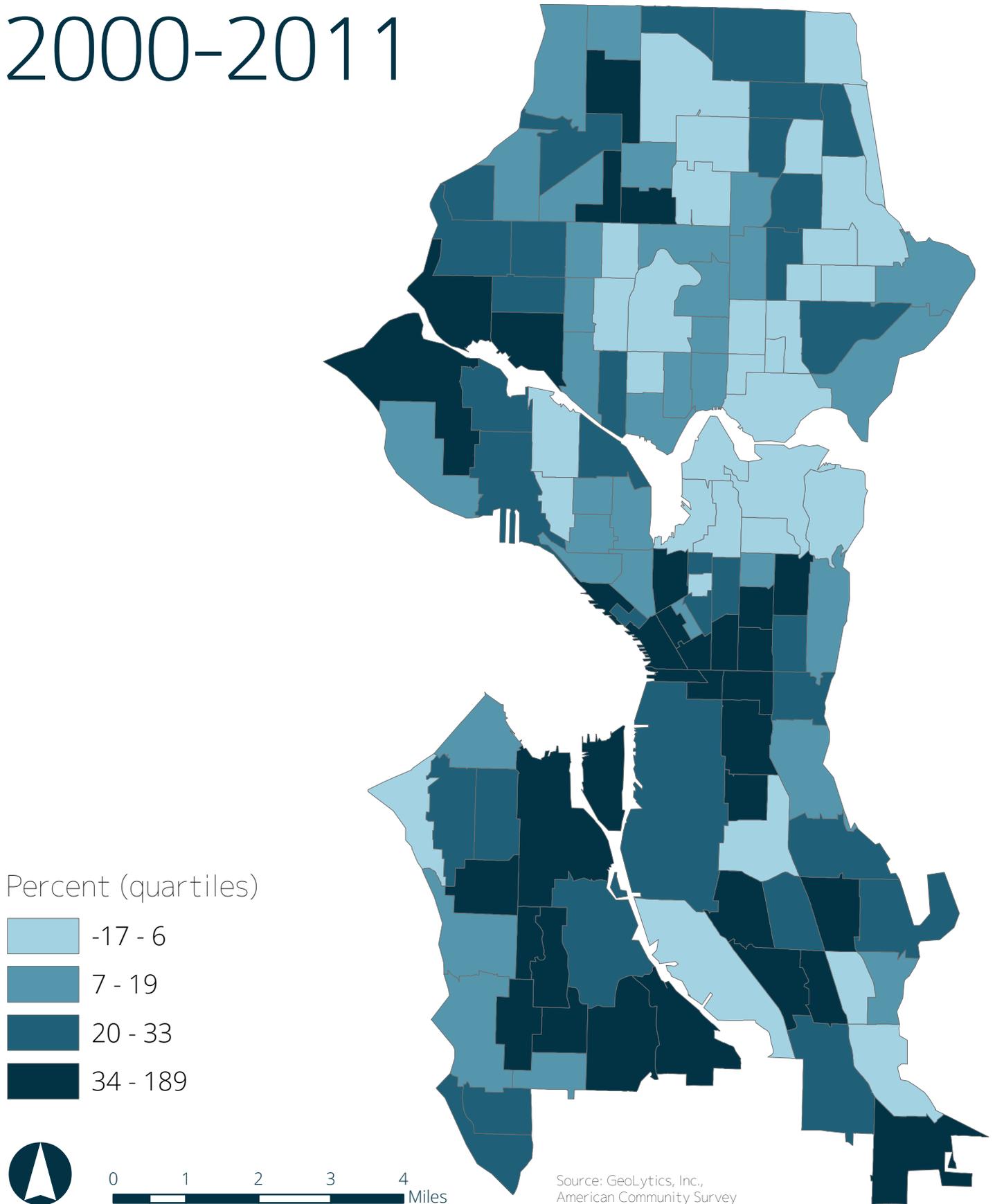
**Figure 36:** Change in share of residents with a Bachelor's degree by tract

1990-2000



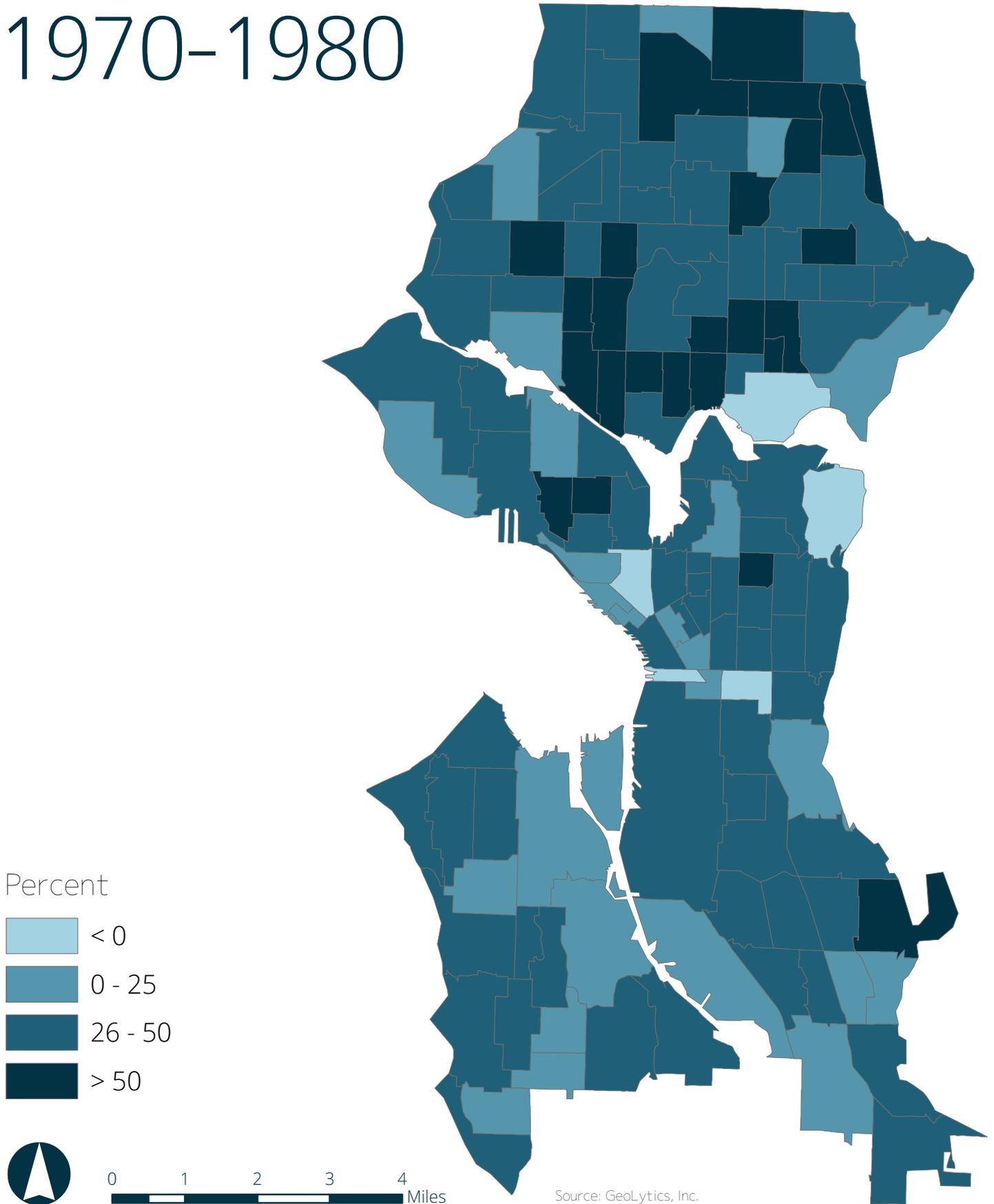
**Figure 37:** Change in share of residents with a Bachelor's degree by tract

2000-2011



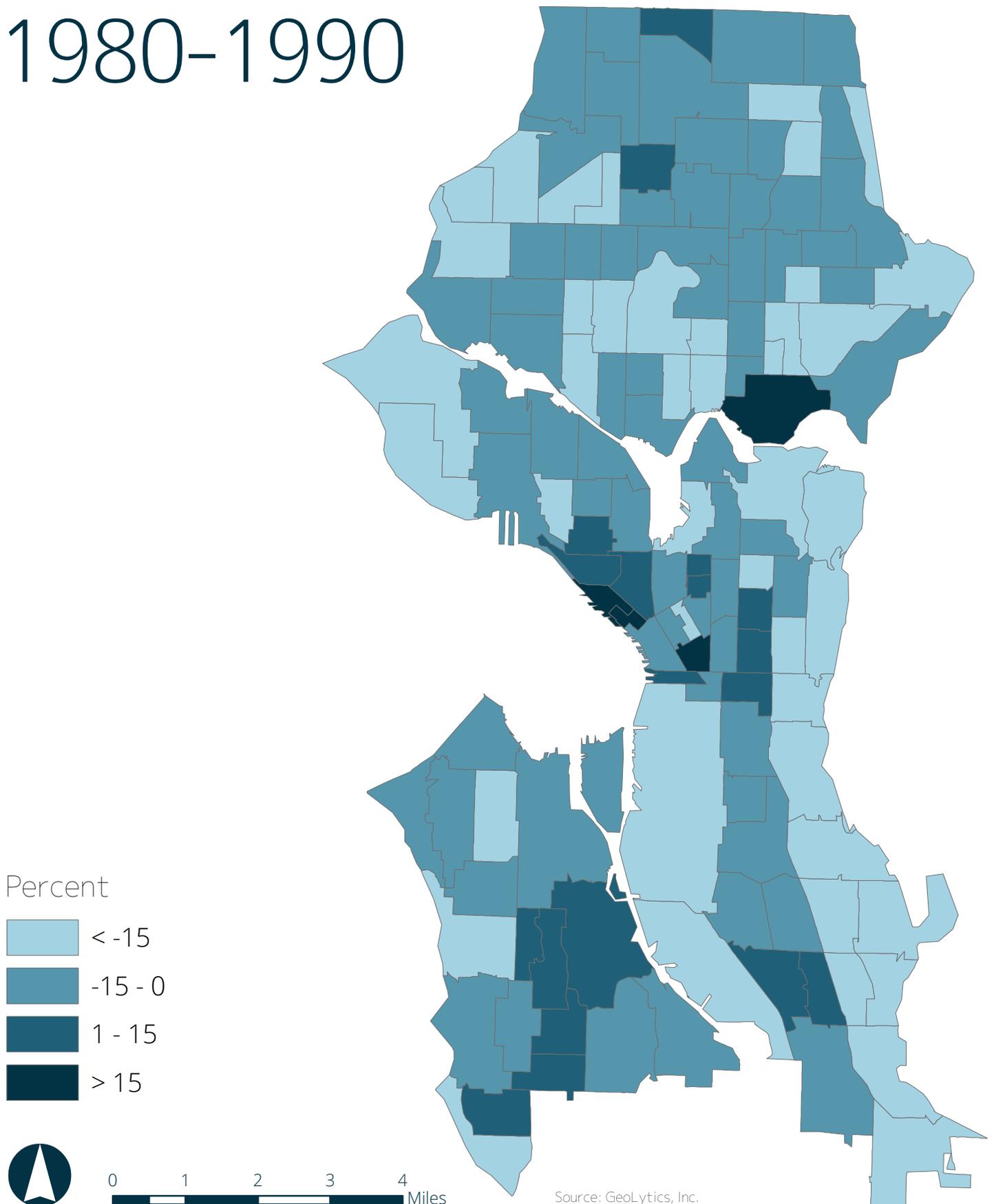
**Figure 38:** Change in ratio of 25-34 and 55-64 age cohorts to total population by tract

1970-1980



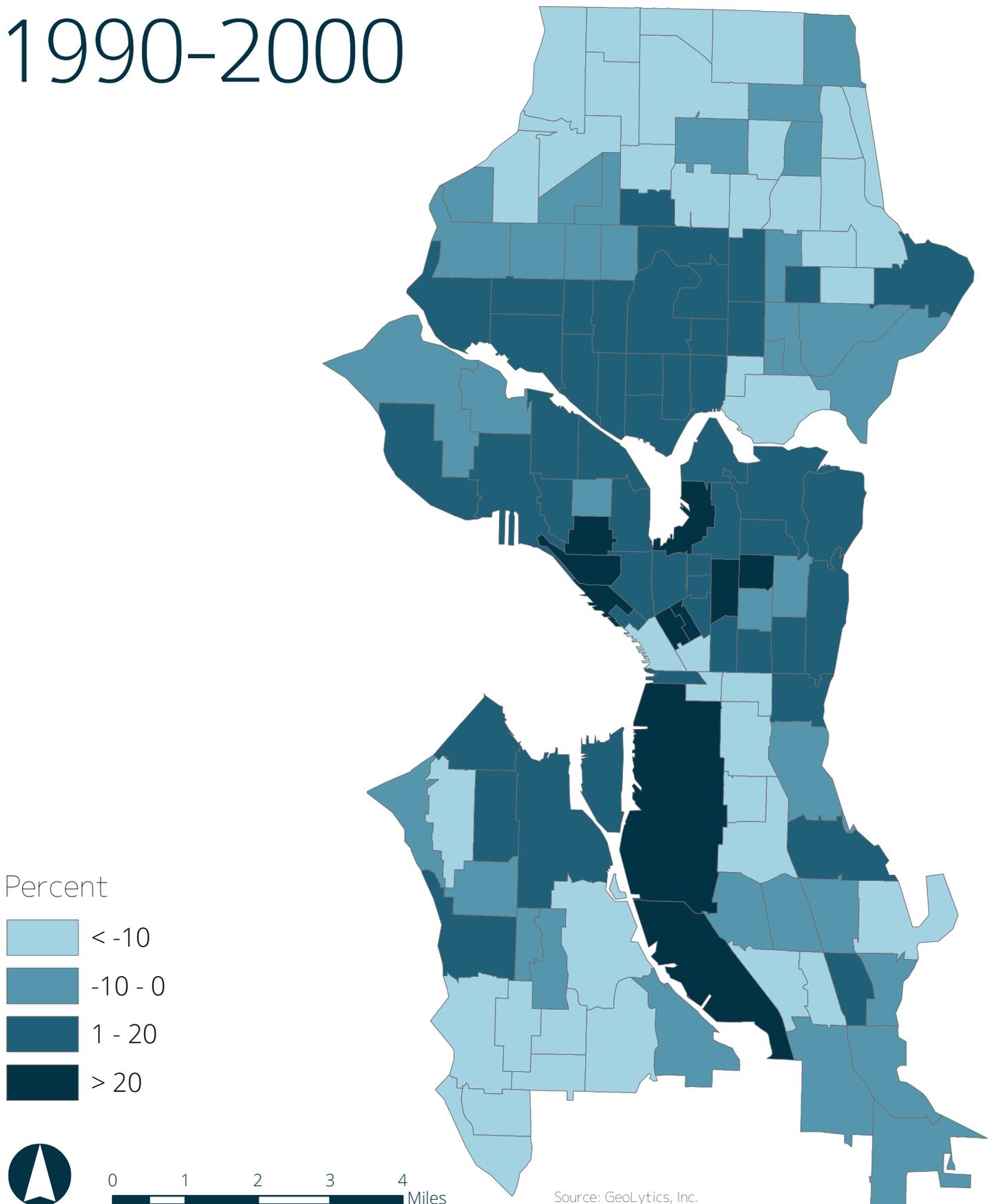
**Figure 39:** Change in ratio of 25-34 and 55-64 age cohorts to total population by tract

