



Older, Smaller, Better

Measuring how the character of buildings and blocks influences urban vitality

APPENDICES MAY 2014



National Trust for Historic Preservation
Preservation Green Lab

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APPENDICES

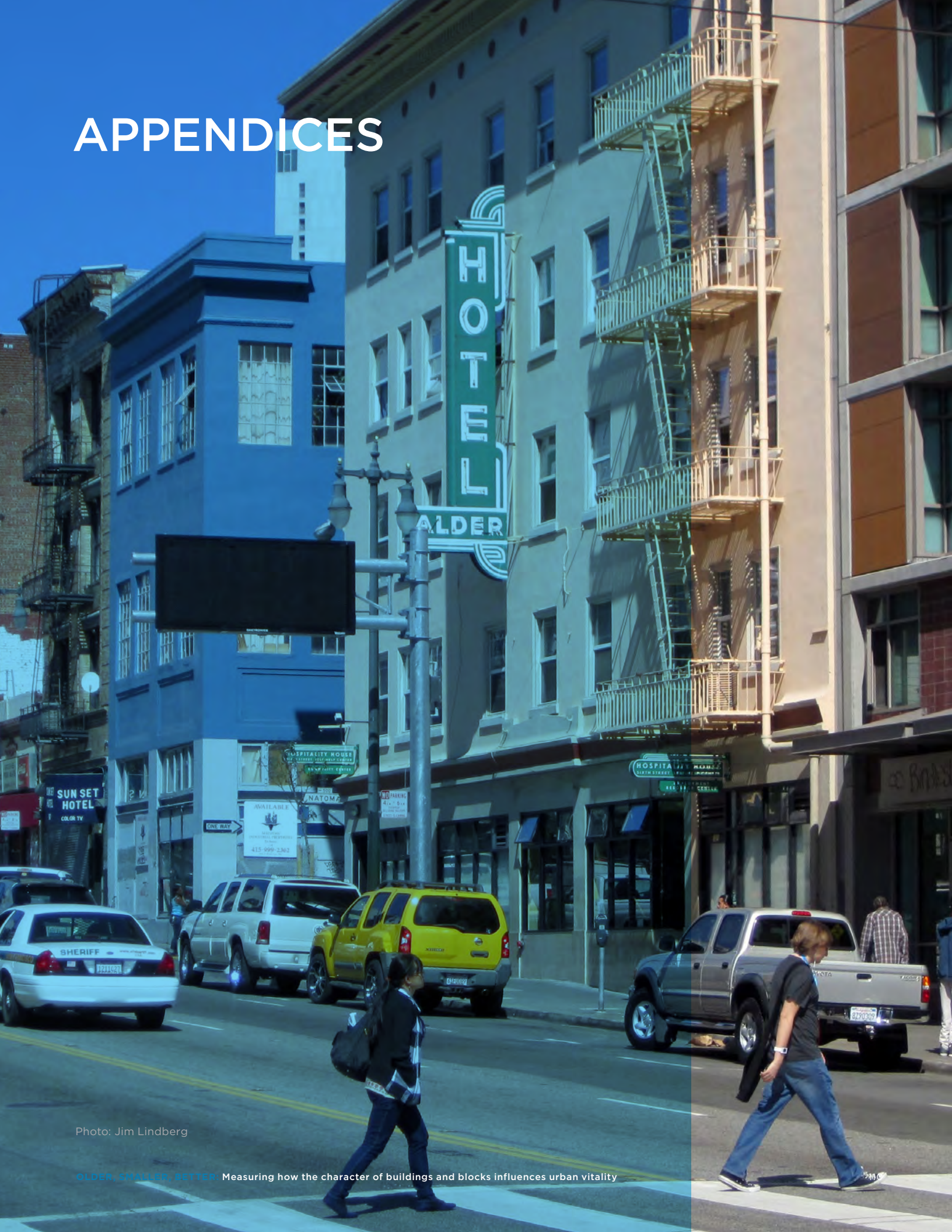


Photo: Jim Lindberg

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APPENDIX A: DETAILS ON THE METHODOLOGICAL APPROACH

This project involved bringing together datasets from many different sources, “fitting” that data into a custom grid geography, and running spatial regression models to test the relationships between characteristics of the built fabric and social, cultural, and economic vitality at the grid square level. This appendix provides a more detailed accounting of the methodological approach taken in this work.

DATA COLLECTION

The bulk of the data used in this project came from governmental sources, though some select data was obtained from non-governmental entities. The research team collected data through a combination of simple web searches of publicly accessible open data platforms (e.g., the U.S. Census Bureau, cities’ open data portals, county assessor websites, etc.), requests to city and county departments and agencies, and targeted collection from non-governmental websites such as Walk Score®, Yelp, Flickr, and Craigslist. Some preliminary analysis was conducted by the Green Lab’s research partners and shared in a processed form. For example, Impresa had access to Spotrank data on intensity of cellphone usage throughout the week. It conducted analysis of the Spotrank data and sent its results to the Green Lab team.

The native geographies of the data in this project varied from spatial points (e.g., latitudinal and longitudinal coordinates for Flickr photos and building polygons, street addresses for businesses, etc.) to Census block groups. (For a detailed accounting of the data used in this project, including information on data sources and native geographies, please refer to the Data Catalog in Appendix B). In instances where only a street address was listed in the original dataset, data was geocoded using the Google Geocoding API.

DATA AGGREGATION AND DEVELOPMENT OF METRICS

Given that the data used in this project uses a variety of native geographies, the research team opted to “fit” the data to a custom 200-meter-by-200 meter grid overlaid over the cities of Seattle, San Francisco, and Washington, D.C. A similar approach to aggregating geographic data was employed by Impresa, Inc., for ArtPlace America in the ArtPlace Vibrancy Indicators research¹, but where ArtPlace America

used an 800-meter-by-800-meter grid, this project aimed to conduct analysis at higher resolution with smaller units of analysis, closer to the block level.¹

After overlaying the geometric grid over the city geographies, data was aggregated and distilled from native geometric units into the grid squares. Point-based data was mapped and spatially joined to the grid. U.S. Census block and block group geographies were overlaid over the grid, and values associated with each block or block group were distributed into grid squares according to the proportion of the census geography that lay in each grid square. For instance, if 40% of a census block was in a given grid square, the research team multiplied the values associated with that census block by 0.40 and added the adjusted values into appropriate grid square data fields. This approach operates on the assumption that the spatial distribution of data was perfectly consistent across the geographic spatial units. Though the assumption may not hold in all cases, this approach to distributing data into the grid geography was ultimately the best available option.