1980-1990



**Figure 40:** Change in ratio of 25-34 and 55-64 age cohorts to total population by tract

1990-2000



**Figure 41:** Change in ratio of 25-34 and 55-64 age cohorts to total population by tract

2000-2011

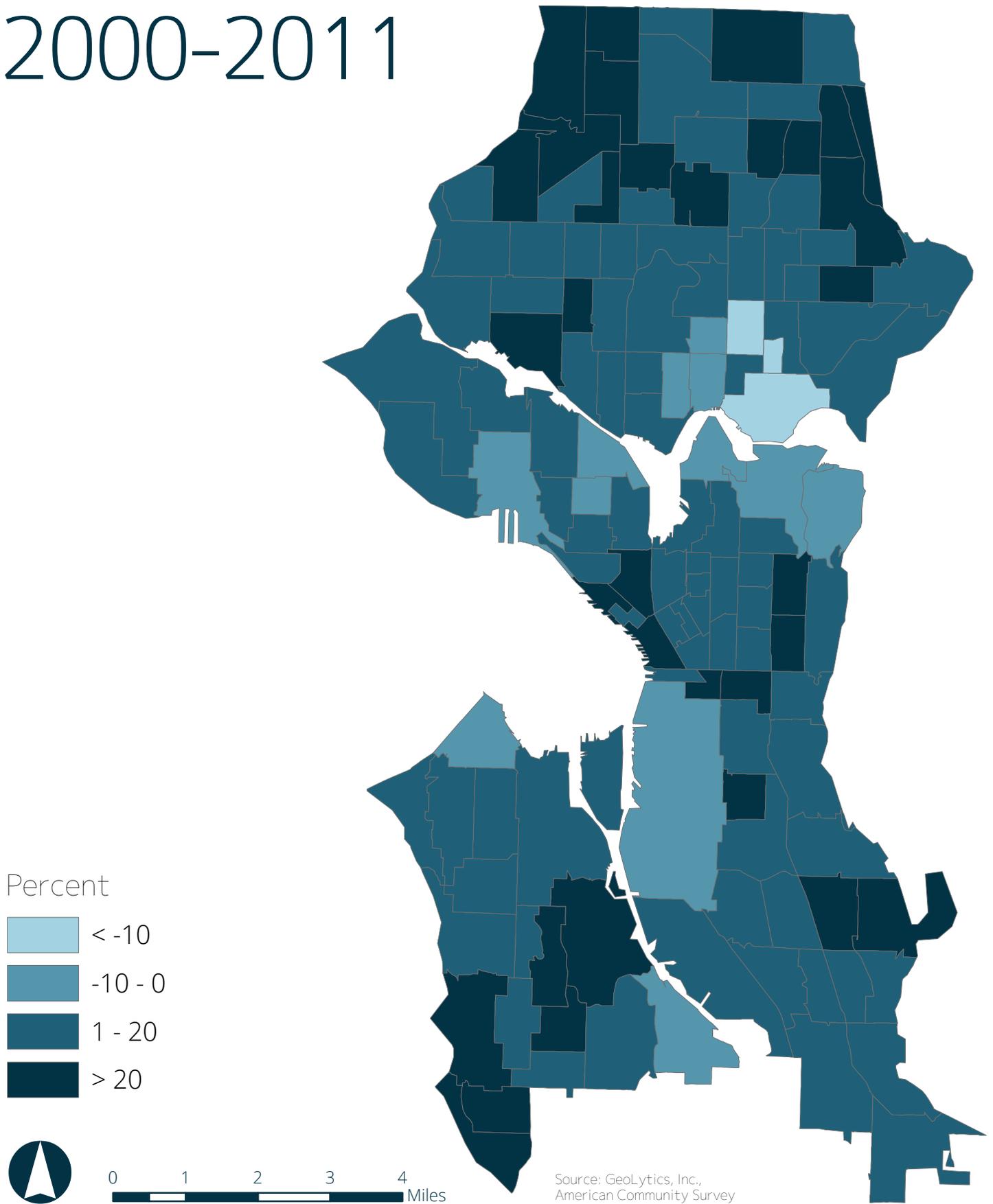


Figure 42: Black residents by tract

1970

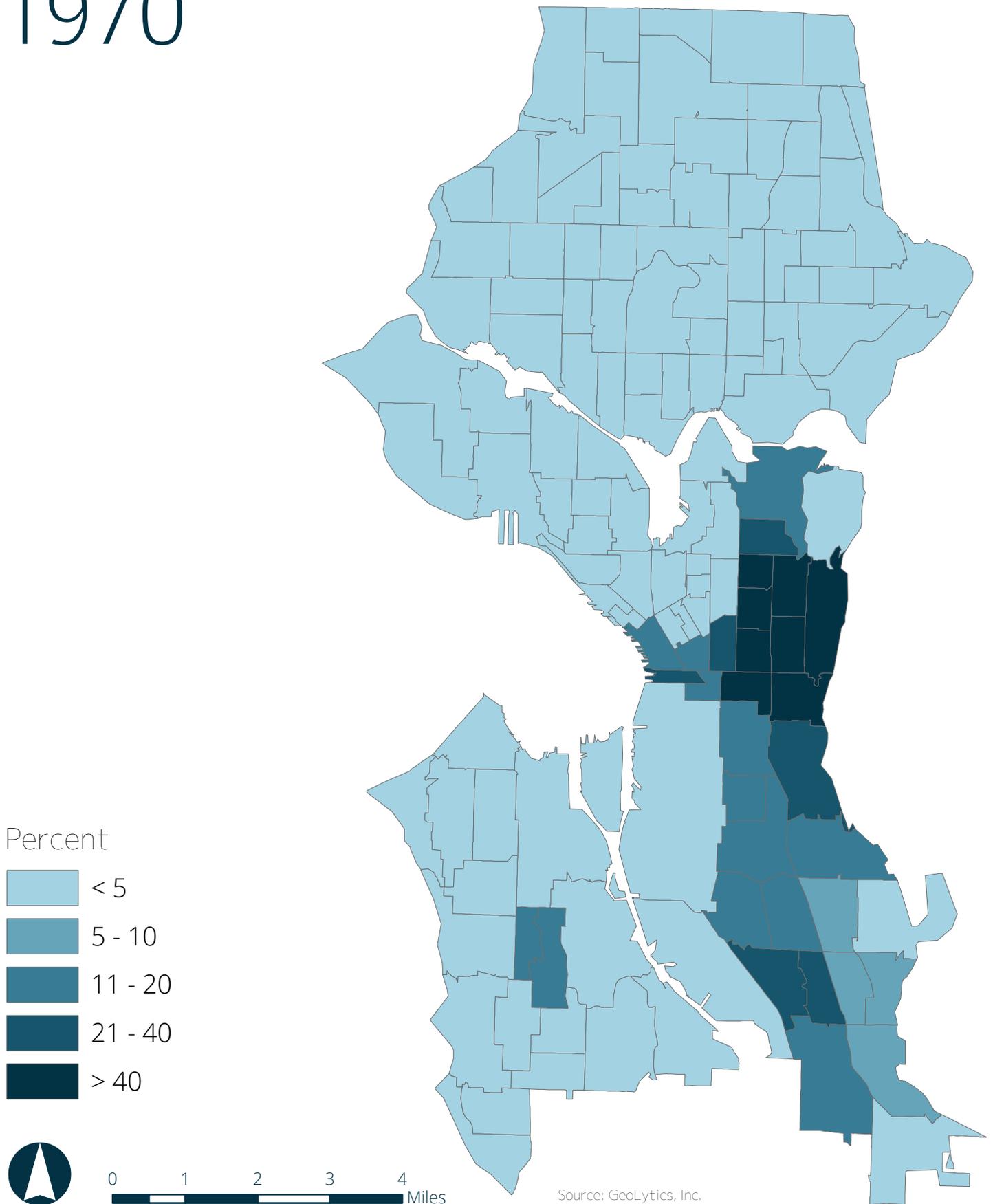


Figure 43: Black residents by tract

1980

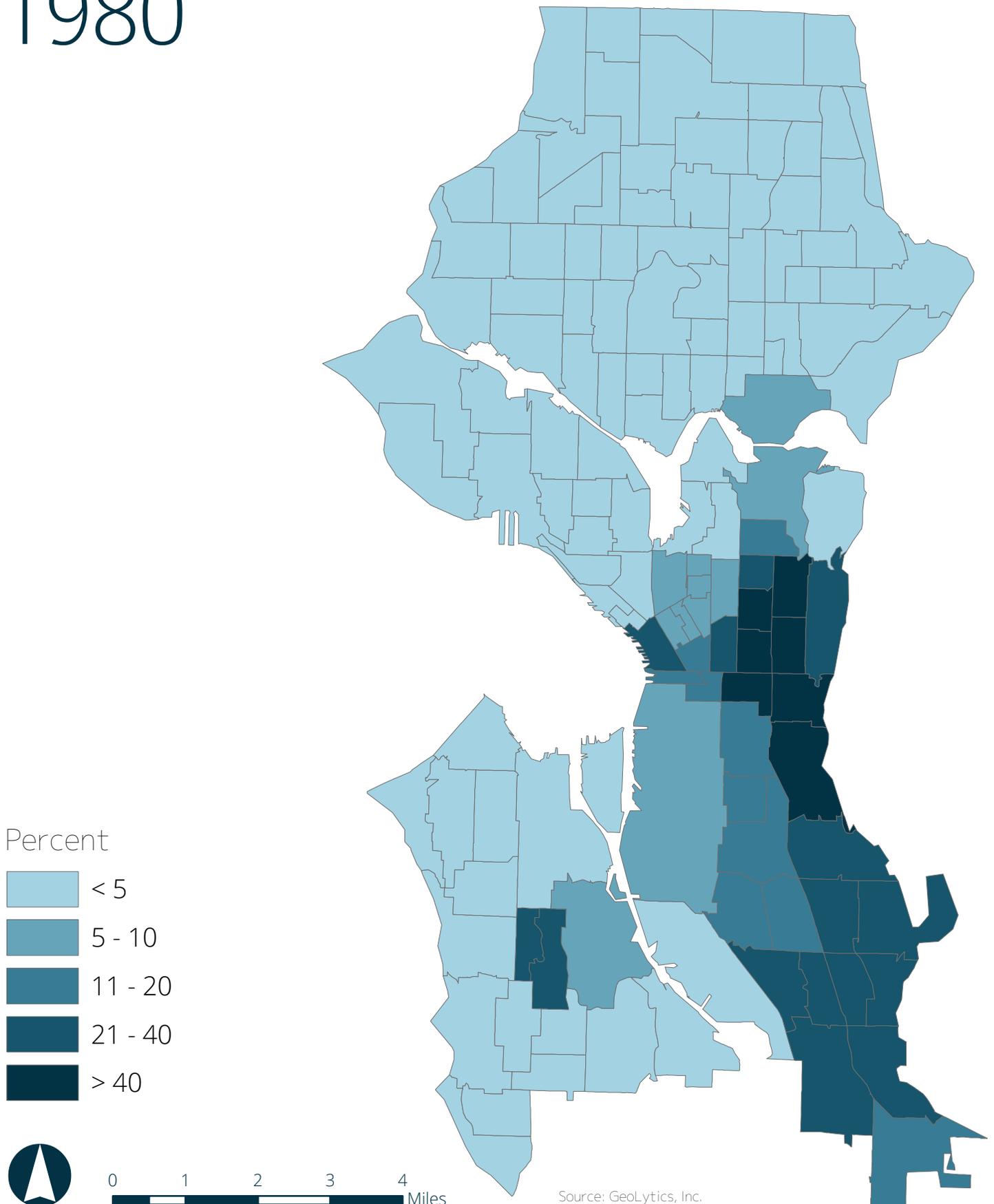


Figure 44: Black residents by tract

1990

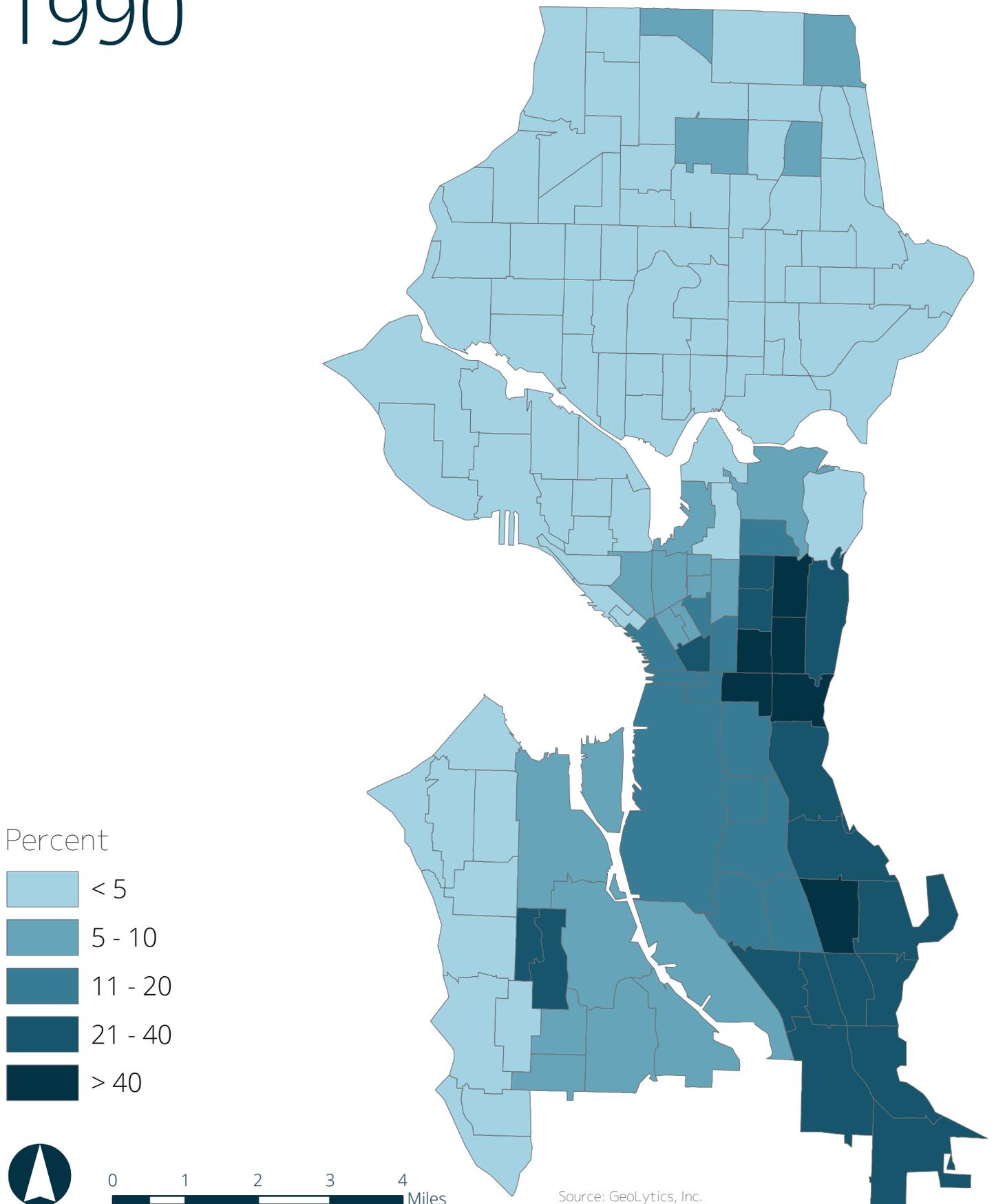
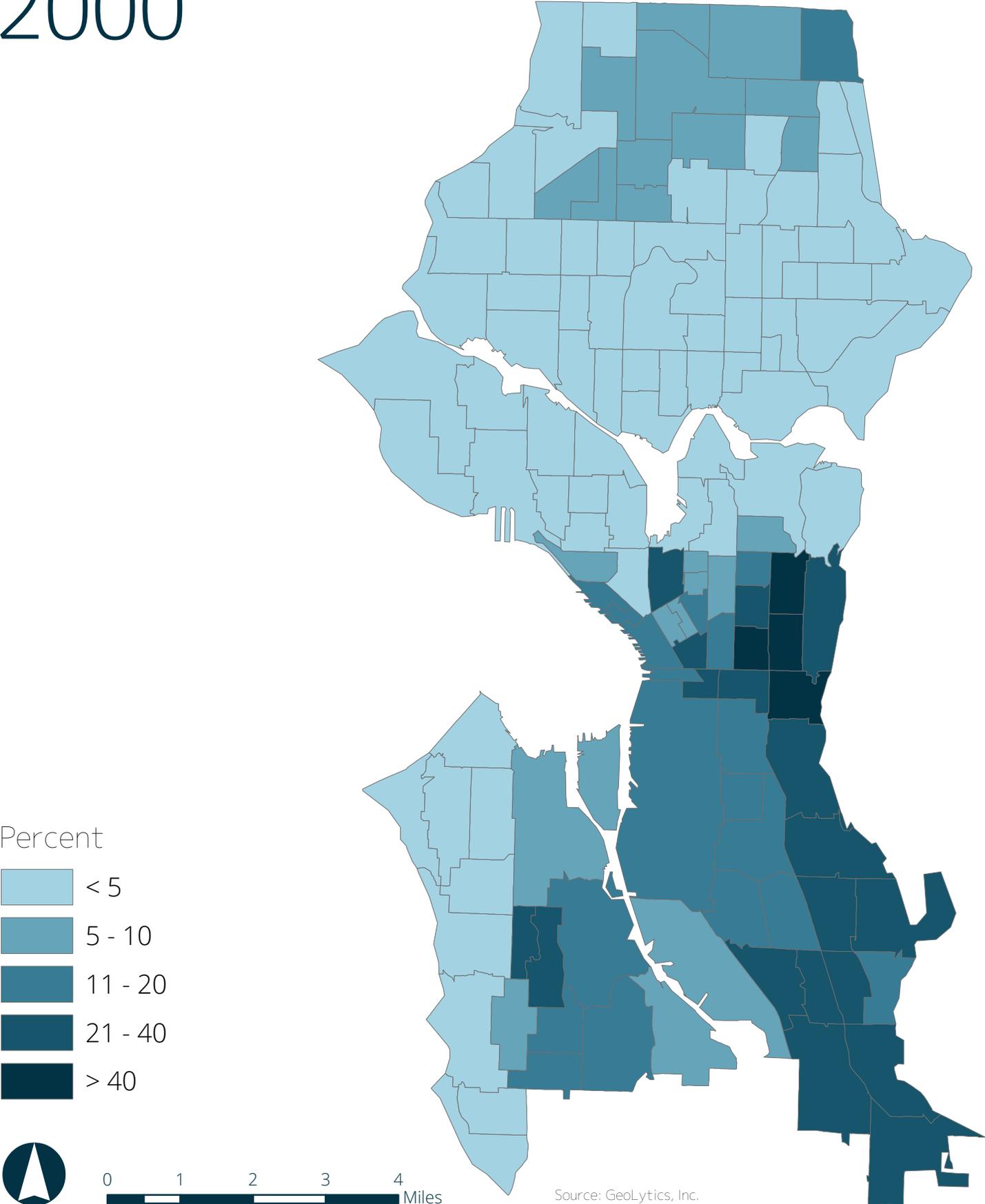


Figure 45: Black residents by tract

# 2000



**Figure 46:** Black or African American residents by tract  
2010

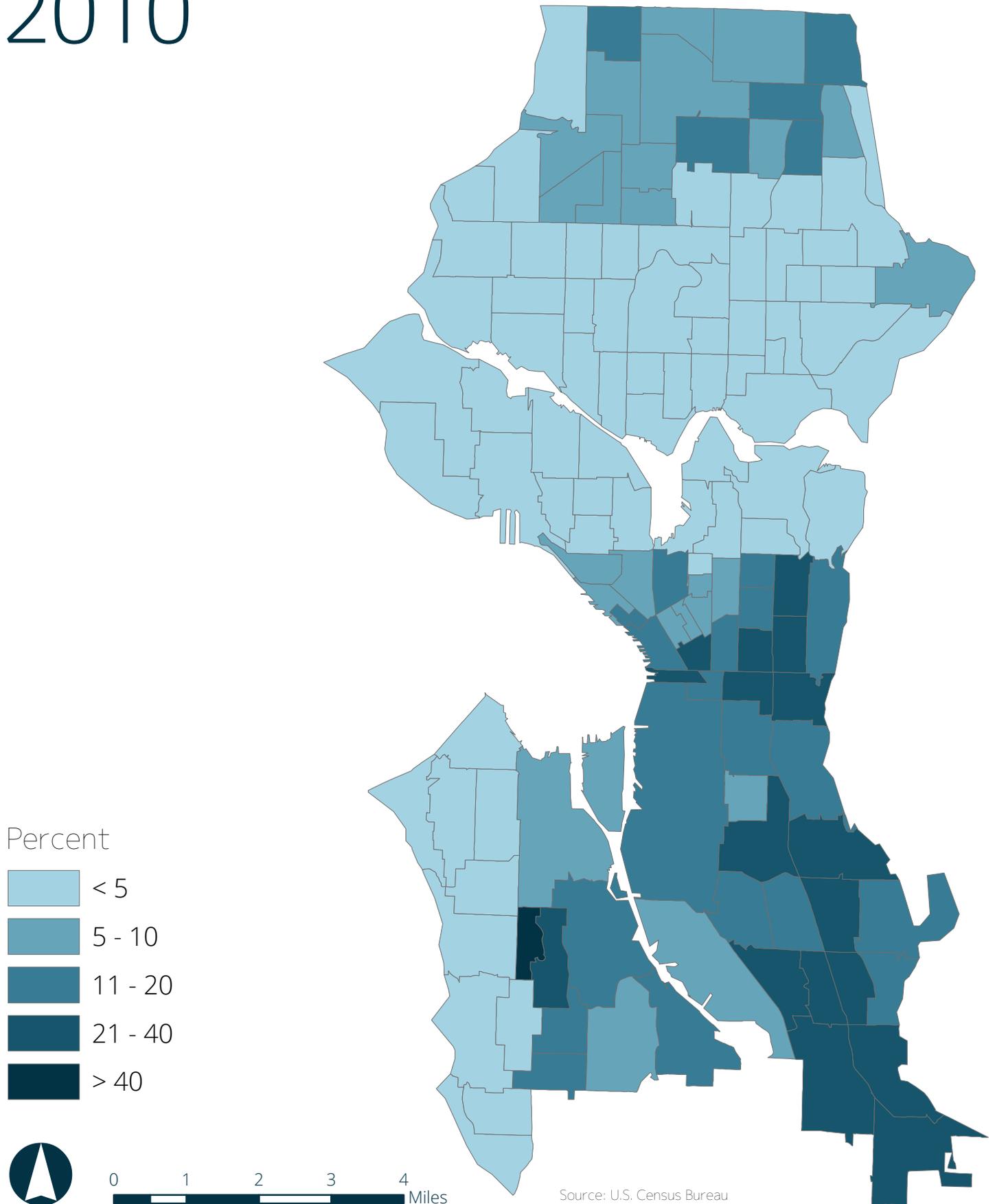


Figure 47: Hispanic residents by tract

# 1970

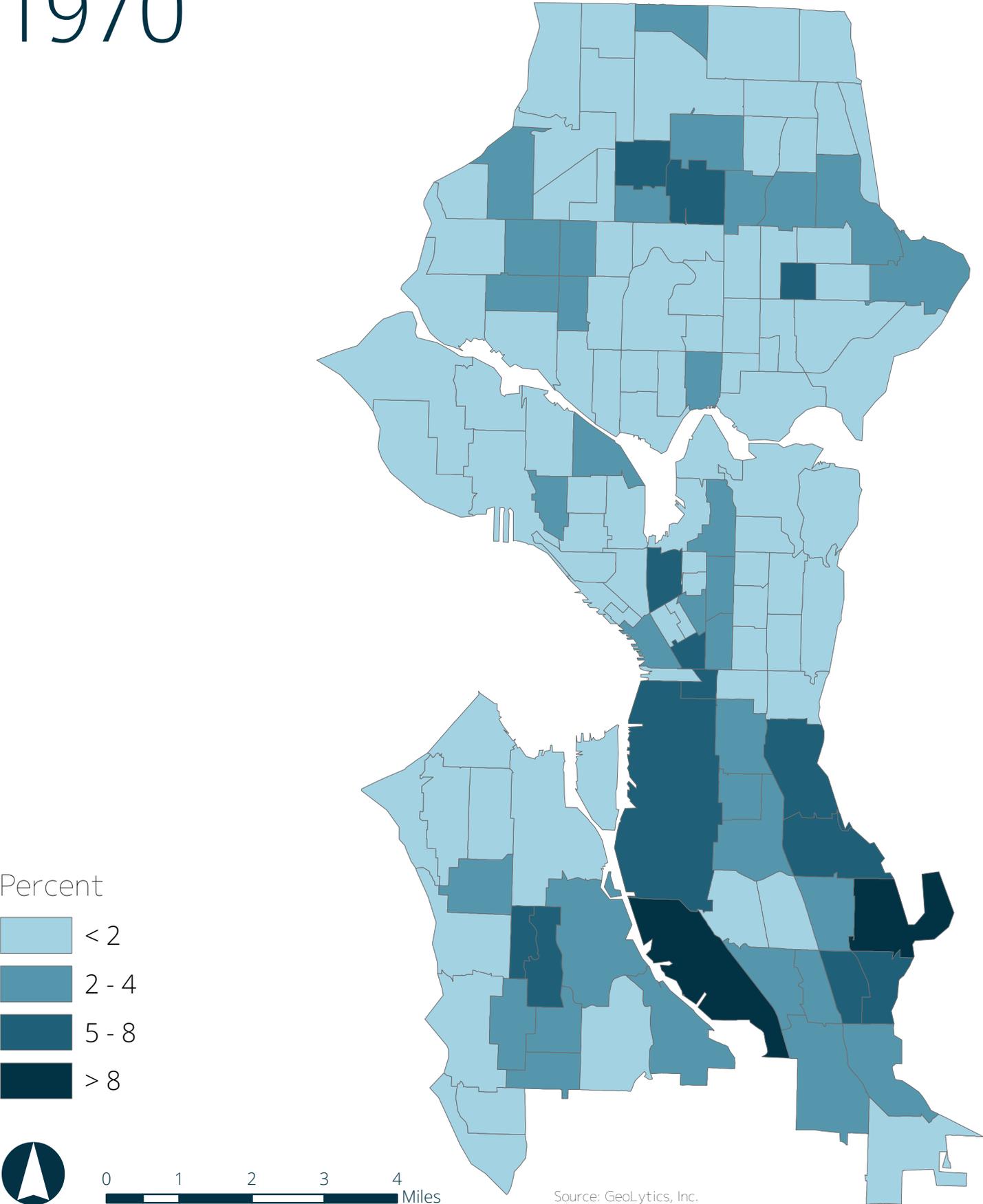


Figure 48: Hispanic residents by tract

1980

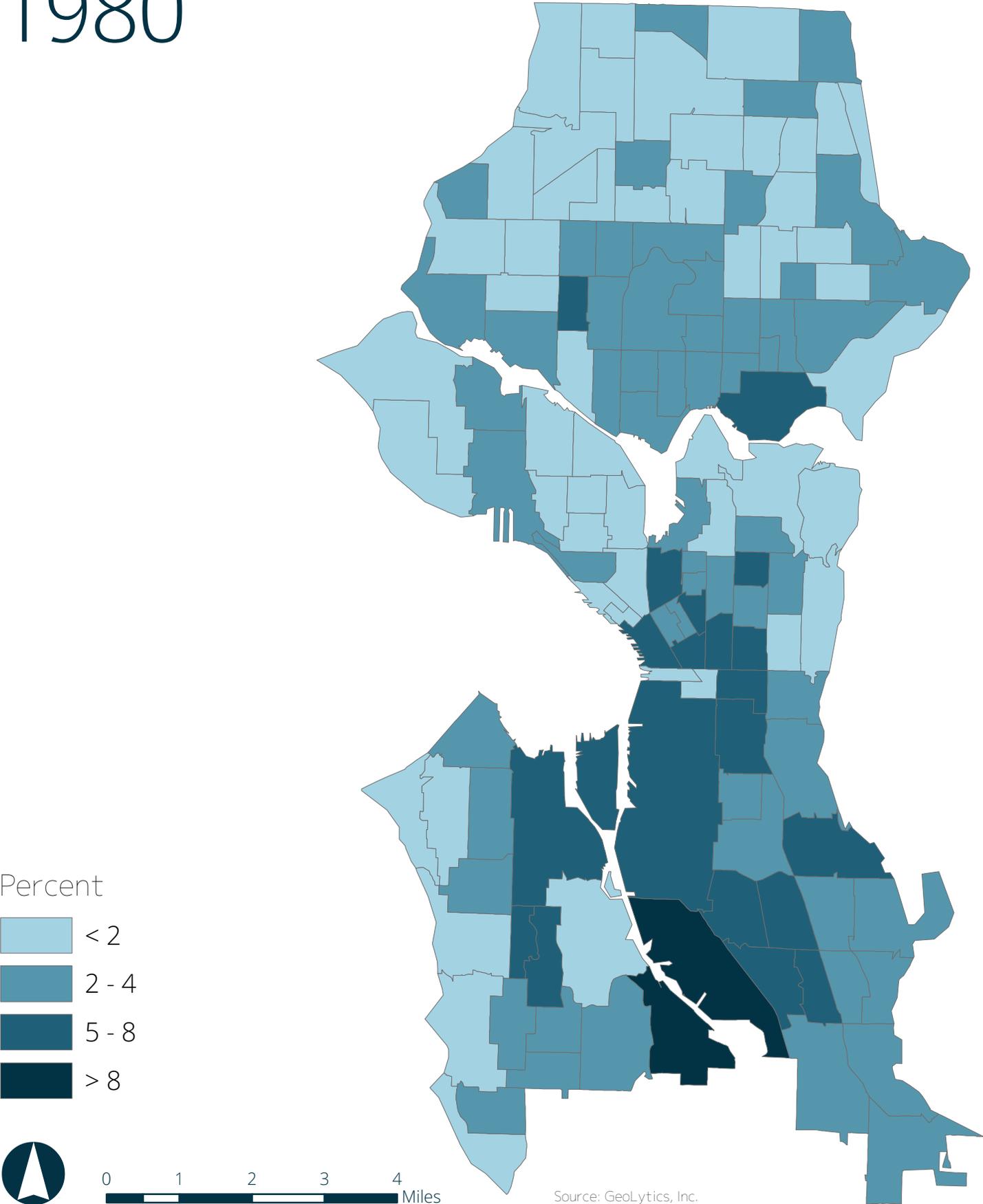


Figure 49: Hispanic residents by tract

1990

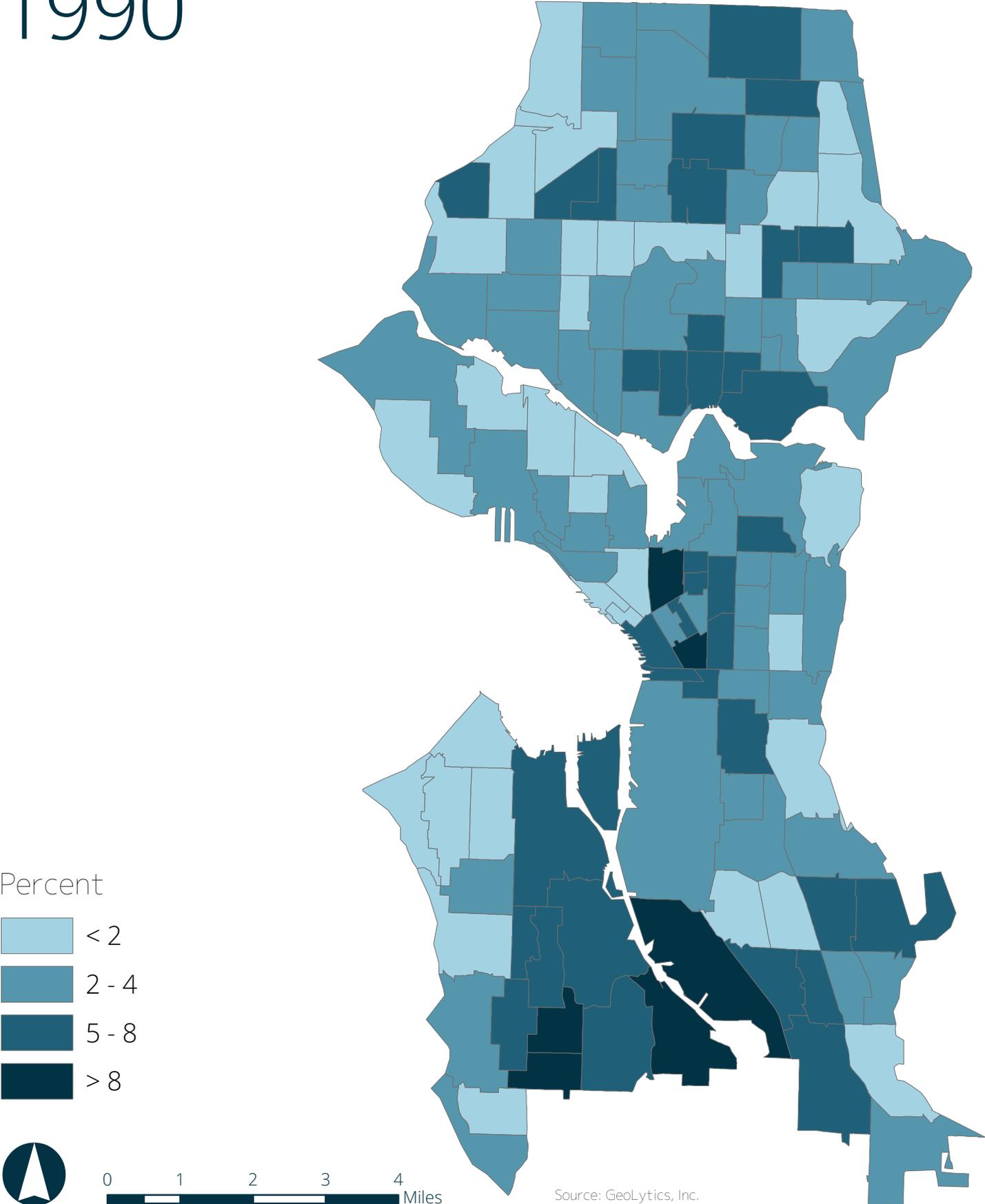


Figure 50: Hispanic residents by tract

2000