The business listing data used in this project came from a variety of sources, and this diversity poses some threat to the validity of the study's results. For instance, the overall count of businesses was distilled from the business listing data posted on Yelp.com, but the count of "new businesses" was taken from city records of new business licenses in Seattle and San Francisco and new certificates of occupancy in Washington, D.C. For the overall count of businesses, the research team explored alternative business listing data, including business license data from governmental sources and "for sale" business databases, but exploratory analysis of other sources revealed the relative limitations of these alternatives. Yelp's listings appeared to be the most exhaustive and frequently updated data available for the study cities.

Yelp's business listings informed the "density of businesses," "non-chain businesses," and "business hours of operation" measures. The "percent non-chain businesses" data was developed by comparing the names of restaurants and retailers listed on Yelp with the names of chains listed in industry publications for restaurant and retail chains, as well as lists of other top chains posted on Wikipedia. All restaurant and retailer names not listed on the lists of chain establishments were deemed "non-chain businesses," and the count of "non-chain businesses" was divided by the total count of businesses listed on Yelp, yielding the "percent non-chain" score. For the "density of businesses" measure, the research team divided the number of businesses in each grid square by the total commercial square footage located in that grid square, as listed in county assessor tables. Combining these disparate data sources may

have resulted in some inaccuracies, but the resultant distortions were likely marginal in size and did not influence the results.

As this research aimed to test the role that older, smaller buildings play in fostering community vitality, the research team developed key measures of the building fabric. The project's measure of building age focused on the median year of construction of all buildings in each grid square. Age diversity was measured by calculating the standard deviation of the years of construction of all buildings in each grid square, and the measure of granularity is equal to the count of the number of buildings that lay in each square. (In Seattle, building polygons were often dissolved, making it difficult to discern the number of buildings that lined some streets. To correct for this, Seattle's granularity score is based on the number of parcels per grid square.) In order to place the relative age, age diversity, and granularity in context with the complete set of buildings in each city, these measures were normalized according to each city's total building stock. This involved transforming the units for each measure into z values, which point to each grid square's number of standard deviations above or below that square's respective city average for these key measures.

Finally, to test the overall effect of building age, age diversity, and granularity, the research team created a composite "Character Score" measure that combined the z values for each measure in each grid square. Various options for weighting the three component measures were considered, but ultimately, each measure was seen as equally important to the overall character of the block's fabric. Given this, the research team opted to simply add up the z-scores for building age, age diversity, and granularity to create the Character Score.

SPATIAL REGRESSION ANALYSIS

In preparation for statistical analysis, select grid squares were excluded from the regression models. First, the research team opted to include only grid squares that included data for each independent variable, so grid squares that did not have data for building age or a count of buildings or parcels were excluded. Second, as this project focuses on mixed-use and commercial corridors, any grid squares that had fewer than three businesses or less than ten feet of commercial square footage were excluded. Grid squares in which 99% or more of the grid square's total land area was listed as single family housing in the assessor tables were also excluded, as well as squares that did not have at least one job listed in the jobs data from the U.S. Census Bureau's Center for Economic Studies.

In order to account for spatial dependence in the study’s statistical models, the research team employed spatial regression models in GeoDa and R. In addition to measures of the character of the grid square’s built fabric, control measures for private investment in the grid square’s buildings, transit accessibility, and income were included. The measure of private investment was equal to the sum of all dollars spent on development projects in a grid square between 2007 and 2012. A log transformation was used on the permit dollar value to limit its range and to improve its use in statistical models. Each grid square’s transit accessibility score is equal to the Transit Score[®] of the grid square’s centroid. Income was measured using the U.S. Census Bureau records for median income that corresponded to each grid square. The research team developed and ran one model that used the composite “Character Score” alongside these control measures. A second model was used that included the *z-scores* for each component measure alongside the control variables. In each of the spatial regression models, the research team employed a spatial weight matrix based on first-order Queen contiguity.

$$\text{Vitality Metric} = a(\text{Character Score}) + b(\text{median income}) + c(\text{Transit Score}^{\text{®}}) + d(\text{construction dollars}) + e(\text{weighted spatial lag or spatial error term}) + \text{error}$$

$$\text{Vitality Metric} = a(\text{z-standardized building age}) + b(\text{z-standardized diversity of building age}) + c(\text{z-standardized granularity of built fabric}) + d(\text{median income}) + e(\text{Transit Score}^{\text{®}}) + f(\text{construction dollars}) + g(\text{weighted spatial lag or spatial error term}) + \text{error}$$

Using the statistical packages included in R and GeoDa, the research team ran OLS regression models and Moran’s *I* diagnostic tests for spatial autocorrelation. In most instances, the Moran’s *I* test showed significant spatial autocorrelation, which posed a significant threat to the validity of the OLS model, so Lagrange-Multiplier diagnostic tests were also run to test for residual spatial dependence. Based on the results of the Lagrange tests, the research team opted to use either spatial lag or spatial error models, depending on whether the tests to point to the presence of “lag” across neighboring grid squares or statistical “error” in measures that vary across space. In this study, a mix of spatial lag and spatial error models were ultimately used. In a few instances, spatial autocorrelation was not an issue and a simple OLS regression model was sufficient.

As suggested by Luc Anselin and his colleagues at Arizona State University's GeoDa Center for Geospatial Analysis and Computation, the research team tested the relative performance of the spatial lag and spatial error models against the performance of the original OLS regression model by comparing the respective Wald statistics, likelihood ratios, and Lagrange multiplier scores.² In many cases, these tests did not fall in the expected order ($LM \leq LR \leq W$), indicating possible misspecification of the model. Given the large size of the project's dataset and some underlying non-normality and heteroskedasticity in the metrics data, the research team was confident that the models are reliable, though this could warrant further exploration.¹ Future research may include additional spatial variables to strengthen the models further.

¹ Early attempts to improve the model included the use of alternative spatial weights, transformations to key independent variables, and the introduction of additional independent variables. The models ultimately used in this study are the result of careful consideration of the underlying theorized relationships between variables and optimization of model performance through the testing of alternatives. Alternative models continually revealed similar results, further inspiring confidence in the approach used in this study.