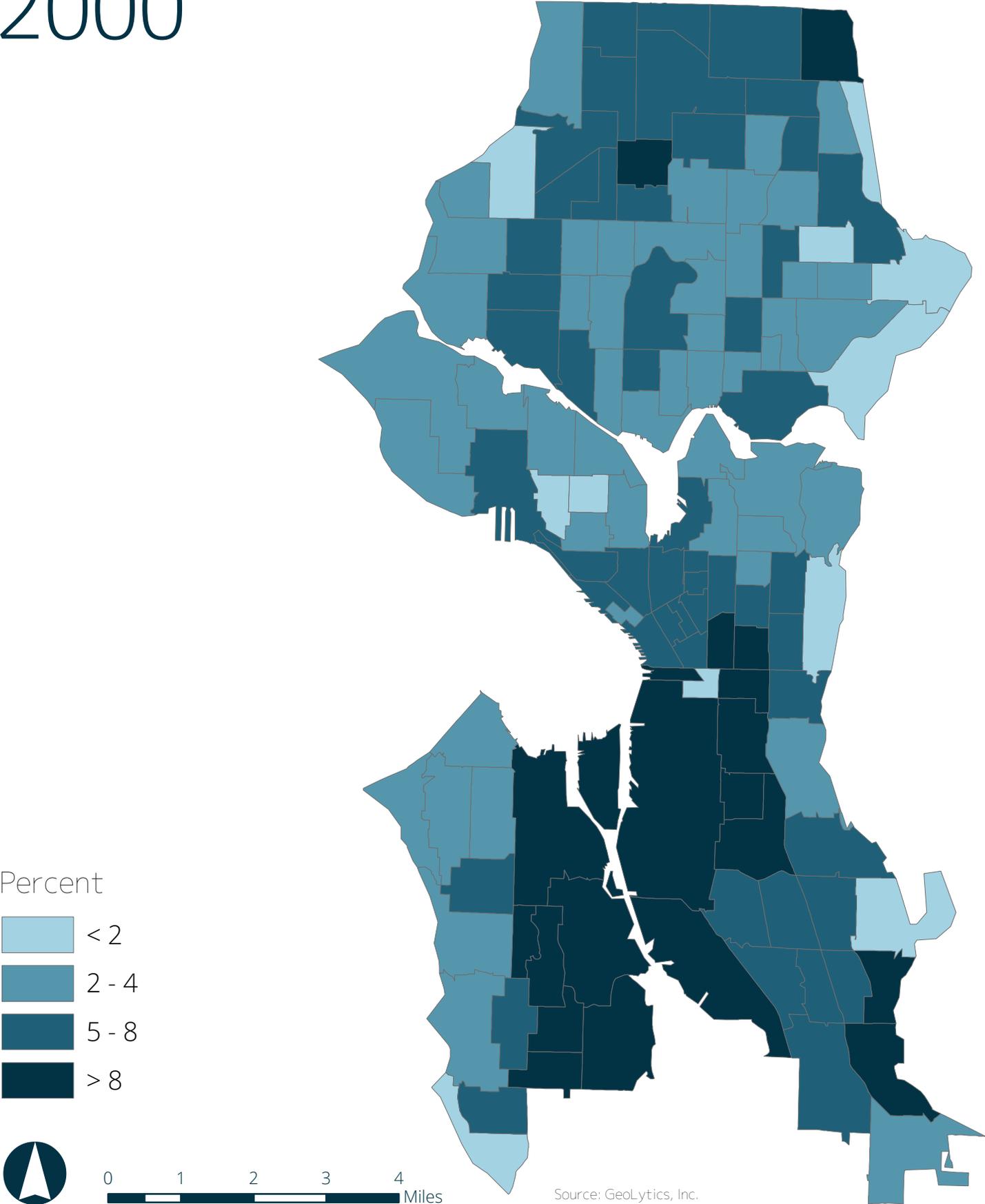


Figure 51: Hispanic or Latino residents by tract

# 2010

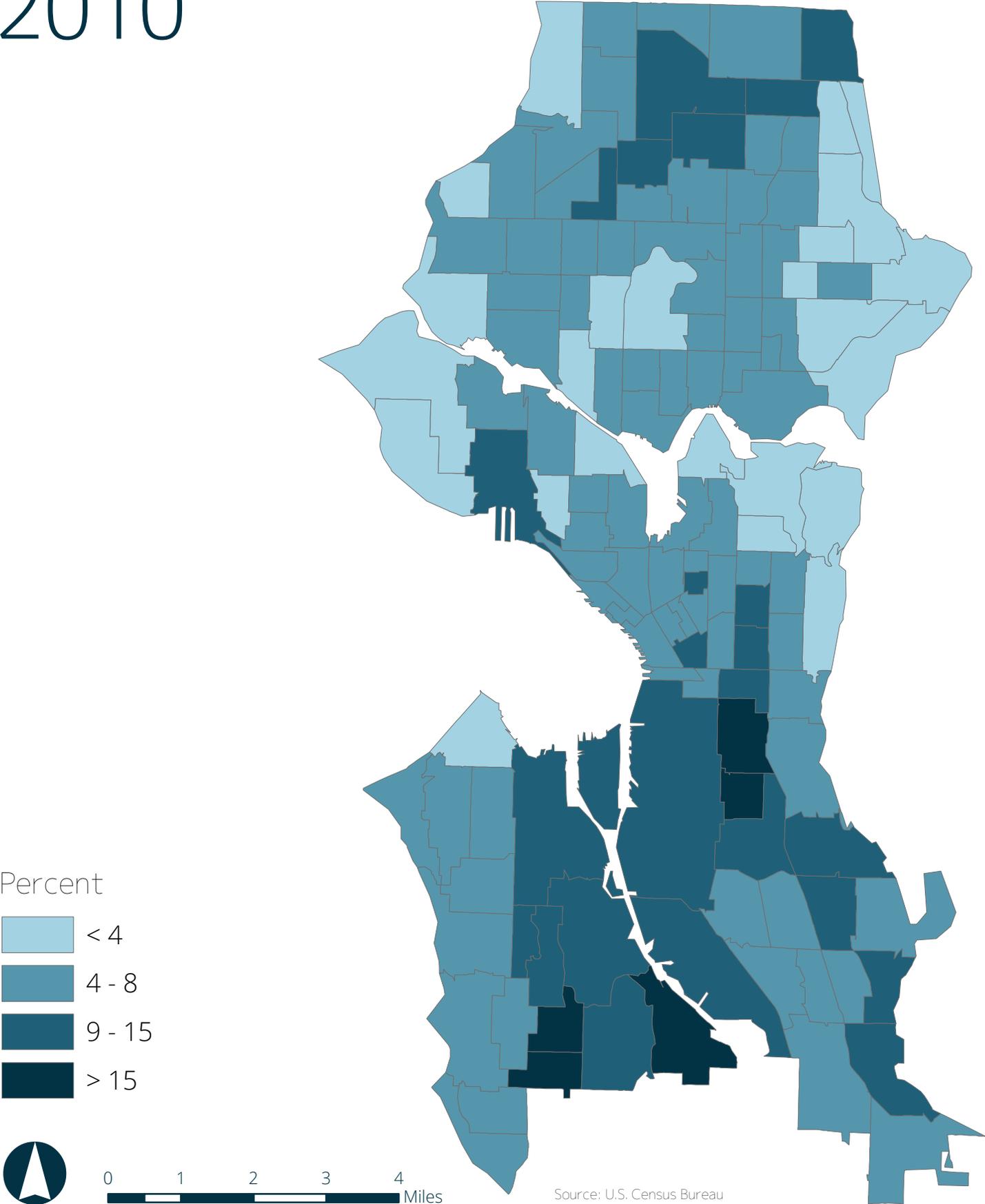


Figure 52: Nonwhite residents by tract

2000

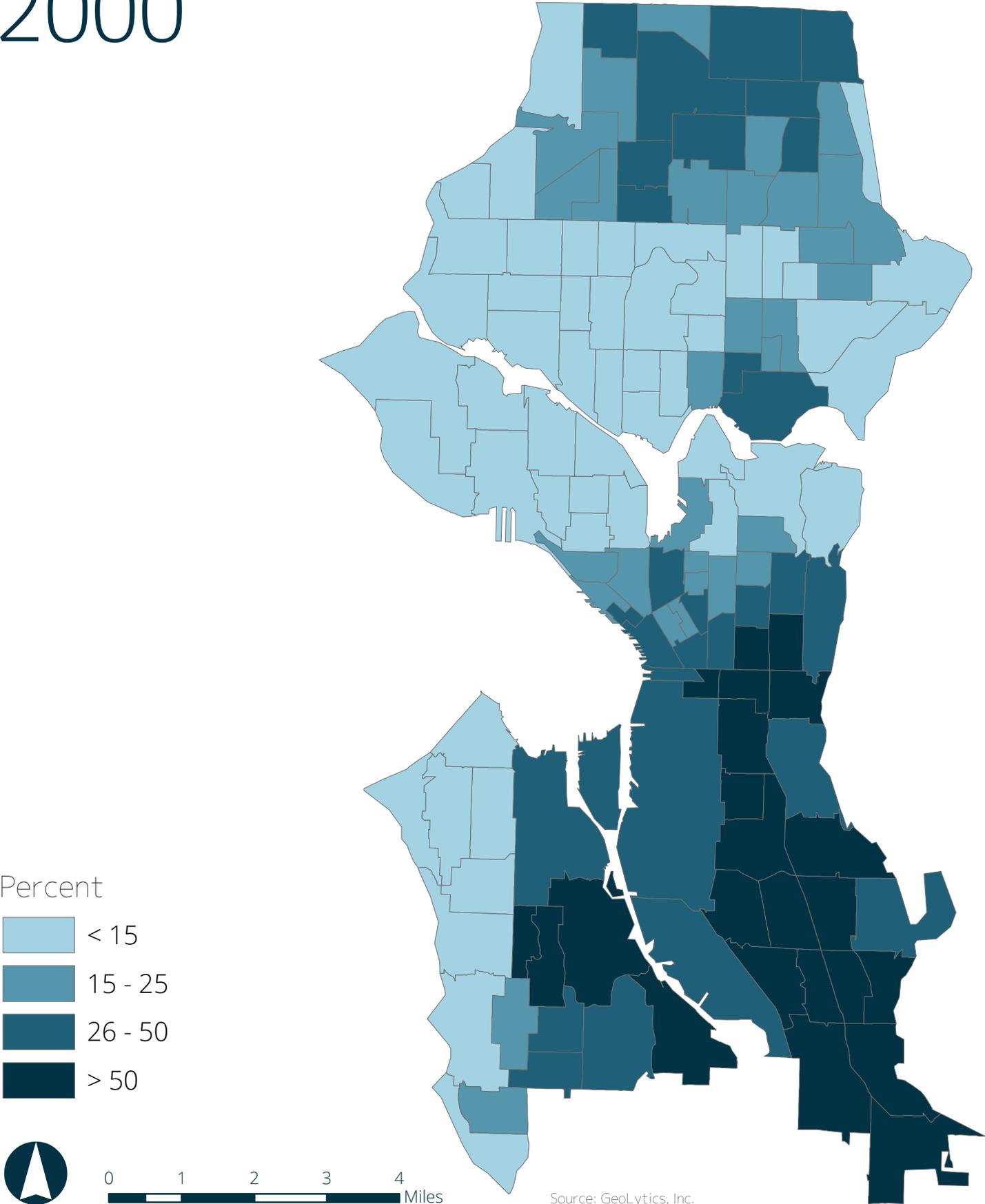
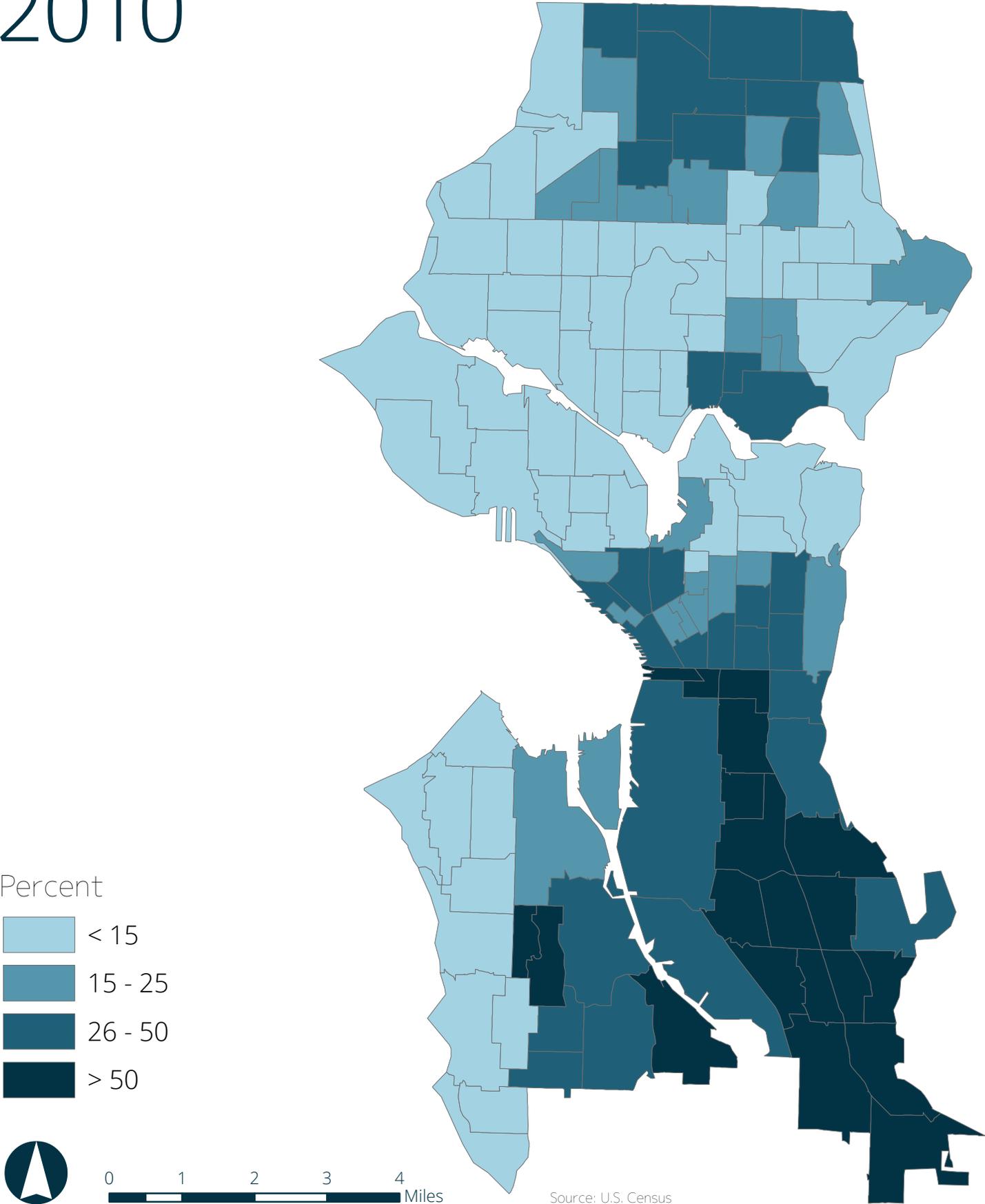
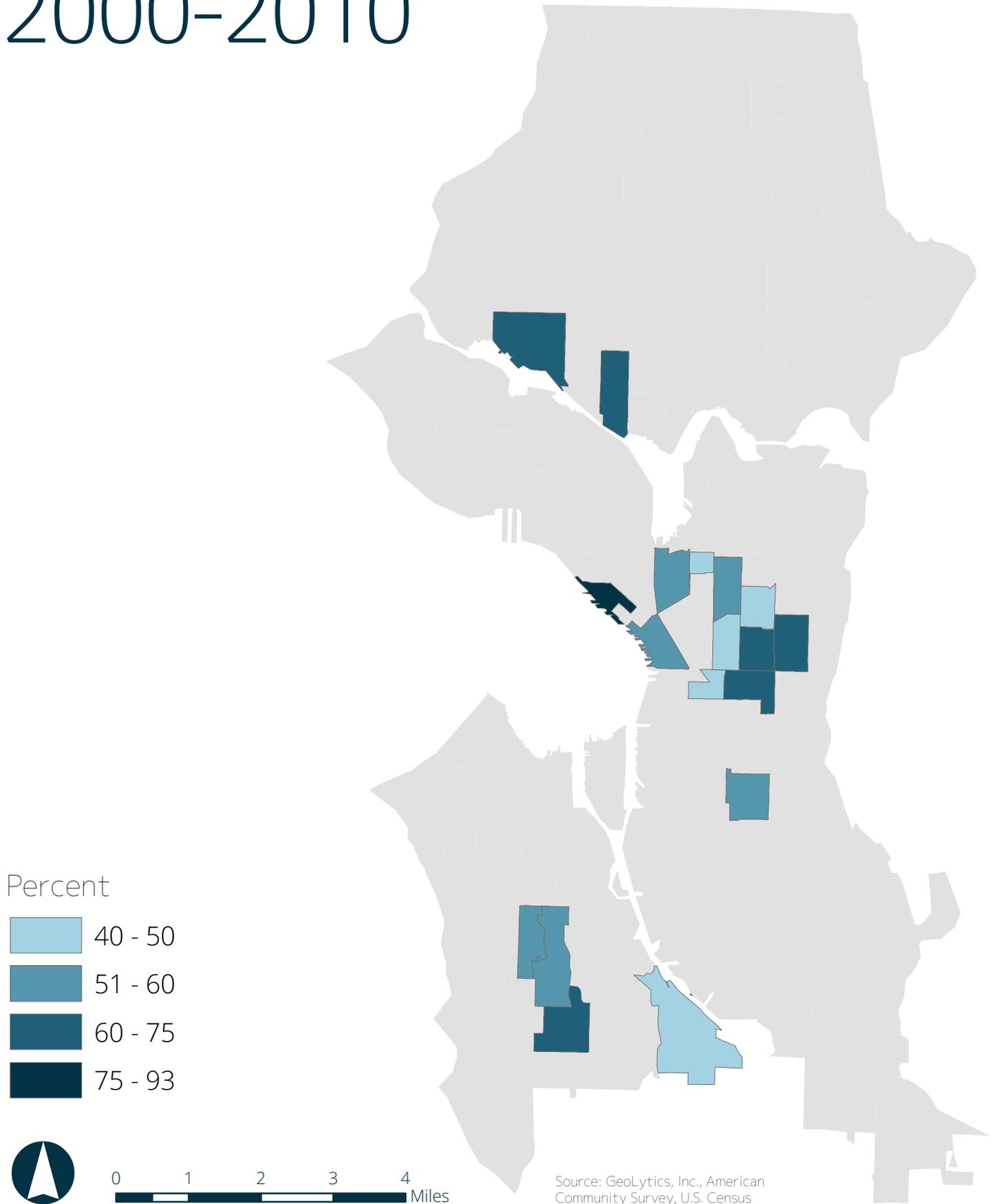


Figure 53: Nonwhite residents by tract

2010



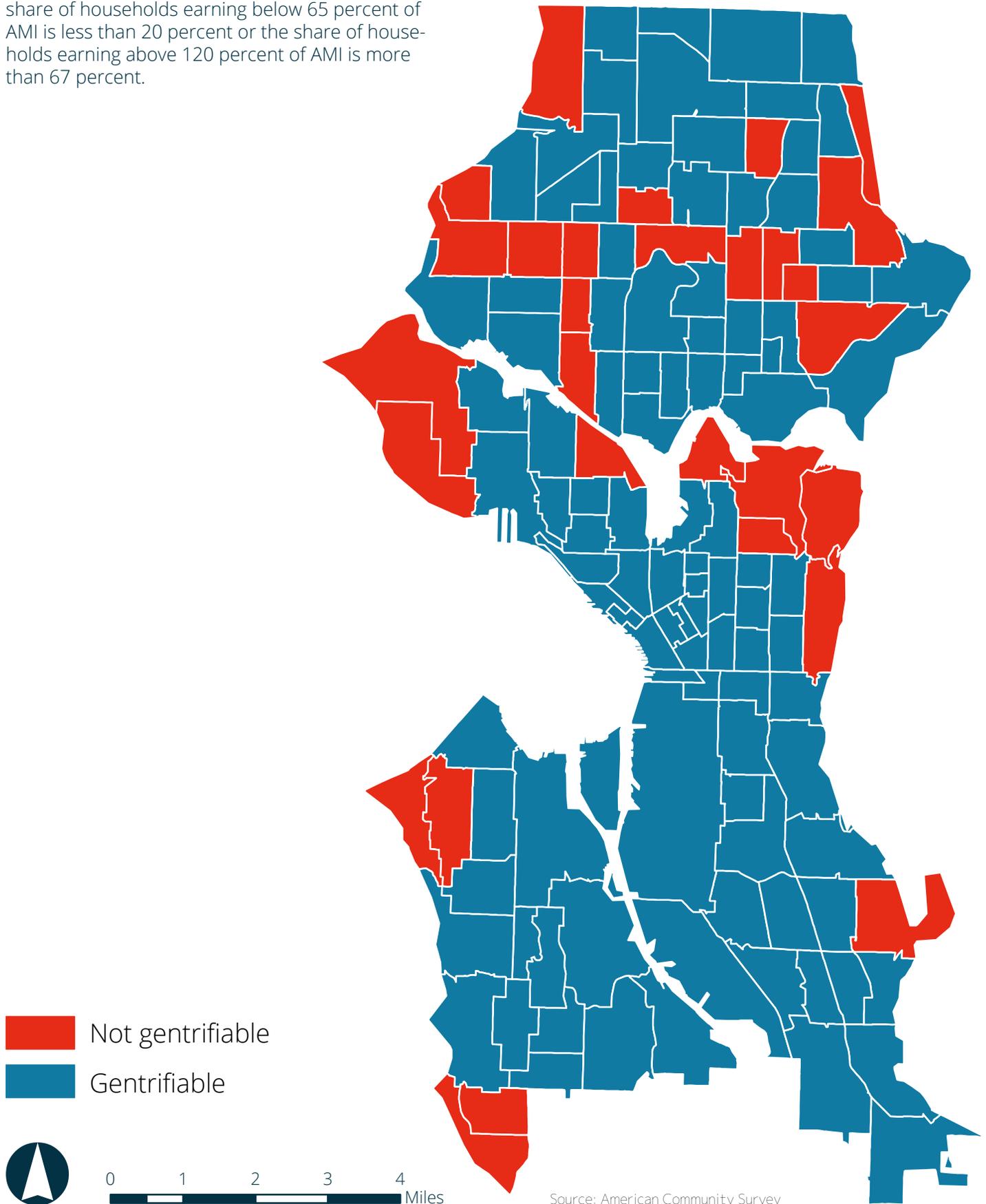
# Figure 54: Median household income growth in gentrified tracts 2000-2010