APPENDIX B: DATA CATALOG

TYPE OF MEASURE	MEASURE	UNITS	DATA	DATA SOURCE AND VINTAGE	NATIVE GEOGRAPHY OF DATA
Social Performance	Median age of residents	Median age	2010 U.S. Census	U.S. Census Bureau - 2010	Census block
	Resident Age Diversity Index	Index calculated to a 0-100 scale using proportions of population from the following age groups: 0-17, 18-34, 35-49, 50-64, 65+. An equal distribution of all groups is equal to 100. Presence of only one group is equal to 0.	2010 U.S. Census	U.S. Census Bureau - 2010	Census block
	Racial and Ethnic Diversity Index (REDI)	Index calculated to a 0-100 scale using proportions of population from the following racial and ethnic groups: Non-Hispanic white, Non-Hispanic African-American, Non-Hispanic Asian, Hispanic, all other races and ethnicities. An equal distribution of all groups is equal to 100. Presence of only one group is equal to 0.	2010 U.S. Census	U.S. Census Bureau - 2010	Census block

TYPE OF MEASURE	MEASURE	UNITS	DATA	DATA SOURCE AND VINTAGE	NATIVE GEOGRAPHY OF DATA
Social Performance (cont.)	Income Diversity Index	Index calculated to a 0-100 scale using the proportions of lower-income (<\$35,000), middle-income (\$35,000 - 99,999), and upper-income groups (\$100,000+). An equal distribution of all groups is equal to 100. Presence of only one group is equal to 0.	2007-2011 American Community Survey	U.S. Census Bureau - 2011	Census block group
	Population density	Households per acre; housing units per acre; persons per square mile	2010 U.S. Census	U.S. Census Bureau - 2010	Census block
	Residential rents	Median of all listed residential rents collected for each grid square	Rental housing listed on Craigslist in August and September 2013	Craigslist - 2013	Point (latitude and longitude of rental property)
	Diversity of residential rents	Standard deviation of residential rents collected for each grid square	Rental housing listed on Craigslist in August and September 2013	Craigslist - 2013	Point (latitude and longitude of rental property)
Economic Performance	Density of businesses	Number of businesses; number of businesses per commercial square foot ³	Yelp business listings	Yelp - 2013	Point (latitude and longitude of business as listed by Yelp)
	Density of jobs	Number of jobs; number of jobs per commercial square foot	Total number of jobs reported by firms according to business location	U.S. Census Bureau - 2011 LEHD data	Census block

TYPE OF MEASURE	MEASURE	UNITS	DATA	DATA SOURCE AND VINTAGE	NATIVE GEOGRAPHY OF DATA
Economic Performance (cont.)	Density of creative jobs	Number of jobs in creative industries; number of jobs in creative industries per commercial square foot	Total number of jobs reported in NAICS sectors 51 (Information) and 71 (Arts, Entertainment, and Recreation)	U.S. Census Bureau - 2011 LEHD data	Census block
	Jobs in small businesses	Percentage of total private sector jobs that are in businesses with fewer than 20 employees	Total number of private sector jobs reported by firms according to business location	U.S. Census Bureau - 2011 LEHD data	Census block
	New businesses	Number of businesses launched in 2012	New businesses licenses or permitted changes of use	City departments and agencies - 2012	Point (address listed on city records)
	Percent of new businesses	Percent of businesses launched in 2012 compared to total number of businesses listed on Yelp	New business licenses and Yelp business listings	City departments and agencies - 2012; Yelp - 2013	Point (address listed on city records and latitude and longitude of business as listed by Yelp)
	Non-chain businesses	Number of non-chain businesses; calculated by comparing names of businesses to lists of national chains	Yelp business listings; lists of top national restaurant and retail chains	Yelp - 2013; Lists of top restaurant and retail chains published	Point (latitude and longitude of business as listed by Yelp)
	Women and minority-owned businesses	Number of women and minority-owned businesses	Women and minority-owned businesses registered with city	City departments and agencies - 2013	Point (address of business listed on permit applications)

TYPE OF MEASURE	MEASURE	UNITS	DATA	DATA SOURCE AND VINTAGE	NATIVE GEOGRAPHY OF DATA
Economic Performance (cont.)	Women and minority-owned businesses	Percent of women and minority-owned businesses compared to total number of businesses listed on Yelp	Women and minority-owned businesses registered with city; Yelp business listings	City departments and agencies - 2013; Yelp - 2013	Point (address of business listed on permit applications and latitude and longitude as listed by Yelp)
		Percent of population that is employed	2007-2011 American Community Survey	U.S. Census Bureau - 2011	Census Block Group
	Change in property values	Average change in property value	Average change in property values between 1999 and 2012	County assessors - 2013	Point (address listed for building or parcel)
Cultural Performance	Vacant lots	Number of vacant lots	Properties listed as vacant in assessor records	County assessors - 2013	Point (address listed for building or parcel)
	Business hours of operation	Percent of all listed businesses open on Sunday at 4 p.m., Wednesday at 10 a.m., Friday at 10 p.m.	Yelp business listings	Yelp - 2013	Point (latitude and longitude of business listed on Yelp)
	Intensity of cellphone usage on Sunday at 4 p.m., Wednesday at 10 a.m., Friday at 10 p.m.	Spotrank proprietary score - 0-10 scale normalized across all cities	Spotrank data from Skyhook, as analyzed and shared by ArtPlace America	Skyhook - 2011	Point (latitude and longitude of centroid of 100m x 100m square on a grid)

TYPE OF MEASURE	MEASURE	UNITS	DATA	DATA SOURCE AND VINTAGE	NATIVE GEOGRAPHY OF DATA
Cultural Performance (cont.)	Permitted outdoor seating attached to cafés and other businesses	Number of permits	Permit data	City departments and agencies - 2013	Point (address of business listed on permit application)
		Number of photos	Geocoded photographs posted to Flickr	Flickr - 2013	Point (latitude and longitude of location of photo posted to Flickr)
	Cultural nonprofits	Number of nonprofit organizations with focus on arts and culture	Nonprofit organizations registered with the IRS	NCCS_NEA - 2011	Point (address of nonprofit organization listed on tax forms)
	Walk Score® rating	Walkability index	Proprietary score for walkability (scale of 0-100)	Walk Score® - 2013	Point (Walk Score® rating for centroid of grid squares)
	Transit Score® rating	Transit accessibility index	Proprietary score for transit accessibility (scale of 0-100)	Walk Score® - 2013	Point (Transit Score® rating for centroid of grid squares)
	Bike Score™ rating	Bike friendliness index	Proprietary score for bicycle friendliness of streets	Walk Score® - 2013	Point (Bike Score™ rating for centroid of grid squares)
	Bike share stations	Locations of bike share stations	Locations of bike share stations in major bike share networks in San Francisco and Washington, D.C.	Location databases for Capitol Bikes (DC) and Bay Area Bike Share (SF) - 2013	Point (Address or latitude and longitude listed for bike share station)

APPENDIX C: COMPLETE RESULTS

The following pages include a complete summary of this study's statistical analyses. The first two tables summarize the significance and direction of relationships between the study's measures of building character and various performance metrics. In these tables, cells are color-coded according to whether or not the statistical analysis supported or contradicted the study's core hypothesis. Where statistical analysis supported the general hypothesis that areas with an older median age of buildings, more diversity of building age, and more building granularity have greater vitality, cells are colored in blue. Where statistical analysis contradicted this hypothesis, cells are colored in peach. Non-significant relationships are shaded in gray.

Also included in this appendix is a set of tables that show t-statistics for all variables and all models employed in the project. A pair of tables are included for each of the study cities: One table includes the composite Character Score, and the other focuses on the study's component measures of the built fabric – median building age, diversity of building age, and building granularity.

SIGNIFICANCE AND DIRECTION OF RELATIONSHIP - COMPOSITE SCORE²

SOCIAL PERFORMANCE		SEATTLE	SAN FRANCISCO	WASHINGTON, D.C.
Characteristics of residents	Median age of residents	-	-	-
	Resident Age Diversity Index	+	+	+
	Racial and Ethnic Diversity Index	Not sig.	+	Not sig.
	Income Diversity Index	Not sig.	+	Not sig.
Population density	Households per acre	+	+	+
	Housing units per acre	+	+	+
	Persons per sq mile	+	+	+
Residential rents	Median residential rent	Not sig.	Not sig.	Not sig.
	Standard deviation (diversity) of rents	+	Not sig.	Not sig.
ECONOMIC PERFORMANCE				
Density of businesses	Number of businesses	Not sig.	-	-
	Logged number of businesses per commercial square foot	+	+	+
Density of jobs	Number of jobs	Not sig.	-	-
	Logged number of jobs per commercial square foot	+	Not sig.	+
Density of creative jobs	Number of creative jobs	-	-	-
	Logged number of creative jobs per commercial square foot ³	+	Not sig.	+
Jobs in small businesses	% of jobs in businesses with fewer than 20 employees	+	+	+
New businesses	Number of businesses that were newly opened in 2012	+	Not sig.	Not sig.

2 Where statistical analysis supported the general hypothesis that areas with a mix of old and new small buildings outperform areas with mostly newer, larger buildings, cells are colored in blue. Where statistical analysis contradicted this hypothesis, cells are colored in peach. Non-significant relationships are shaded in gray.

3 Analysis of logged number of creative jobs per commercial square feet and logged number of new businesses per commercial square feet exclude all cells that did not have a single creative job or a single new business.

ECONOMIC PERFORMANCE (cont.)		SEATTLE	SAN FRANCISCO	WASHINGTON, D.C.
	% of businesses that were newly opened in 2012	+	+	Not sig.
New businesses	Logged number of new businesses per commercial square foot	+	+	+
Local businesses	Percent of non-chain businesses	+	+	+
Women or minority-owned businesses	% of businesses that are women or minority-owned	+	Not sig.	+
	Number of women or minority-owned businesses	+	-	Not sig.
Employment	Employment rate	Not sig.	Not sig.	Not sig.
Property values	Average annual change in property values (1999 - 2012)	-	+	+
Vacancies	% of lots that are vacant	-	Not sig.	Not sig.
CULTURAL PERFORMANCE				
Business hours of operation	% businesses open on Sunday at 4 p.m.	+	Not sig.	Not sig.
	% businesses open on Wednesday at 10 a.m.	+	Not sig.	Not sig.
	% businesses open on Friday at 10 p.m.	+	Not sig.	Not sig.
Intensity of cellphone usage	Intensity of cellphone usage on Sunday at 4 p.m.	Not sig.	-	-
	Intensity of cellphone usage on Wednesday at 10 a.m.	-	-	-
	Intensity of cellphone usage on Friday at 10 p.m.	+	Not sig.	Not sig.
Outdoor seating	Number of outdoor café permits ⁴	+	Not sig.	Not sig.
Locations of photos available on Flickr	Logged number of photos posted in 2012	+	Not sig.	Not sig.

4 Data on Seattle outdoor café permits, cultural non-profits, farmers' markets, and percent new businesses did not show statistical signs of spatial autocorrelation. The Moran's I statistic was not significant. Therefore, these variables were tested using a simple OLS regression model. Reported numbers are *t* values.

CULTURAL PERFORMANCE (cont.)		SEATTLE	SAN FRANCISCO	WASHINGTON, D.C.
Cultural non-profit organizations	Locations of cultural non-profits	Not sig.	Not sig.	Not sig.
Farmers' markets	Locations of farmers' markets	Not sig.	Not sig.	Not sig.
TRANSPORTATION PERFORMANCE⁵				
Walkability	Walk Score [®] rating	+	+	Not sig.
Bike friendliness	Bike Score [™] rating	+	Not sig.	+
	Locations of bike share stations	N/A	-	Not sig.
Transit accessibility	Transit Score [®] rating	+	+	Not sig.

⁵ Regression models for Walk Score[®], Bike Score[™], and Transit Score[®] measures excluded the use of Transit Score[®] metric as a control measure.

SIGNIFICANCE AND DIRECTION OF RELATIONSHIP – COMPONENT MEASURES OF BUILDING CHARACTER⁶

SOCIAL PERFORMANCE		SEATTLE			SAN FRANCISCO			WASHINGTON, D.C.		
		Median Building Age	Diversity of Building Age	Granularity	Median Building Age	Diversity of Building Age	Granularity	Median Building Age	Diversity of Building Age	Granularity
Charac- teristics of residents	Median age of residents	Not sig.	Not sig.	-	+	Not sig.	Not sig.	Not sig.	-	-
	Resident Age Diversity Index	Not sig.	Not sig.	+	-	Not sig.	+	Not sig.	Not sig.	+
	Racial and Ethnic Diversity Index	+	+	Not sig.	Not sig.	Not sig.	+	Not sig.	Not sig.	Not sig.
	Income Diversity Index	Not sig.	Not sig.	Not sig.	Not sig.	Not sig.	+	Not sig.	-	Not sig.
Population density	House- holds per acre	+	Not sig.	+	+	-	+	+	+	+
	Housing units per acre	+	+	+	+	-	+	+	+	+
	Persons per sq mile	+	Not sig.	+	Not sig.	Not sig.	+	+	+	+
Residential rents	Median rent	Not sig.	Not sig.	-	-	Not sig.	-	Not sig.	Not sig.	Not sig.
	Standard deviation (diversity) of rents	-	Not sig.	Not sig.	Not sig.	+	Not sig.	Not sig.	+	Not sig.

6 Where statistical analysis supported the general hypothesis that areas with an older median age of buildings, more diversity of building age, and more building granularity have greater vitality, cells are colored in blue. Where statistical analysis contradicted this hypothesis, cells are colored in peach. Non-significant relationships are shaded in gray.