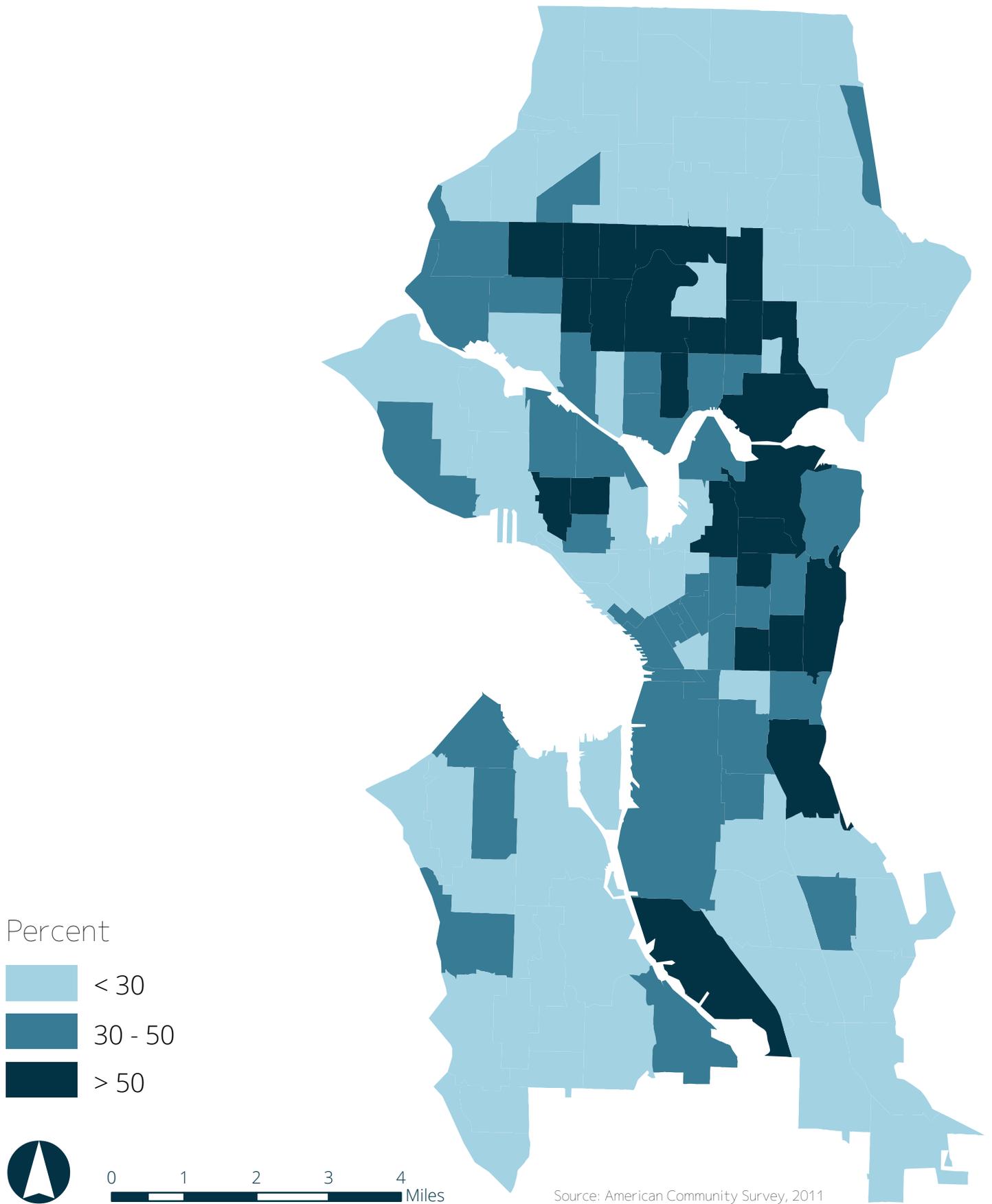
# APPENDIX B: GENTRIFICATION SUSCEPTIBILITY INDICATORS

## Figure 55: Eligibility for gentrification

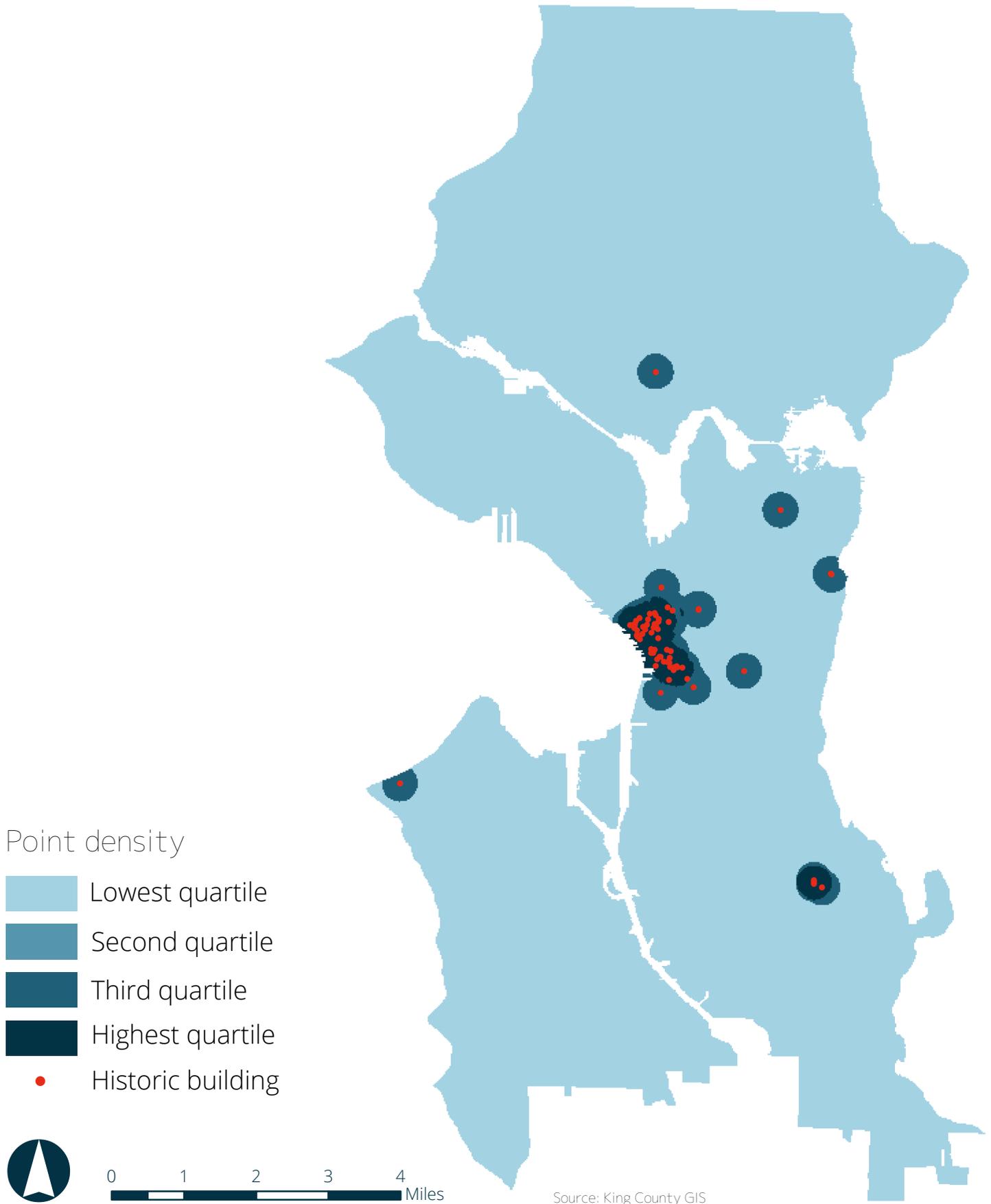
Non-gentrifiable tracts are those where either the share of households earning below 65 percent of AMI is less than 20 percent or the share of households earning above 120 percent of AMI is more than 67 percent.



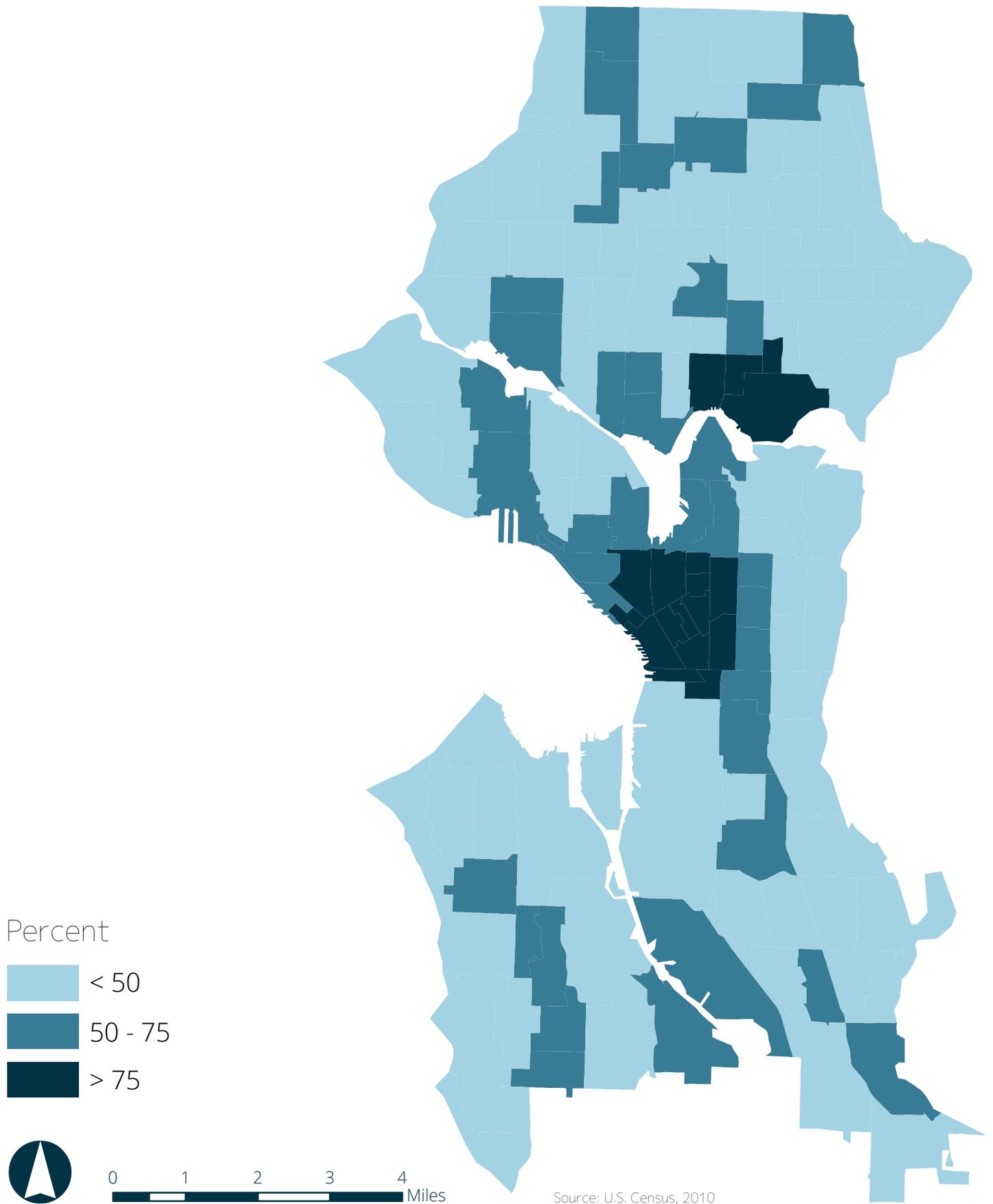
**Figure 56:** Concentration of pre-1940 housing



**Figure 57:** Concentration of historic buildings

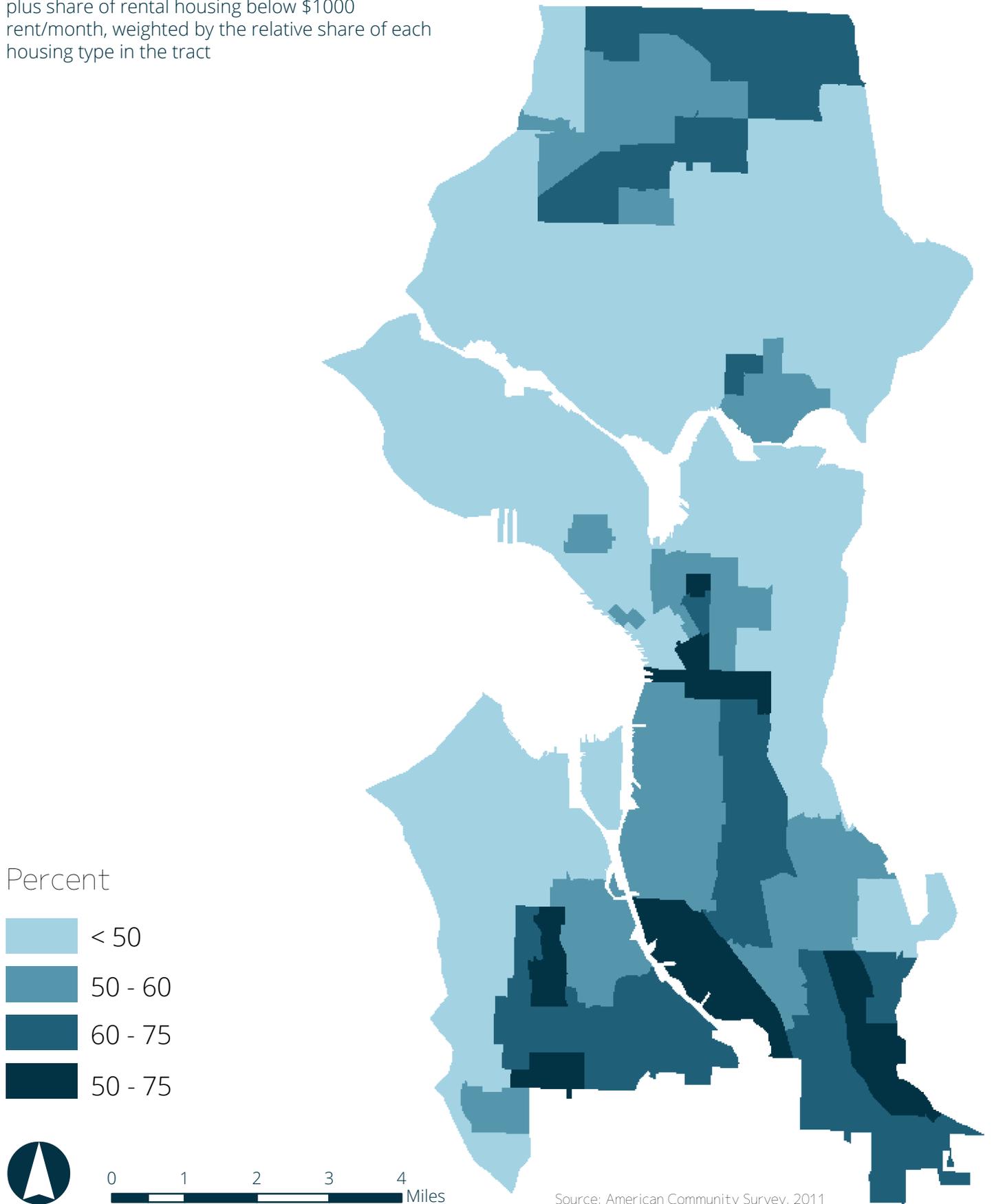


**Figure 58:** Concentration of renter-occupied housing



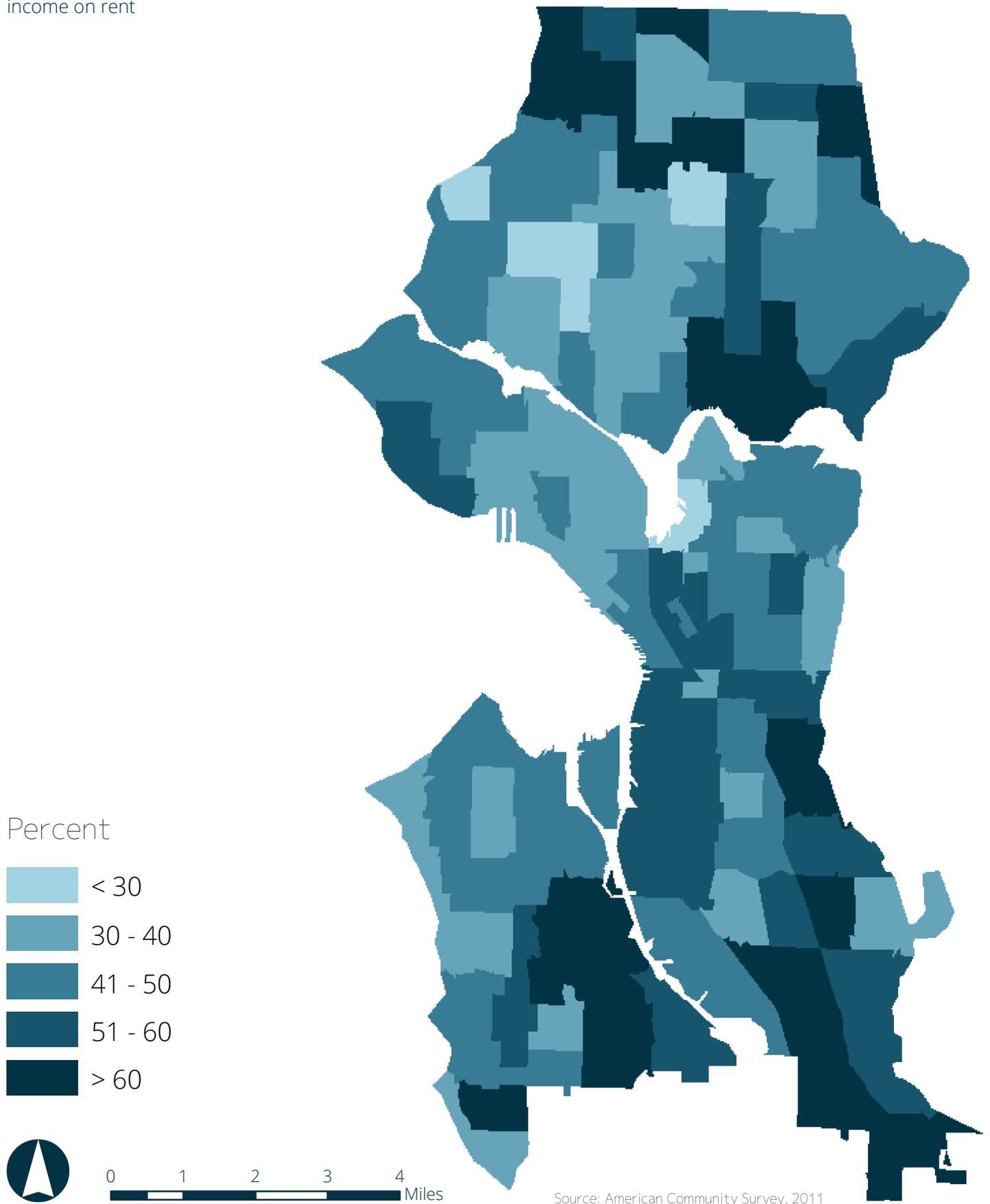
## Figure 59: Low dwelling value

Share of owner-occupied housing below \$400,000 plus share of rental housing below \$1000 rent/month, weighted by the relative share of each housing type in the tract