ECONOMIC PERFORMANCE		SEATTLE			SAN FRANCISCO			WASHINGTON, D.C.		
		Median Building Age	Diversity of Building Age	Granularity	Median Building Age	Diversity of Building Age	Granularity	Median Building Age	Diversity of Building Age	Granularity
Density of businesses	Number of businesses	Not sig.	Not sig.	-	Not sig.	Not sig.	-	+	Not sig.	-
	Logged number of businesses per commercial square foot	-	-	+	-	-	+	-	Not sig.	+
Density of jobs	Number of jobs	Not sig.	Not sig.	Not sig.	+	Not sig.	-	+	Not sig.	Not sig.
	Logged number of jobs per commercial square foot	-	-	+	Not sig.	-	Not sig.	-	Not sig.	+
Density of creative jobs	Number of creative jobs	Not sig.	Not sig.	Not sig.	Not sig.	Not sig.	-	Not sig.	Not sig.	Not sig.
	Logged number of creative jobs per commercial square foot	-	-	+	+	Not sig.	Not sig.	Not sig.	Not sig.	+
Jobs in small businesses	% of jobs in businesses with fewer than 20 employees	-	Not sig.	+	-	-	+	Not sig.	Not sig.	+
New businesses	Number of new businesses	Not sig.	Not sig.	Not sig.	Not sig.	Not sig.	-	+	+	Not sig.
	% of businesses that were newly opened in 2012	Not sig.	Not sig.	+	Not sig.	Not sig.	+	Not sig.	Not sig.	Not sig.

ECONOMIC PERFORMANCE (cont.)		SEATTLE			SAN FRANCISCO			WASHINGTON, D.C.		
		Median Building Age	Diversity of Building Age	Granularity	Median Building Age	Diversity of Building Age	Granularity	Median Building Age	Diversity of Building Age	Granularity
	Logged number of new businesses per commercial square foot	-	-	+	-	-	+	Not sig.	Not sig.	+
Local businesses	Percent of non-chain businesses	-	Not sig.	+	-	Not sig.	Not sig.	-	Not sig.	+
Women or minority-owned businesses	% of businesses that are women or minority-owned	Not sig.	+	+	+	Not sig.	Not sig.	Not sig.	Not sig.	+
	Number of women or minority-owned businesses	Not sig.	+	+	Not sig.	Not sig.	-	Not sig.	Not sig.	Not sig.
Employment	Employment rate	Not sig.	Not sig.	+	Not sig.	Not sig.	Not sig.	Not sig.	+	Not sig.
Property values	Average annual change in property values (1999-2012)	+	+	-	-	Not sig.	+	-	+	Not sig.
Vacancies	% of lots that are vacant	Not sig.	Not sig.	-	+	+	Not sig.	-	Not sig.	-

CULTURAL PERFORMANCE		SEATTLE			SAN FRANCISCO			WASHINGTON, D.C.		
		Median Building Age	Diversity of Building Age	Granularity	Median Building Age	Diversity of Building Age	Granularity	Median Building Age	Diversity of Building Age	Granularity
Business hours of operation	% businesses open on Sunday at 4 p.m.	Not sig.	+	+	Not sig.	-	Not sig.	Not sig.	Not sig.	Not sig.
	% businesses open on Wednesday at 10 a.m.	Not sig.	Not sig.	Not sig.	Not sig.	Not sig.	Not sig.	Not sig.	Not sig.	Not sig.
	% businesses open on Friday at 10 p.m.	-	+	Not sig.	Not sig.	-	+	Not sig.	Not sig.	Not sig.
Intensity of cellphone usage	Intensity of cellphone usage on Sunday at 4 p.m.	Not sig.	Not sig.	-	-	Not sig.	-	Not sig.	Not sig.	Not sig.
	Intensity of cellphone usage on Wednesday at 10 a.m.	Not sig.	Not sig.	-	Not sig.	+	-	+	+	-
	Intensity of cellphone usage on Friday at 10 p.m.	-	Not sig.	Not sig.	-	+	-	Not sig.	+	Not sig.
Outdoor seating	Number of outdoor café permits	-	+	Not sig.	-	Not sig.	-	Not sig.	+	Not sig.
Locations of photos available on Flickr	Logged number of photos posted in 2012	-	+	-	-	Not sig.	-	Not sig.	Not sig.	-
Cultural non-profit organizations	Locations of cultural non-profits	Not sig.	Not sig.	Not sig.	Not sig.	Not sig.	-	Not sig.	Not sig.	Not sig.
Farmers' markets	Locations of farmers' markets	Not sig.	Not sig.	Not sig.	Not sig.	Not sig.	Not sig.	Not sig.	Not sig.	Not sig.

TRANSPORTATION PERFORMANCE		SEATTLE			SAN FRANCISCO			WASHINGTON, D.C.		
		Median Building Age	Diversity of Building Age	Granularity	Median Building Age	Diversity of Building Age	Granularity	Median Building Age	Diversity of Building Age	Granularity
Walkability	Walk Score® rating	-	Not sig.	+	-	Not sig.	Not sig.	Not sig.	+	Not sig.
Bike friendliness	Bike Score™ rating	-	Not sig.	+	Not sig.	Not sig.	-	-	Not sig.	Not sig.
	Locations of bike share stations	N/A	N/A	N/A	Not sig.	+	-	Not sig.	+	-
Transit accessibility	Transit Score® rating	Not sig.	Not sig.	+	Not sig.	+	Not sig.	Not sig.	Not sig.	Not sig.

VALUES OF *t*-STATISTICS FOR COMPOSITE SCORE AND OTHER INDEPENDENT VARIABLES - SEATTLE

SEATTLE					
		Built Fabric Composite ⁷	Private Investment	Median Income	Transit Score [®] rating
SOCIAL PERFORMANCE					
Characteristics of residents	Median age of residents	-9.2772***	-1.9339	7.6869***	3.3414***
	Resident Age Diversity Index	3.3760***	-2.5664*	4.300***	-8.6733***
	Racial and Ethnic Diversity Index	-1.2705	-0.4773	-7.2891***	2.3932*
	Income Diversity Index	0.6350	0.6295	N/A	-3.3668***
Population density	Households per acre	6.7965***	4.1449***	-4.5490***	3.3155***
	Housing units per acre	5.9738***	4.5151***	-4.3837***	3.9431***
	Persons per sq mile	8.6071***	4.0912***	-5.9338***	3.1498***
Residential rents	Median residential rent	-1.0418	0.0154	4.1665***	19.5883***
	Standard deviation (diversity) of rents	3.1204**	0.7161	2.4690*	10.2448***
ECONOMIC PERFORMANCE					
Density of businesses	Number of businesses	-0.9407	3.7692***	-1.322	6.0087***
	Logged number of businesses per commercial square foot	20.7949***	-2.5622*	3.3323***	9.0081***
Density of jobs	Number of jobs	-1.1875	3.0161**	-1.5180	5.7056***
	Logged number of jobs per commercial square foot	12.9908***	-1.6120	0.0421	4.1382***
Density of creative jobs	Number of creative jobs	-3.3856***	2.1244*	1.3524	7.5930***
	Logged number of creative jobs per commercial square foot ⁸	7.5353***	-4.1108***	3.0570**	2.8355**

7 Asterisks indicate level of significance associated with each variable. * < .05, ** < .01, *** < .001

8 Analysis of logged number of creative jobs per commercial square feet and logged number of new businesses per commercial square feet exclude all cells that did not have a single creative job or a single new business.