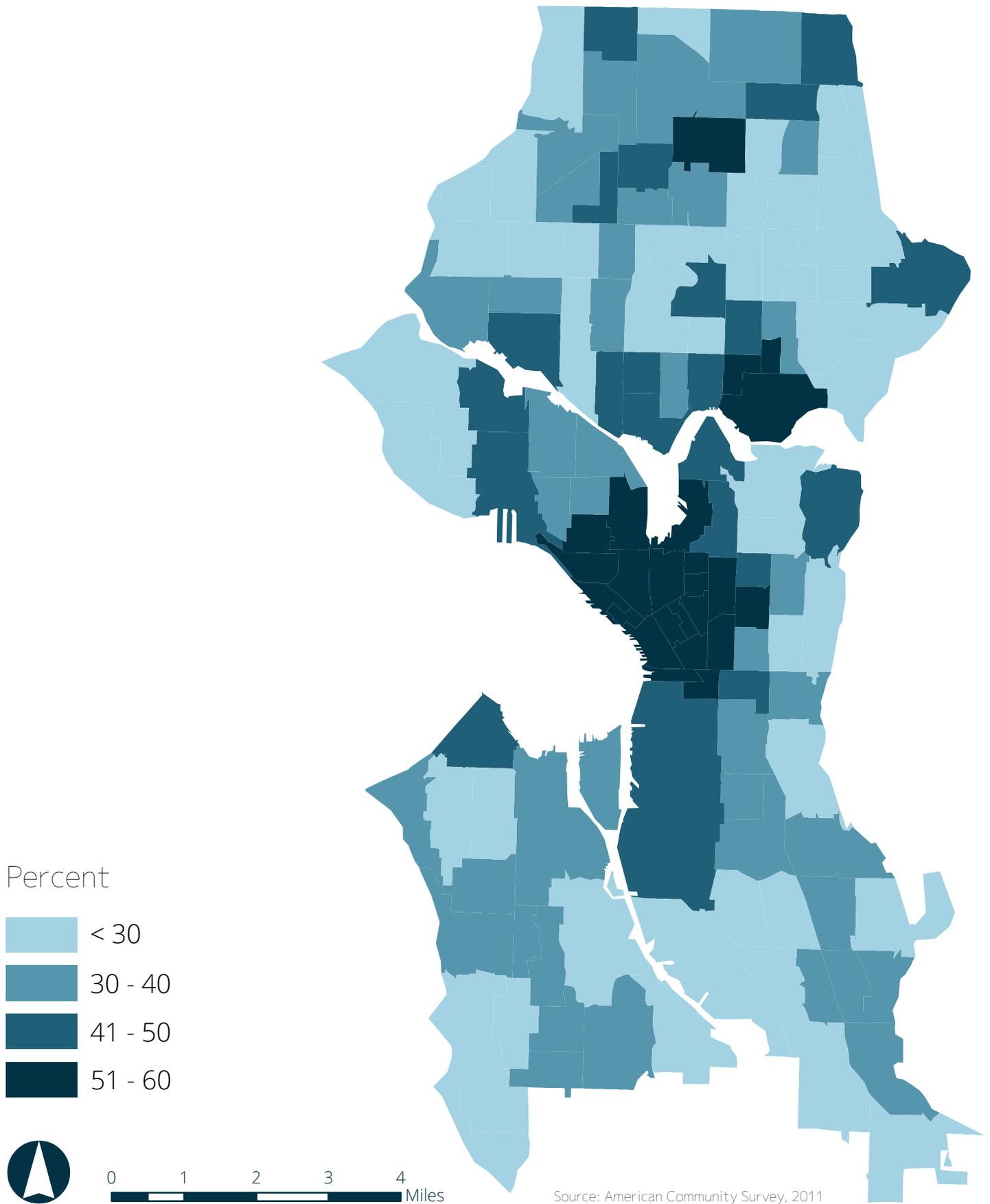


## Figure 60: Rent burden

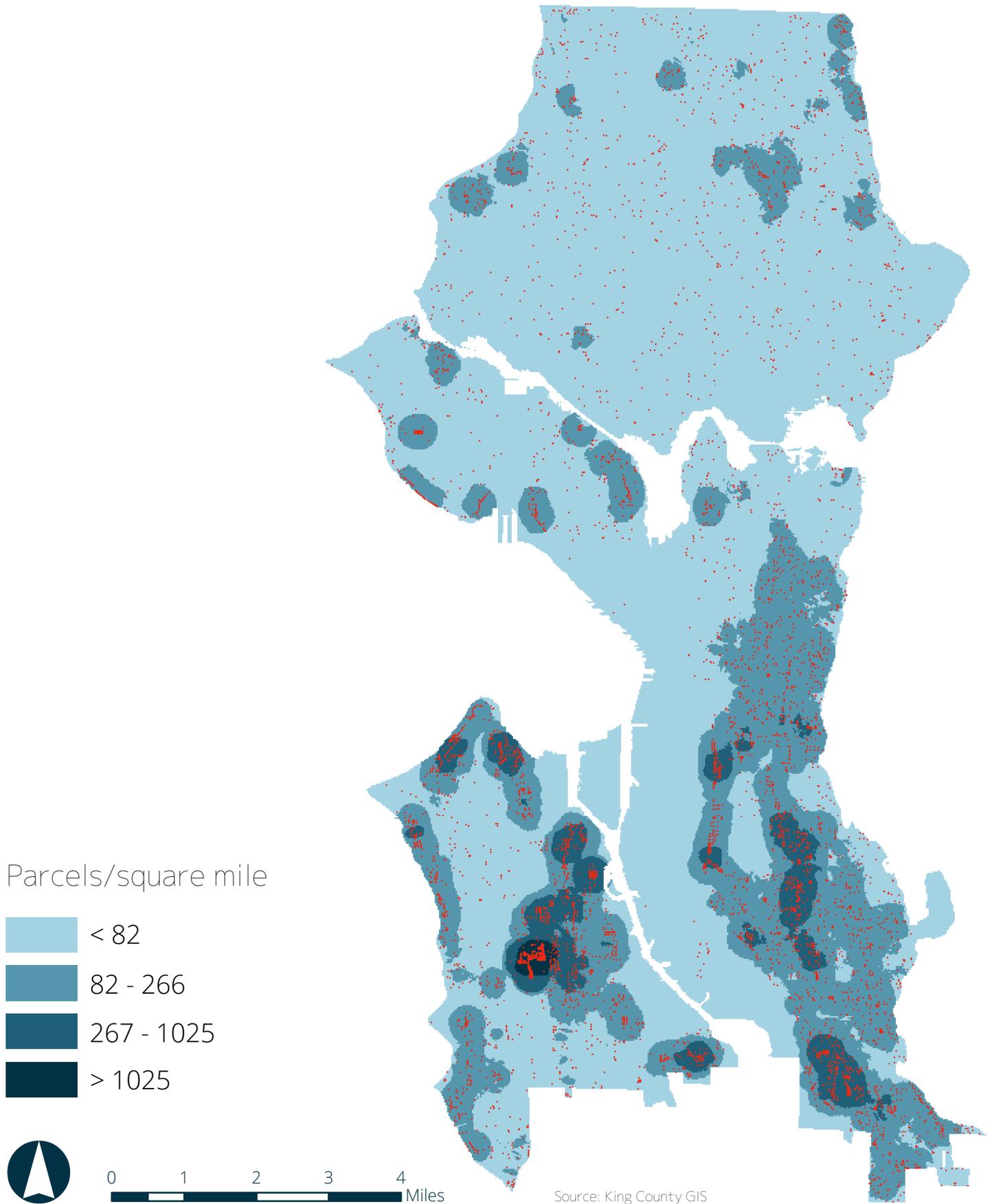
Share of households paying over 30 percent of income on rent



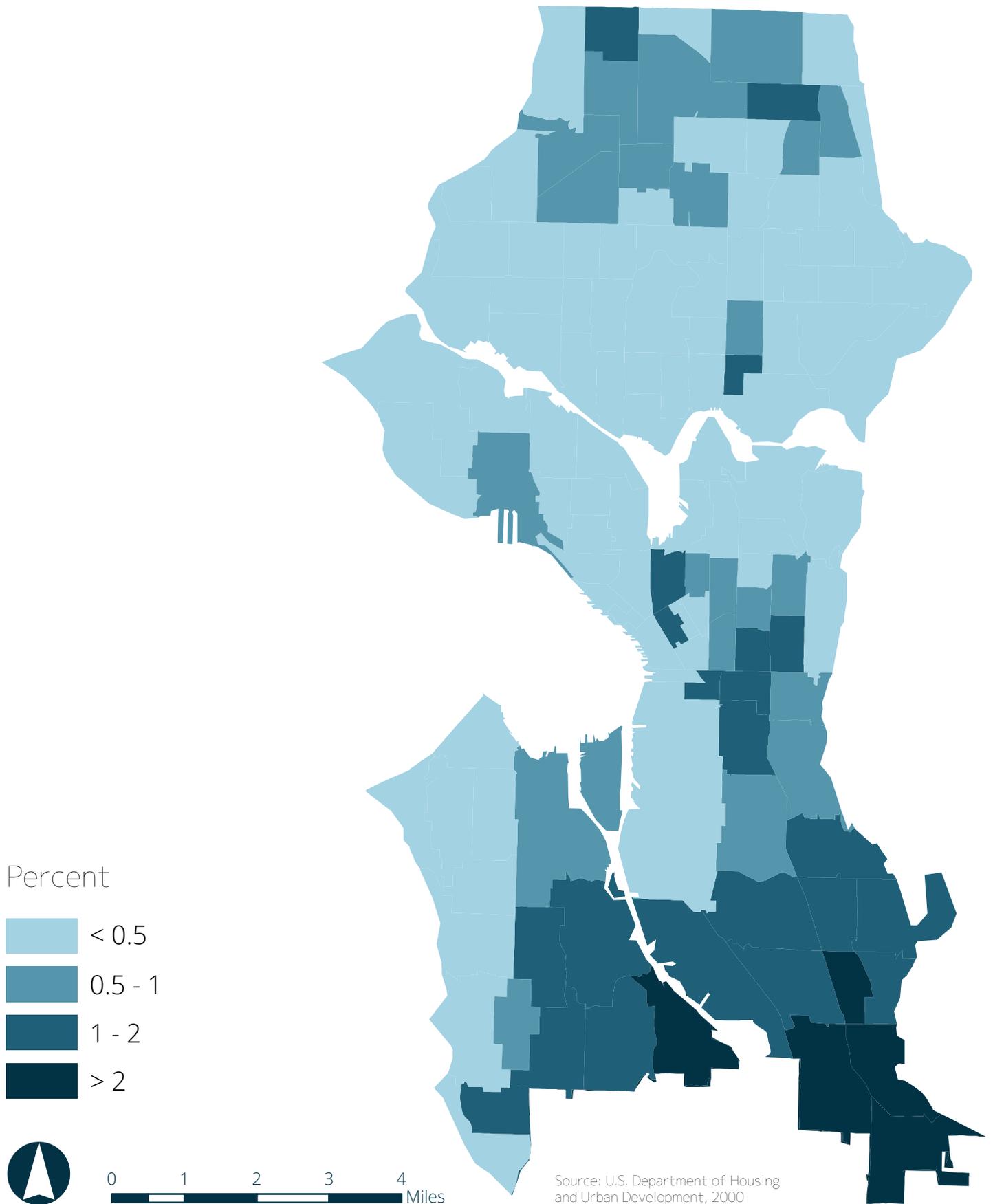
**Figure 61:** Share of buildings with 3 or more units



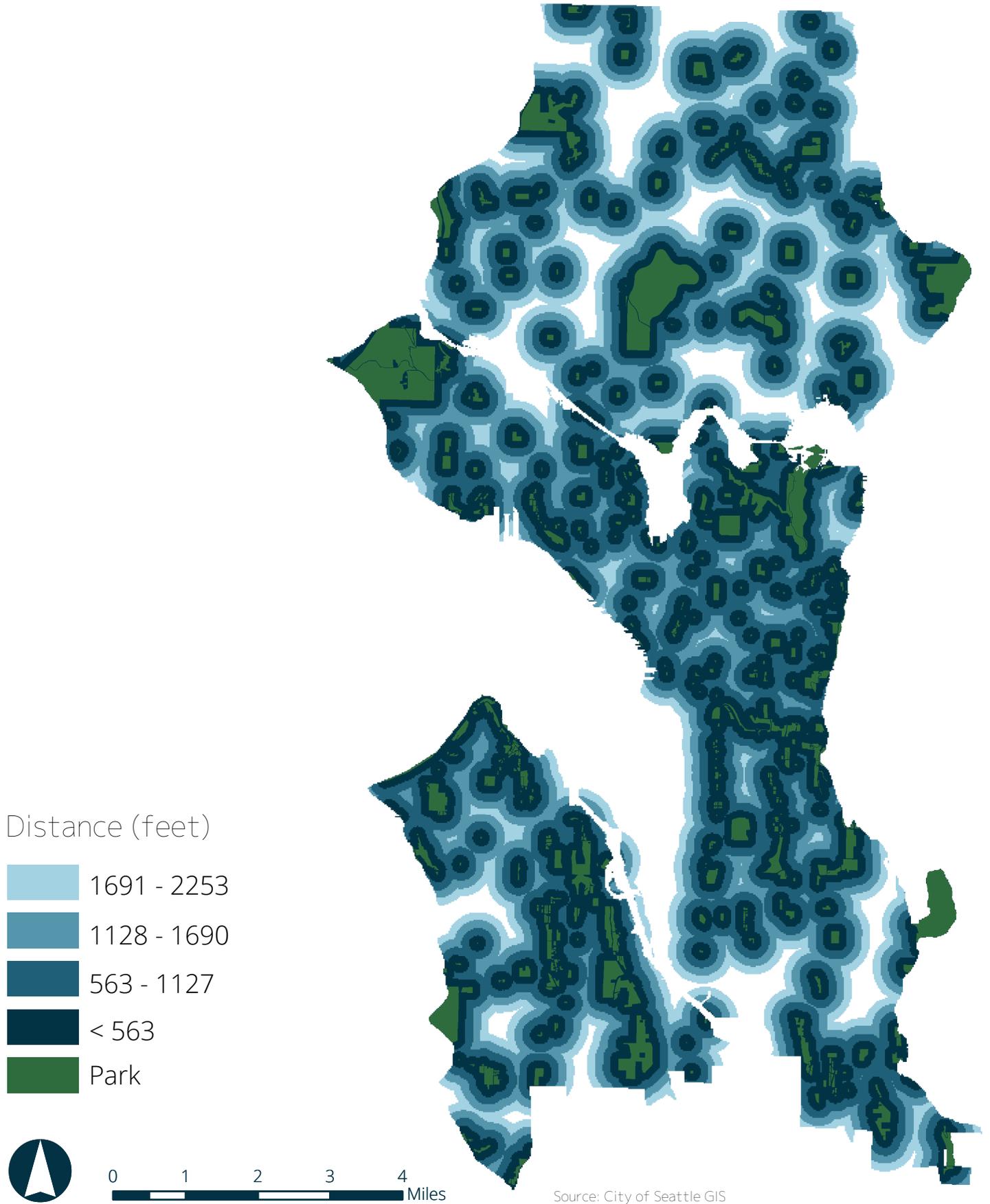
**Figure 62:** Residential vacancy in surrounding quarter-mile



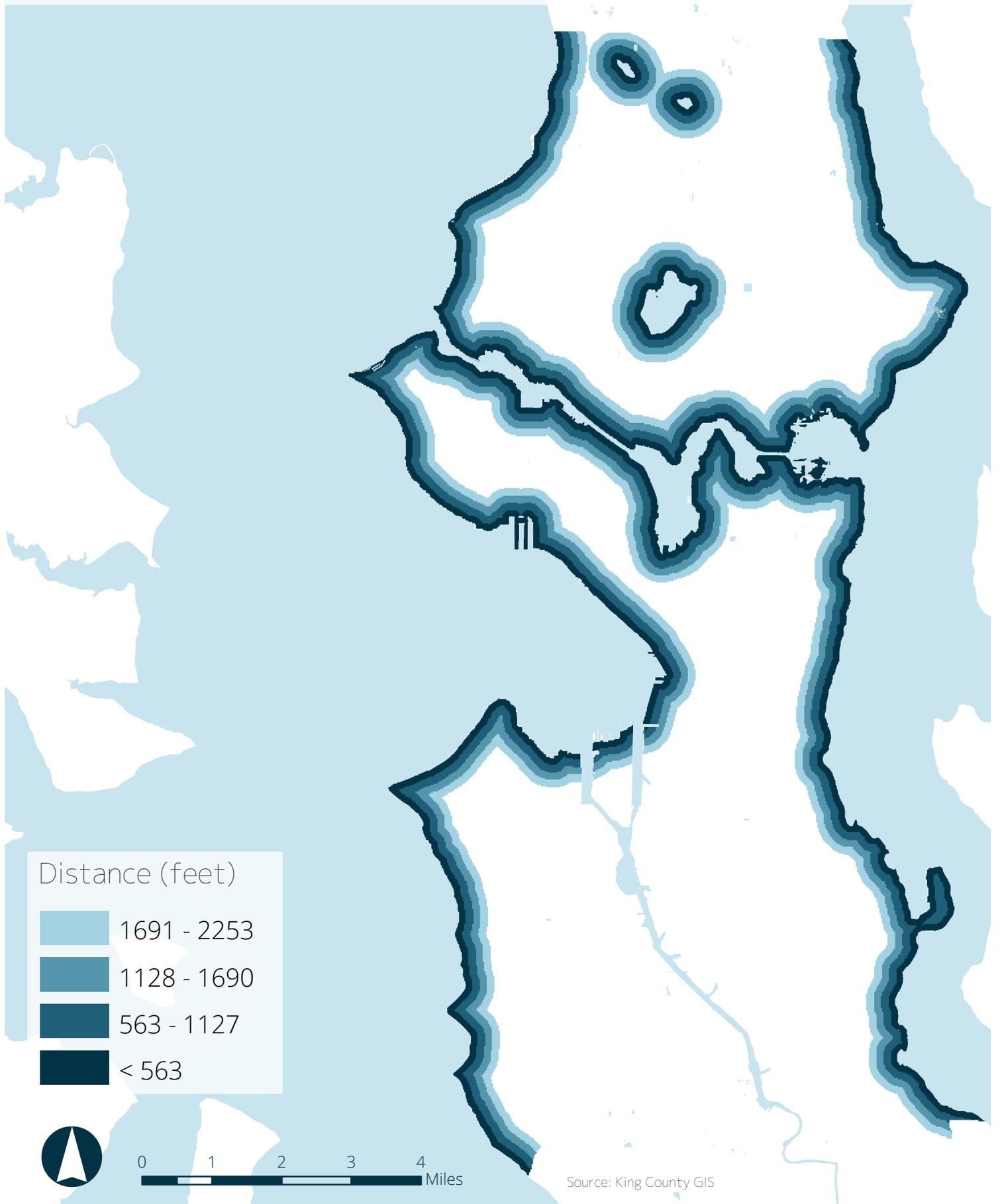
**Figure 63:** Foreclosure rate (2000 HUD data)



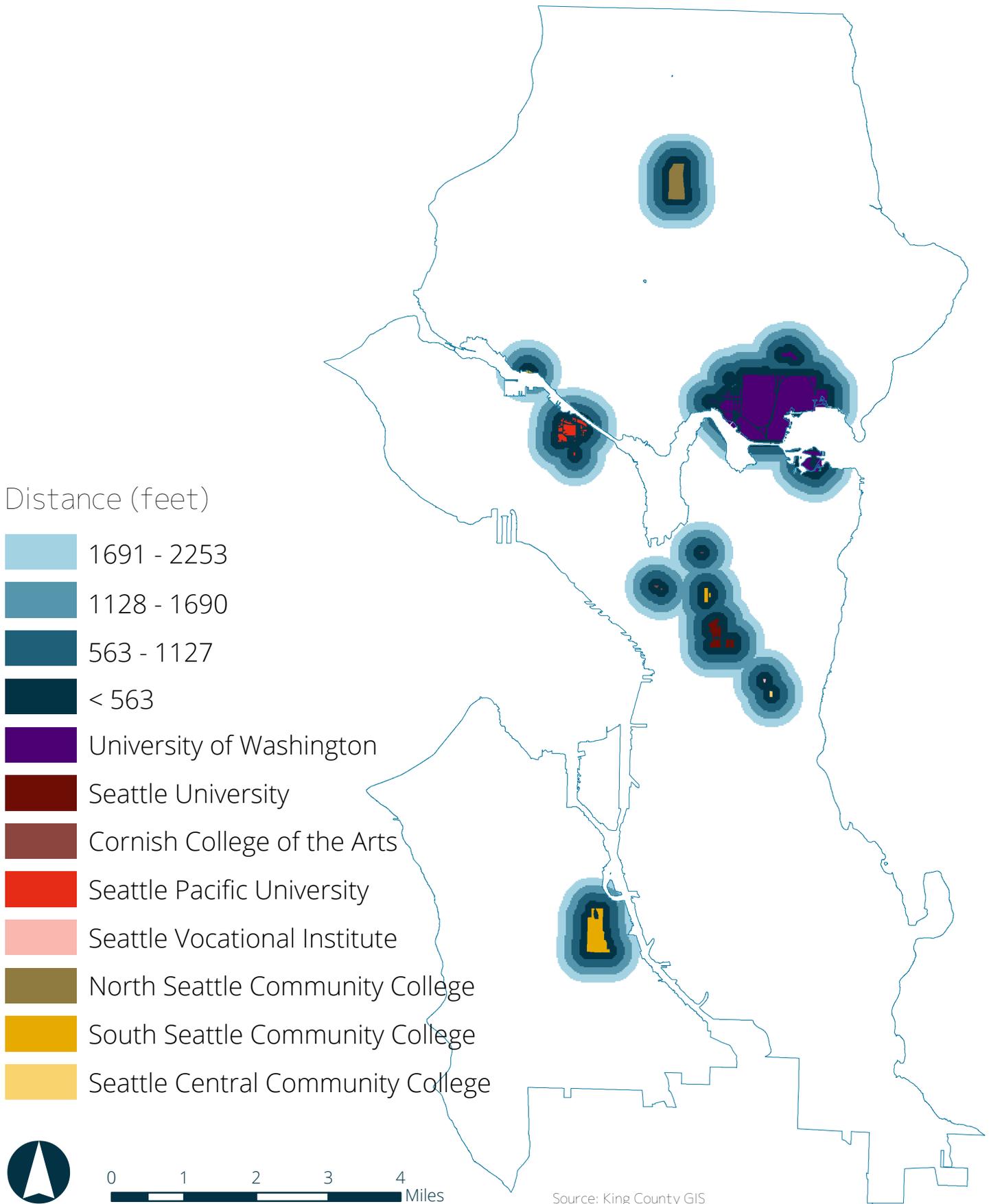
**Figure 64:** Proximity to parks and open space