SEATTLE					
		Built Fabric Composite ⁷	Private Investment	Median Income	Transit Score [®] rating
ECONOMIC PERFORMANCE (cont.)					
Jobs in small businesses	% of jobs in businesses with fewer than 20 employees	17.3450***	-1.7275	1.7585	-10.4516***
New businesses	Number of businesses that were newly opened in 2012	3.0893**	5.6624***	-2.4284*	6.9032***
New businesses	% of businesses that were newly opened in 2012	5.672***	2.330*	-1.671	1.763
	Logged number of new businesses per commercial square foot	18.0433***	-3.4417***	2.6235**	-10.5375***
Local businesses	Percent of non-chain businesses	7.1068***	-0.9626	0.6255	2.0452*
Women or minority-owned businesses	% of businesses that are women or minority-owned	10.4654***	1.9514	-0.1490	-1.8708
	Number of women or minority-owned businesses	6.6836***	6.2452***	-1.5375	4.4852***
Employment	Employment rate	1.3526	0.6040	8.8544***	-1.8800
Property values	Average annual change in property values (1999 - 2012)	-3.2259***	-0.0582	1.4695	4.2475***
Vacancies	% of lots that are vacant	-2.2818*	-2.0596*	-0.2306	1.1469
CULTURAL PERFORMANCE					
Business hours of operation	% businesses open on Sunday at 4 p.m.	3.9437***	-2.1624*	-1.2296	0.0895
	% businesses open on Wednesday at 10 a.m.	1.992*	-3.635***	-1.263	-2.368*
	% businesses open on Friday at 10 p.m.	3.949***	-1.857	-2.035*	2.735**
Intensity of cellphone usage	Intensity of cellphone usage on Sunday at 4 p.m.	-0.4175	4.6215***	-1.7991	9.1097***
	Intensity of cellphone usage on Wednesday at 10 a.m.	-3.1515**	3.6611***	-1.0541	12.6831***

SEATTLE					
		Built Fabric Composite ⁷	Private Investment	Median Income	Transit Score [®] rating
CULTURAL PERFORMANCE (cont.)					
	Intensity of cellphone usage on Friday at 10 p.m.	4.4969***	5.0401***	-2.7891**	13.9086***
Outdoor seating	Number of outdoor café permits ⁹	4.666***	2.295*	-0.277	1.791
Locations of photos available on Flickr	Logged number of photos posted in 2012	2.0586*	4.0609***	2.5278*	12.8546***
Cultural non-profit organizations	Locations of cultural non-profits	-0.534	1.685	-0.650	4.181***
Farmers' markets	Locations of farmers' markets	1.1351	1.7464	0.6540	-1.1320
TRANSPORTATION PERFORMANCE¹⁰					
Walkability	Walk Score [®] rating	5.7299***	3.5442***	-2.8690**	N/A
Bike friendliness	Bike Score [™] rating	3.8563***	1.3356	-1.607	N/A
	Locations of bike share stations	N/A	N/A	N/A	N/A
Transit accessibility	Transit score [®] rating	2.4314*	1.9211	-3.6879**	N/A

9 Data on Seattle outdoor café permits, cultural non-profits, farmers' markets, and percent new businesses did not show statistical signs of spatial autocorrelation. The Moran's I statistic was not significant. Therefore, these variables were tested using a simple OLS regression model.

10 Regression models for Walk Score[®], Bike Score[™], and Transit Score[®] measures excluded the use of Transit Score[®] metric as a control measure.

VALUES OF *t*-STATISTICS FOR COMPONENT MEASURES OF BUILDING FABRIC AND OTHER INDEPENDENT VARIABLES - SEATTLE

SEATTLE							
		Median Building Age ¹¹	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
SOCIAL PERFORMANCE							
Charac- teristics of residents	Median age of residents	-0.8978	-1.6748	-9.9651***	-1.6935	7.0842***	0.8446
	Resident Age Diversity Index	-1.0208	-1.7841	5.2217***	-2.5260*	4.0750***	-7.5251***
	Racial and Ethnic Diversity Index	5.2100***	2.4204*	0.2672	-0.5819	-6.6996***	2.3159*
	Income Diversity Index	1.9188	0.6499	1.9335	0.6119	N/A	-3.3496***
Population density	Households per acre	4.7745***	1.6365	9.9498***	3.5878***	-3.5745***	5.5604***
	Housing units per acre	5.1980***	1.9795*	9.0806***	4.0048***	-3.4007***	5.9474***
	Persons per sq mile	4.2675***	0.6647	12.6247***	3.5559***	-5.0933***	6.2613***
Residential rents	Median rent	-0.4242	0.2378	-2.0897*	0.0295	4.1351***	19.4024***
	Standard deviation (diversity) of rents	-2.0640*	1.263	1.4683	0.7252	2.4007*	10.1767***

11 Asterisks indicate level of significance associated with each variable. * < .05, ** < .01, *** < .001

SEATTLE							
		Median Building Age ¹¹	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
ECONOMIC PERFORMANCE							
Density of businesses	Number of businesses	0.4981	0.7884	-2.0938*	3.8246***	-1.3576	4.7141***
	Logged number of businesses per commercial square foot	-11.3415***	-2.3140*	19.7302***	-2.3923*	2.3517*	-5.2367***
Density of jobs	Number of jobs	0.2270	-0.0021	-1.5212	3.0555**	-1.5628	4.8446***
	Logged number of jobs per commercial square foot	-7.3320***	-2.7139**	13.4414***	-1.5859	-0.8449	6.6316***
Density of creative jobs	Number of creative jobs	1.5968	-0.7572	-1.7947	2.0791*	1.3871	6.7884***
Density of creative jobs	Logged number of creative jobs per commercial square foot	-5.7003***	-2.2069*	7.9410***	-3.8006***	2.7351**	4.1075***
Jobs in small businesses	% of jobs in businesses with fewer than 20 employees	-7.0667***	1.5210	14.0565***	-1.7034	1.3327	-7.5098***
New businesses	Number of new businesses	-0.5721	1.9116	1.3948	5.5801***	-2.2479*	6.3525***

SEATTLE							
		Median Building Age ¹¹	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
ECONOMIC PERFORMANCE (cont.)							
	% of businesses that were newly opened in 2012	0.912	1.868	5.362***	2.052*	1.228	2.714**
	Logged number of new businesses per commercial square foot	-7.8565***	-3.0396**	18.2152***	-3.2701**	2.1833*	-5.8913***
Local businesses	Percent of non-chain businesses	-5.9483***	0.1751	3.6275***	-1.1039	0.3443	2.9624**
Women or minority-owned businesses	% of businesses that are women or minority-owned	0.4893	2.3633*	10.5936***	1.6560	0.2930	0.3361
	Number of women or minority-owned businesses	-1.7541	3.6191***	3.1943**	6.2110***	-1.5908	6.0990***
Employment	Employment rate	0.0049	-0.3308	2.2902*	0.6179	8.7904***	-1.7620
Property values	Average annual change in property values (1999-2012)	3.6663***	2.2504*	-2.6683**	-0.2728	2.0833*	3.0276**