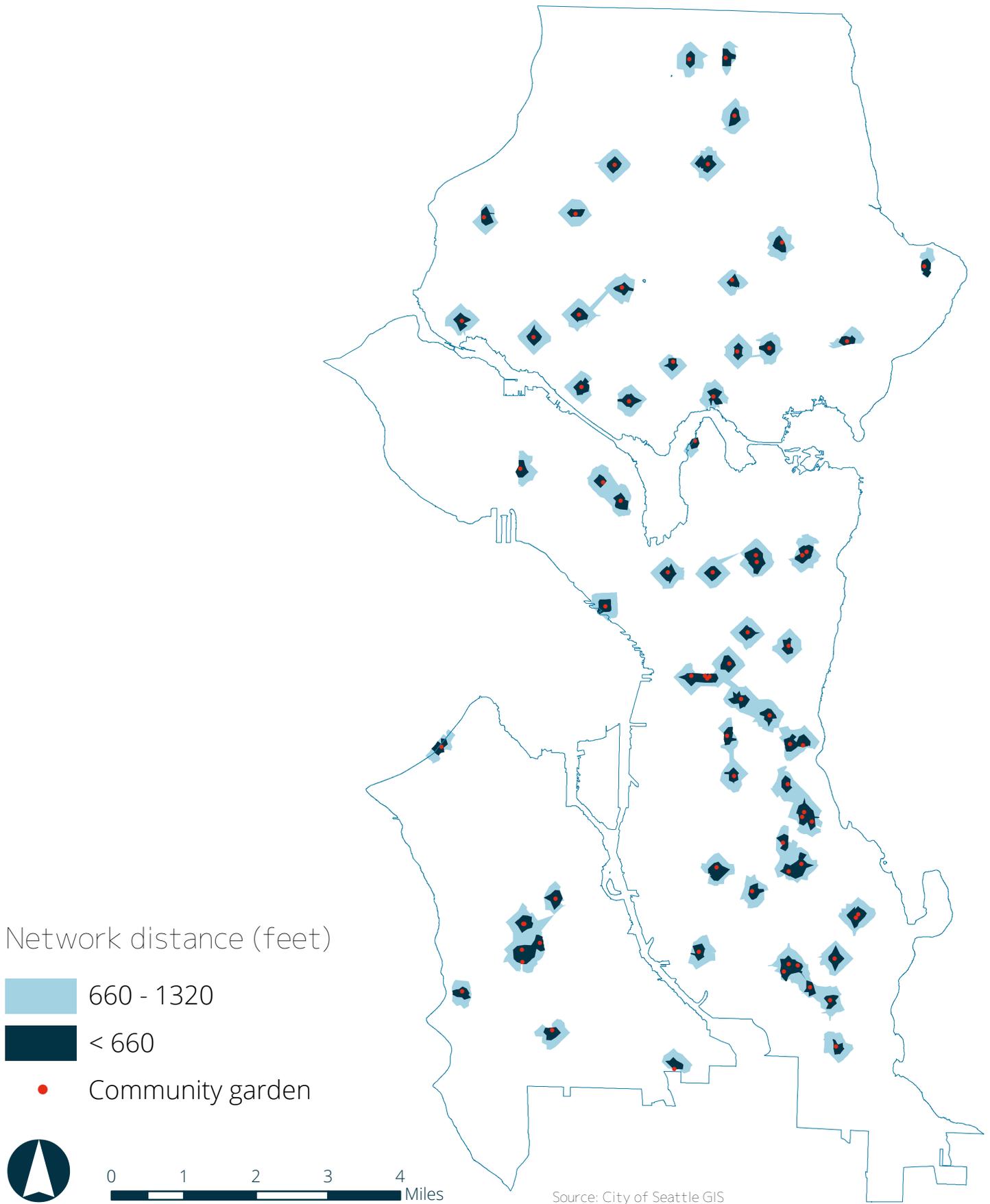
**Figure 65:** Proximity to the waterfront



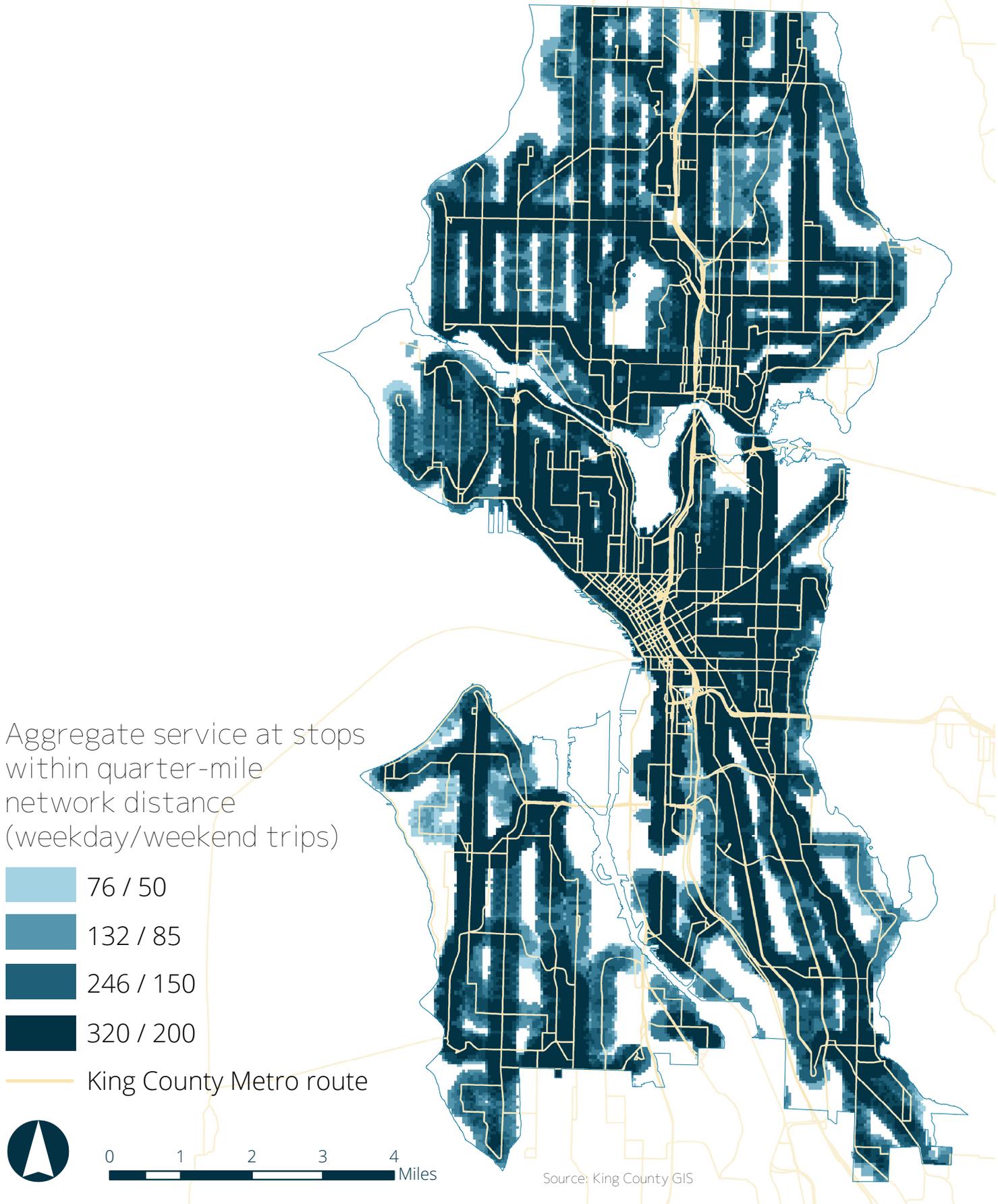
**Figure 66:** Proximity to a college or university



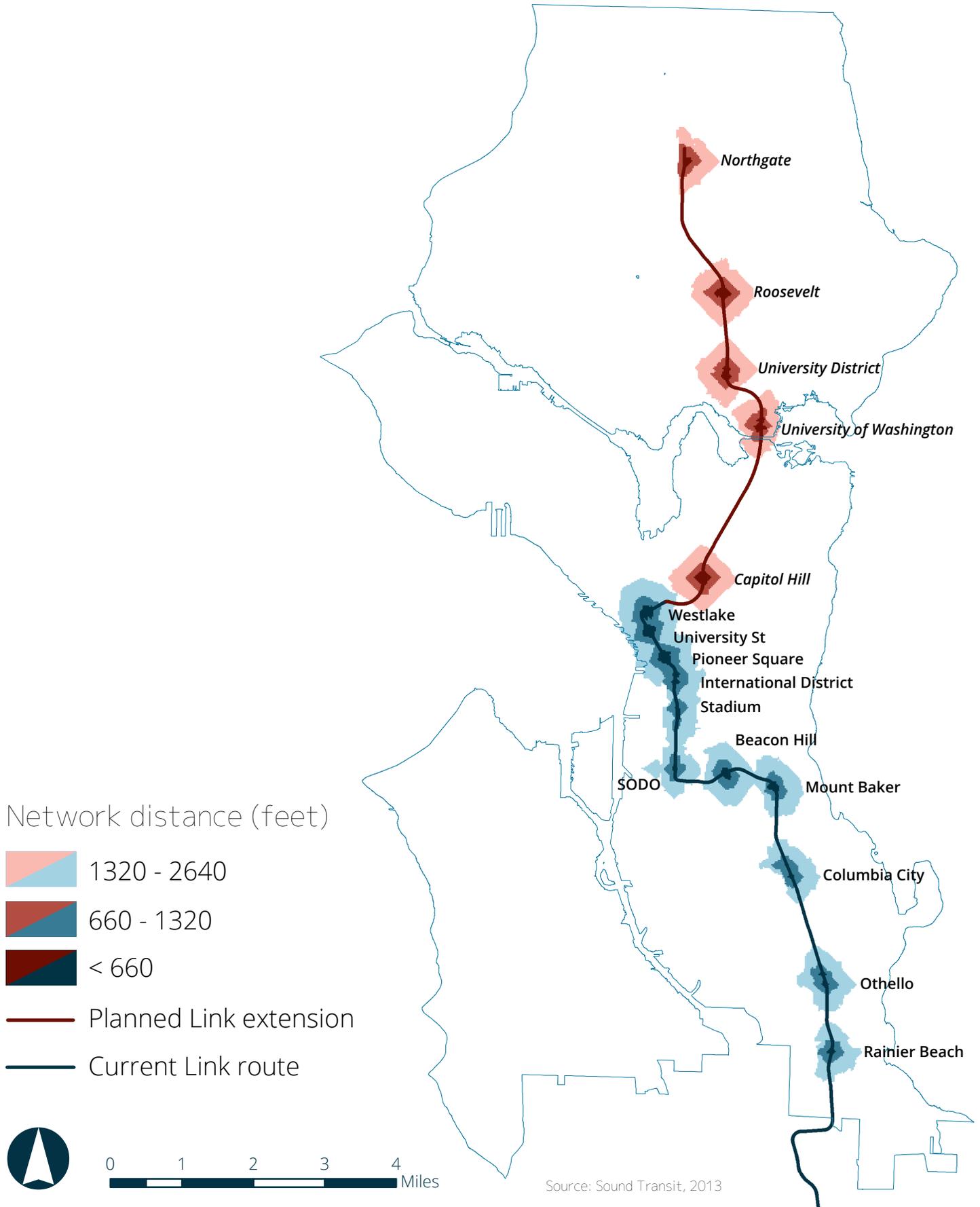
**Figure 67:** Proximity to a community garden



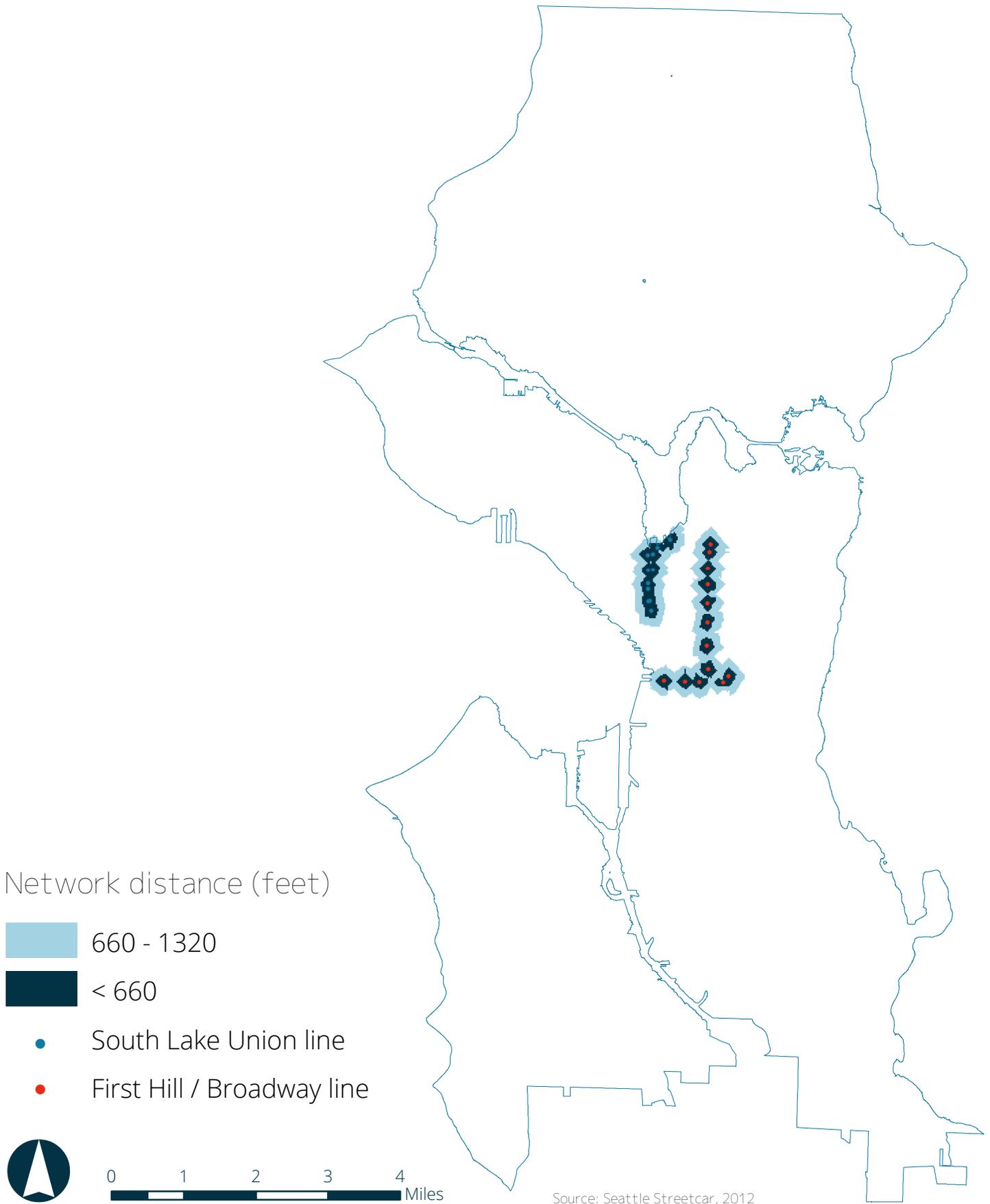
**Figure 68:** Proximity to high-quality bus service



**Figure 69:** Proximity to Link light rail station



**Figure 70:** Proximity to streetcar station



**Figure 71:** Location in an Urban Village

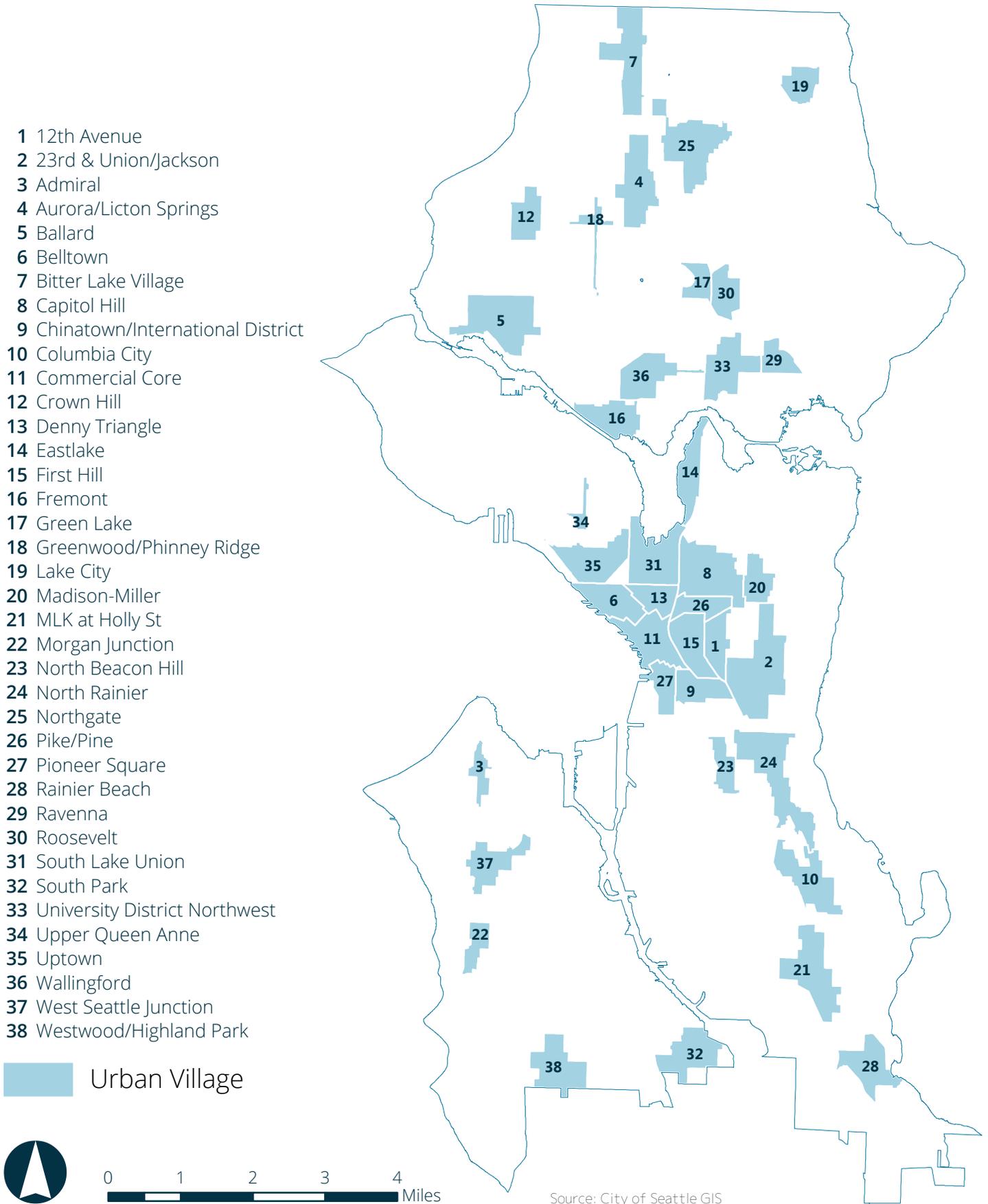
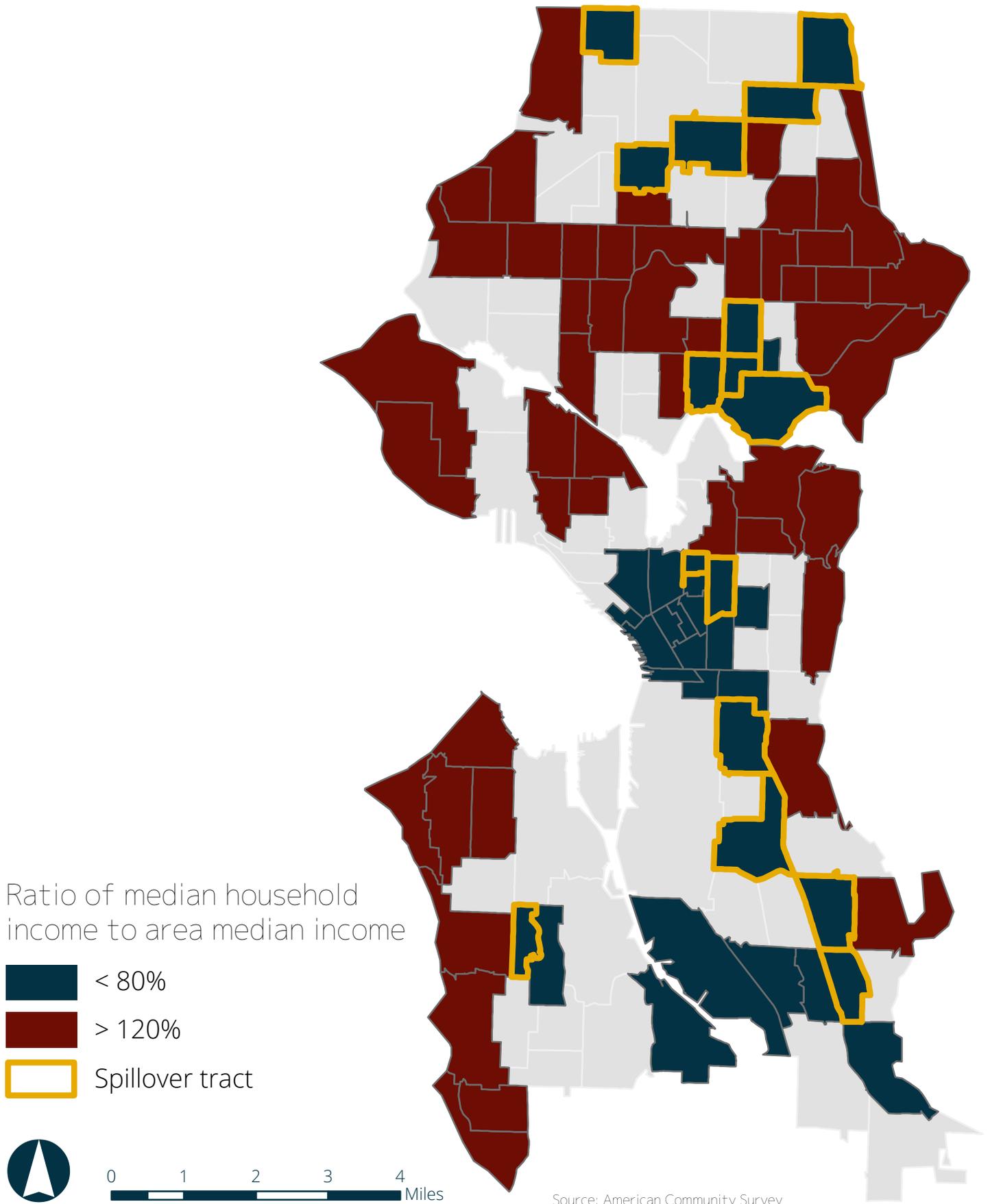