SEATTLE							
		Median Building Age ¹¹	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
CULTURAL PERFORMANCE							
Vacancies	% of lots that are vacant	1.1549	0.9291	-2.6022**	-2.0951*	-0.0427	0.4032
Business hours of operation	% businesses open on Sunday at 4pm	-0.6336	1.9994*	2.2486*	-2.2471*	-1.0163	0.2819
	% businesses open on Wednesday at 10 a.m.	0.845	1.231	1.868	-3.767***	-0.948	-1.780
Business hours of operation	% businesses open on Friday at 10 p.m.	-2.187*	3.040**	0.138	-1.818	-1.955	1.730
Intensity of cellphone usage	Intensity of cellphone usage on Sunday at 4 p.m.	-1.2865	1.6271	-2.8344**	4.7073***	-1.8492	7.3021***
	Intensity of cellphone usage on Wednesday at 10 a.m.	-0.7261	1.7196	-5.5819***	3.8274***	-1.1287	10.3123***
	Intensity of cellphone usage on Friday at 10 p.m.	-4.2736***	1.3028	-0.5133	3.9902***	-2.3729*	7.6153***
Outdoor seating	Number of outdoor café permits	-3.888***	3.691***	-0.966	2.415*	-0.361	0.438

SEATTLE							
		Median Building Age ¹¹	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
CULTURAL PERFORMANCE (cont.)							
Locations of photos available on Flickr	Logged number of photos posted in 2012	-4.7234***	4.3966***	-4.8431***	4.2853***	2.3233*	10.3866***
Cultural non-profit	Locations of cultural non-profits	-0.908	-0.111	-1.193	1.773	-0.789	3.477***
Farmers' markets	Locations of farmers' markets	-1.1148	0.4553	0.0063	1.7818	0.5797	-1.1847
TRANSPORTATION PERFORMANCE¹²							
Walkability	Walk Score [®] rating	-2.1005*	1.2236	5.4049***	3.5736***	-2.8992**	N/A
Bike friendliness	Bike Score [™] rating	-3.1238**	0.6397	2.2882*	1.3657	-1.3121	N/A
	Locations of bike share stations	N/A	N/A	N/A	N/A	N/A	N/A
Transit accessibility	Transit score [®] rating	-0.5502	1.0830	2.0325*	1.9216	-3.6433***	N/A

12 Regression models for Walk Score[®], Bike Score[™], and Transit Score[®] measures excluded the use of Transit Score[®] metric as a control measure.

VALUES OF *t*-STATISTICS FOR COMPOSITE SCORE AND OTHER INDEPENDENT VARIABLES – SAN FRANCISCO

SAN FRANCISCO					
		Built Fabric Composite ¹³	Private Investment	Median Income	Transit Score [®] rating
SOCIAL PERFORMANCE					
Characteristics of residents	Median age of residents	-3.7255***	-0.7447	-0.6403	1.5823
	Resident Age Diversity Index	8.2578***	2.7010**	-3.2065**	-5.3896***
	Racial and Ethnic Diversity Index	2.3234*	-0.6242	-6.5904***	-2.2574*
	Income Diversity Index	2.7048**	2.7953**	N/A	-0.6270
Population density	Households per acre	3.0733**	3.1326**	-4.3949***	4.2109***
	Housing units per acre	2.7401**	3.3614***	-4.2352***	4.4480***
	Persons per sq mile	3.7127***	3.7318***	-5.4510***	2.5296*
Residential rents	Median rent	-1.6280	-0.0597	5.1608***	13.4045***
	Standard deviation (diversity) of rents	1.1816	0.3269	-0.3441	10.5483***
ECONOMIC PERFORMANCE					
Density of businesses	Number of businesses	-2.8195**	5.1140***	-3.1086**	3.3480***
	Logged number of businesses per commercial square foot	2.3430*	-3.4595***	2.0224*	-6.2939***
Density of jobs	Number of jobs	-3.3339***	4.5572***	-1.6851	2.0859*
	Logged number of jobs per commercial square foot	-0.4572	-1.7273	1.3102	1.3715
Density of creative jobs	Number of creative jobs	-2.7144**	3.6070***	0.1288	3.4129***

13 Asterisks indicate level of significance associated with each variable. * < .05, ** < .01, *** < .001

SAN FRANCISCO					
		Built Fabric Composite ¹³	Private Investment	Median Income	Transit Score [®] rating
ECONOMIC PERFORMANCE (cont.)					
	Logged number of creative jobs per commercial square foot	-1.6799	-0.7502	3.7737***	2.2205*
Jobs in small businesses	% of jobs in businesses with fewer than 20 employees	7.7861***	-0.5978	5.4607***	-6.034***
New businesses	Number of new businesses	-1.5665	7.3207***	-3.9030***	4.0834***
	% of businesses that were newly opened in 2012	3.700***	2.372*	-0.805	-3.108**
New businesses	Logged number of new businesses per commercial square foot	2.6840**	-0.0293	2.1328*	-7.3080***
Local businesses	Percent of non-chain businesses	5.1687***	-0.6401	1.9528	0.7584
Women or minority-owned businesses	% of businesses that are women or minority-owned	-0.5695	-2.2880*	0.4334	1.8297
	Number of women or minority-owned businesses	-2.1187*	4.1025***	-0.7917	1.8346
Employment	Employment rate	0.8288	0.1388	13.6837***	3.3764***
Property values	Average annual change in property values (1999 - 2012)	5.4404***	-0.3270	2.2104	-1.1936
Vacancies	% of lots that are vacant	-1.1410	-0.2142	-1.7954	-1.2122
CULTURAL PERFORMANCE					
Business hours of operation	% businesses open on Sunday at 4 p.m.	1.7378	-0.3427	-2.3372*	-2.5625*
	% businesses open on Wednesday at 10 a.m.	-0.2756	-0.0533	-0.4548	-3.7007***