Figure 72: Neighboring tract spillover effect

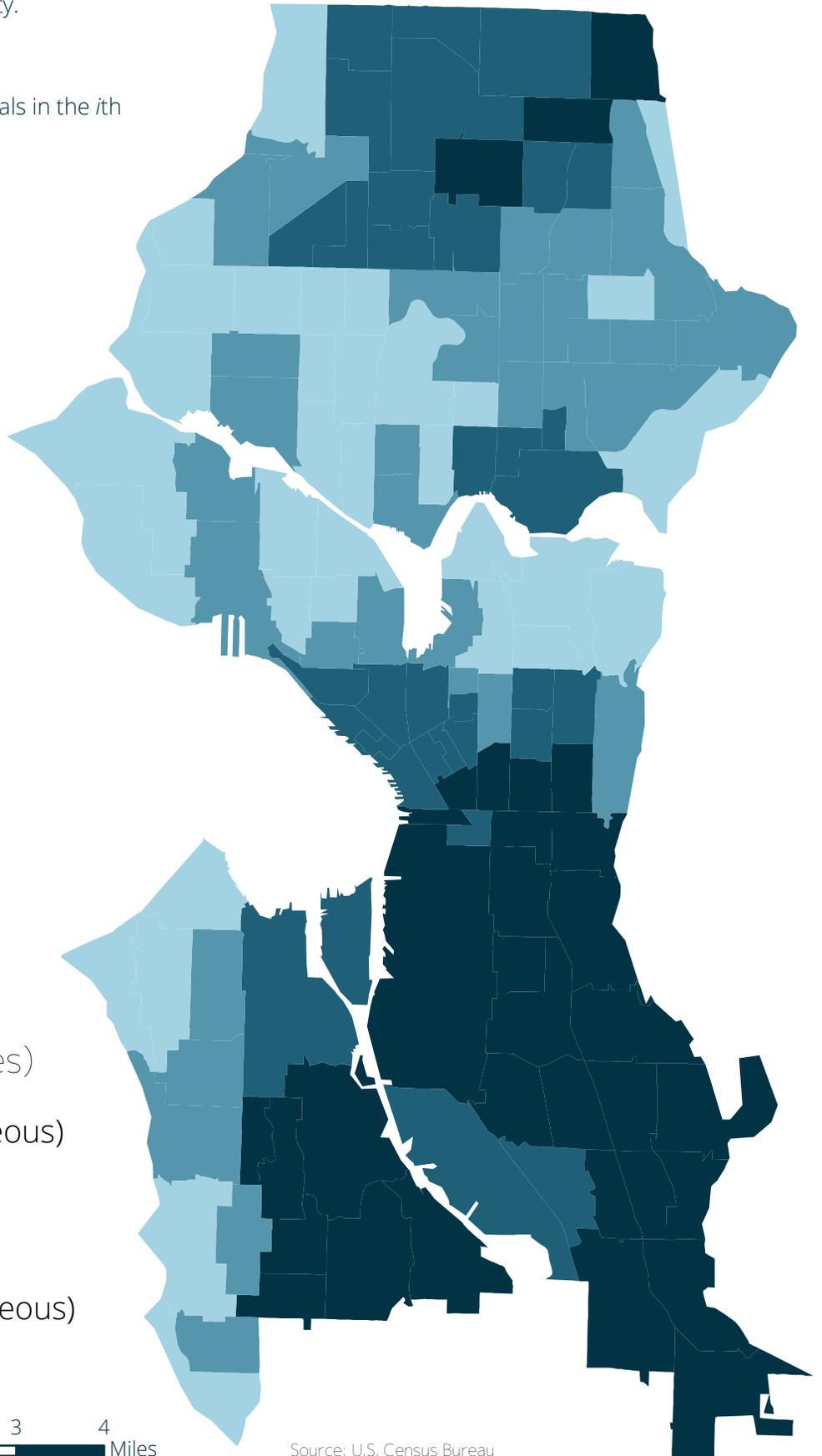


# Figure 73: Heterogeneous racial composition

Racial heterogeneity is estimated with the Shannon index, a standard measure of diversity.

$$\text{Shannon index} = - \sum_{i=1}^R p_i \ln(p_i)$$

where  $p_i$  is the proportion of individuals in the  $i$ th category



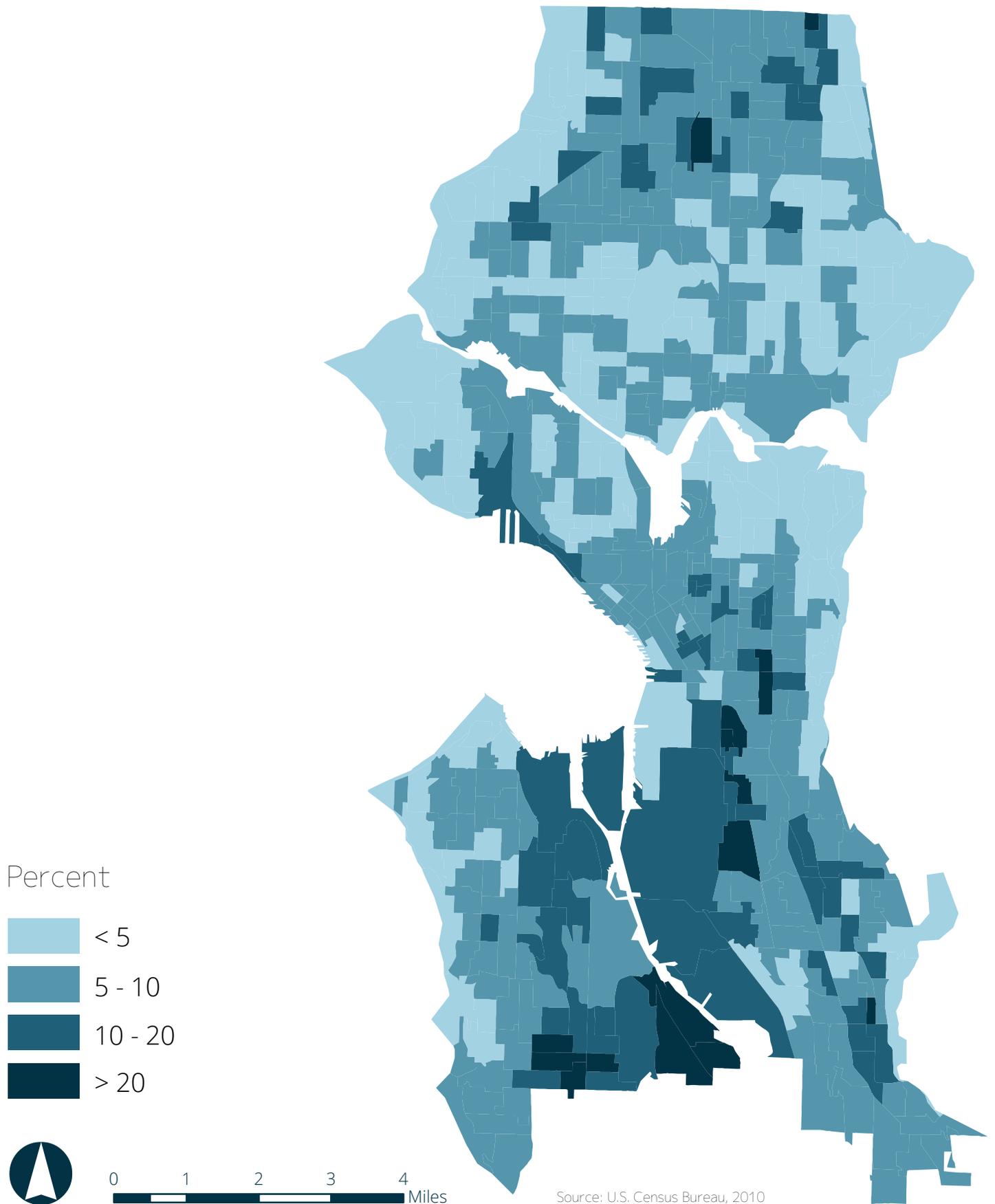
Shannon index (quartiles)

-  1 (more homogeneous)
-  2
-  3
-  4 (more heterogeneous)

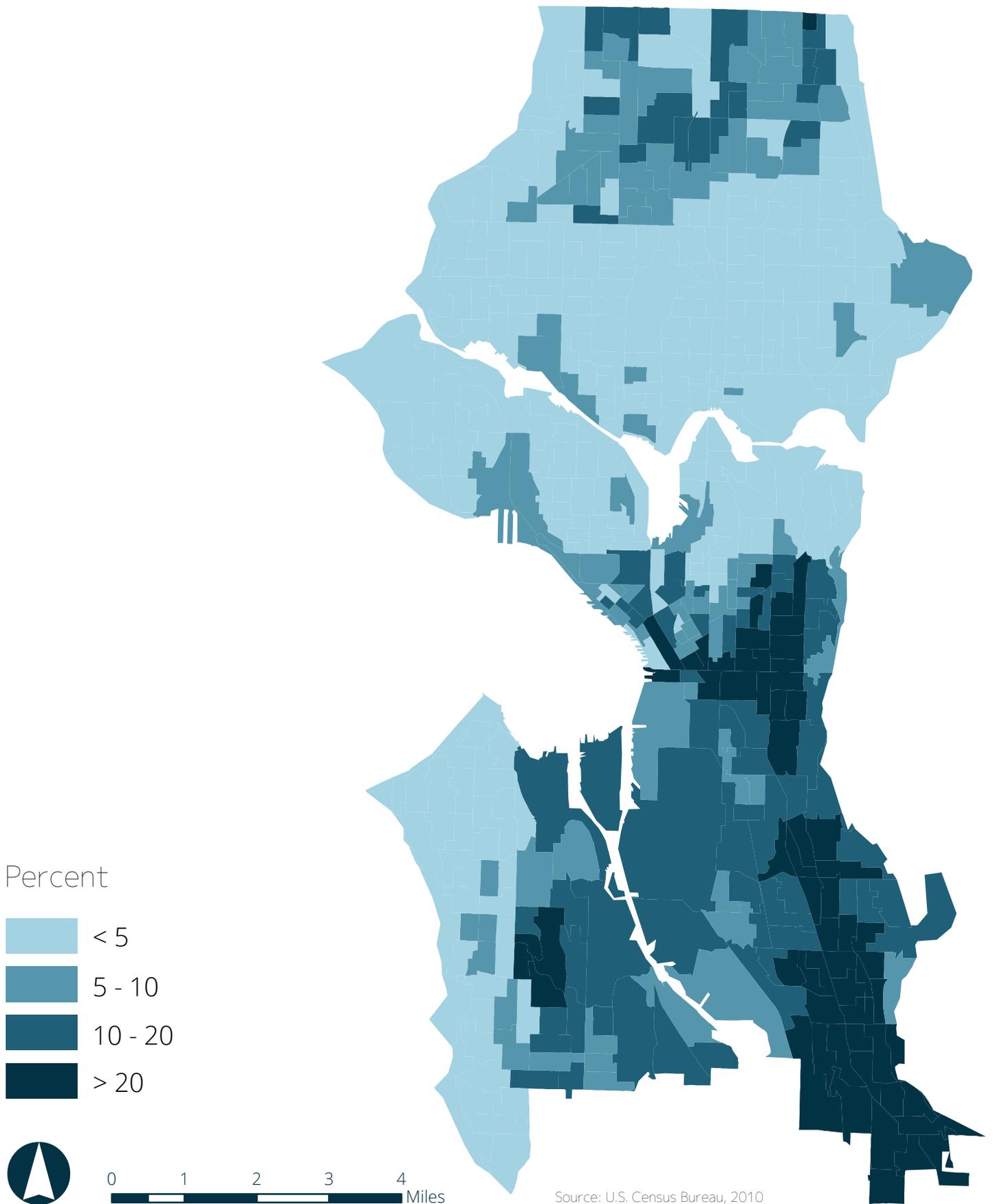


Source: U.S. Census Bureau

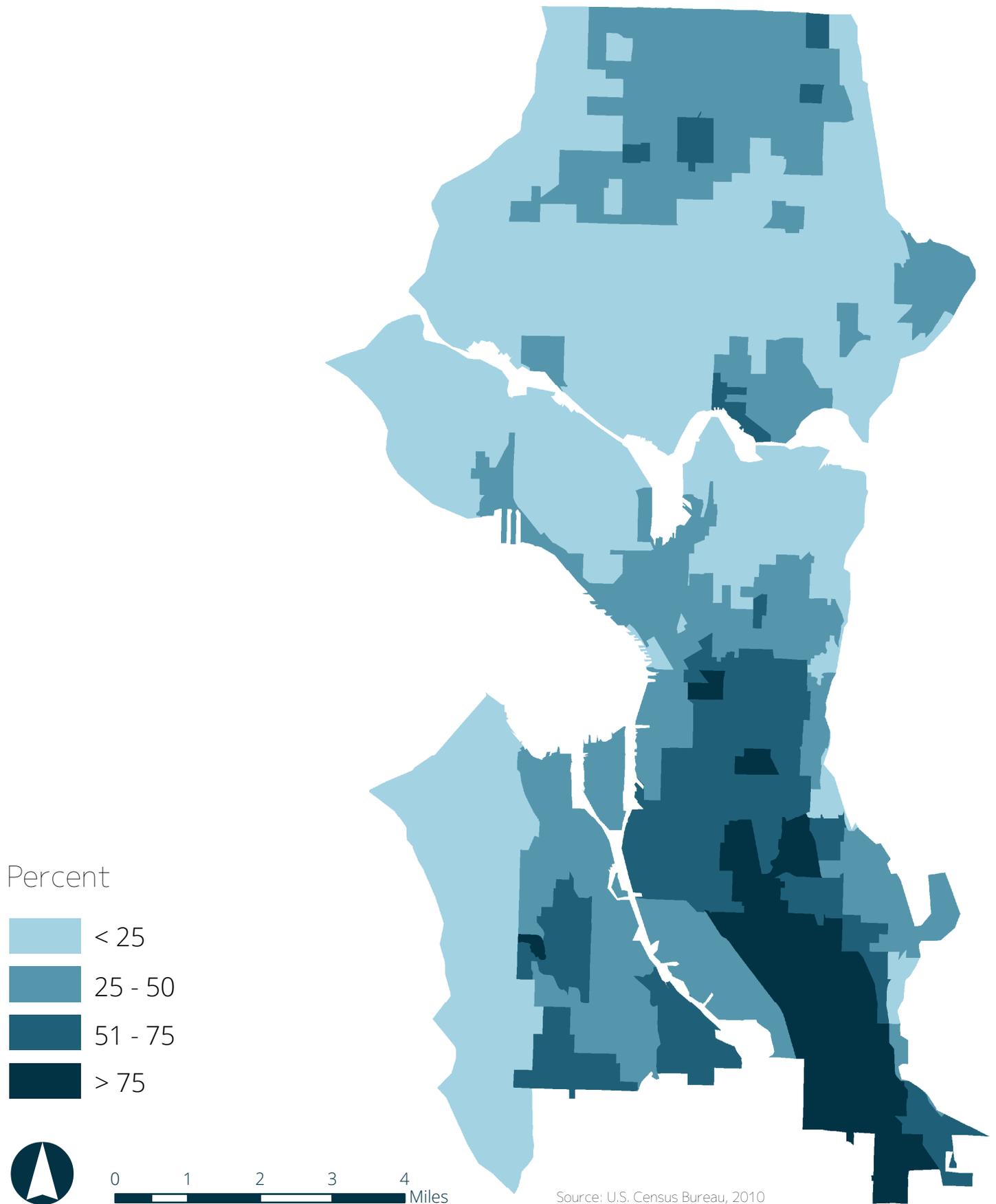
**Figure 74:** Hispanic residents by block group



**Figure 75:** Black residents by block group



**Figure 76:** Nonwhite residents by block group



**Figure 77:** Population over 25 without a Bachelor's degree