SAN FRANCISCO					
		Built Fabric Composite ¹³	Private Investment	Median Income	Transit Score [®] rating
CULTURAL PERFORMANCE (cont.)					
	% businesses open on Friday at 10 p.m.	1.0150	0.8409	-1.7495	-2.3587*
Intensity of cellphone usage	Intensity of cellphone usage on Sunday at 4 p.m.	-2.6178**	2.1124*	0.1404	9.4030***
	Intensity of cellphone usage on Wednesday at 10 a.m.	-4.9387***	3.9741***	0.7240	10.7325***
	Intensity of cellphone usage on Friday at 10 p.m.	-0.2696	2.6373**	-2.1398*	11.9110***
Outdoor seating	Number of outdoor café permits	1.1314	2.5839**	-1.7859	2.7836**
Locations of photos available on Flickr	Number of photos	-1.5607	1.6191	-3.2847**	7.2502***
Cultural non-profit organizations	Locations of cultural non-profits	-0.6743	3.3456***	-3.6810***	5.1484***
Farmers' markets	Locations of farmers' markets	-1.0025	-0.1160	-0.7331	0.7406
TRANSPORTATION PERFORMANCE¹⁴					
Walkability	Walk Score [®] rating	2.3901*	1.5544	-0.5860	N/A
Bike friendliness	Bike Score [™] rating	-1.5338	0.7302	1.0778	N/A
	Locations of bike share stations	-2.3002*	2.6347**	-0.1725	4.6113***
Transit accessibility	Transit Score [®] rating	2.4758*	2.5767**	1.2819	N/A

14 Regression models for Walk Score[®], Bike Score[™], and Transit Score[®] measures excluded the use of Transit Score[®] metric as a control measure.

VALUES OF *t*-STATISTICS FOR COMPONENT MEASURES OF BUILDING FABRIC AND OTHER INDEPENDENT VARIABLES – SAN FRANCISCO

SAN FRANCISCO							
		Median Building Age ¹⁵	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
SOCIAL PERFORMANCE							
Characteristics of residents	Median age of residents	3.8601***	-0.5997	-1.3684	-0.8038	-0.6087	1.6188
	Resident Age Diversity Index	-2.7698**	0.8792	10.1900***	2.1997*	-3.5098***	-3.8450***
	Racial and Ethnic Diversity Index	0.3271	1.3439	2.9282**	-0.7961	-6.6468***	-1.8996
	Income Diversity Index	-1.6495	0.6065	2.1449*	2.7134**	N/A	-0.4508
Population density	Households per acre	2.1065*	-3.4689***	7.2299***	2.5719*	-6.0494***	5.1731***
	Housing units per acre	2.2711*	-3.5096***	6.8877***	2.9990**	-5.9380***	5.2216***
	Persons per sq mile	1.0472	-1.5702	9.3673***	2.9091**	-5.6579***	3.3769***
Residential rents	Median rent	-2.8658**	-1.2114	-4.6379***	0.3661	5.2581***	13.3132***
	Standard deviation (diversity) of rents	-1.4181	2.1165*	-1.5914	0.5574	-0.2559	10.1693***

15 Asterisks indicate level of significance associated with each variable. * < .05, ** < .01, *** <.001

SAN FRANCISCO							
		Median Building Age ¹⁵	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
ECONOMIC PERFORMANCE							
Density of businesses	Number of businesses	-0.6140	0.4016	-4.3046***	5.1615***	-2.9951**	1.3317
	Logged number of businesses per commercial square foot	-3.6612***	-3.7295***	3.0032**	-3.6630***	2.1558*	-5.2159***
Density of jobs	Number of jobs	2.3488*	0.3801	-2.0852*	4.6718***	-1.7811	1.1850
	Logged number of jobs per commercial square foot	0.2336	-3.0850**	1.8892	-1.9199	1.1767	2.2319*
Density of creative jobs	Number of creative jobs	1.4493	1.2734	-2.6220**	3.6902***	0.0785	2.0898*
Density of creative jobs	Logged number of creative jobs per commercial square foot	2.1046*	-1.7325	1.0318	-0.8505	3.6273***	2.7391**
Jobs in small businesses	% of jobs in businesses with fewer than 20 employees	-4.5405***	-3.3491***	7.6774***	-0.6022	6.0990***	-2.8339**
New businesses	Number of new businesses	-0.6656	0.2854	-2.7677**	7.3662***	-3.7994***	2.6279**
	% of businesses that were newly opened in 2012	-0.367	-0.424	4.469***	2.375*	-0.908	-1.053

SAN FRANCISCO							
		Median Building Age ¹⁵	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
ECONOMIC PERFORMANCE (cont.)							
	Logged number of new businesses per commercial square foot	-5.1244***	-4.5704***	8.6038***	-3.7700**	3.0796**	-6.2276***
Local businesses	Percent of non-chain businesses	-5.4583***	-0.2051	1.6989	-0.6237	2.3821*	0.9160
Women or minority-owned businesses	% of businesses that are women or minority-owned	3.3090***	1.5754	1.7632	-2.3733*	0.1545	-1.1048
	Number of women or minority-owned businesses	1.1982	1.5045	-2.2290*	4.1476***	-0.8528	0.6112
Employment	Employment rate	-0.3719	1.1273	-0.0944	0.1894	13.7047***	3.1530**
Property values	Average annual change in property values (1999–2012)	-4.3421***	1.7239	2.0698*	-0.2874	2.2918*	-1.1808
Vacancies	% of lots that are vacant	3.1956**	2.2658*	0.2636	-0.3611	-2.2163*	-1.3472

SAN FRANCISCO							
		Median Building Age ¹⁵	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
CULTURAL PERFORMANCE							
Business hours of operation	% businesses open on Sunday at 4 p.m.	-1.5237	-2.2506*	1.9089	-0.3729	-2.2708*	-1.2687
	% businesses open on Wednesday at 10 a.m.	-0.0899	-1.4895	0.3127	-0.0657	-0.4135	-2.8859**
Business hours of operation	% businesses open on Friday at 10 p.m.	-0.0803	-2.0980*	2.2677*	-1.7692	-0.8172	-0.0803
Intensity of cellphone usage	Intensity of cellphone usage on Sunday at 4 p.m.	-3.4924***	1.2761	-7.2501**	2.1770*	0.6926	6.4419***
	Intensity of cellphone usage on Wednesday at 10 a.m.	-1.3630	3.4045***	-9.3664***	4.3298***	1.2443	6.7278***
	Intensity of cellphone usage on Friday at 10 p.m.	-2.3249*	2.3585*	-3.6393***	2.6832**	-1.9456	9.8477***

SAN FRANCISCO							
		Median Building Age ¹⁵	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
CULTURAL PERFORMANCE (cont.)							
Outdoor seating	Number of outdoor café permits	-3.9076***	-0.4986	-2.2762*	2.6493**	-1.4616	1.5144
Locations of photos available on Flickr	Number of photos	-2.7693**	0.4881	-4.9898***	1.6748	-3.0259**	4.7357***
Cultural non-profit organizations	Locations of cultural non-profits	-1.3980	0.8866	-2.6469**	3.3845***	-3.5699***	3.4221***
Farmers' markets	Locations of farmers' markets	-0.4827	-0.5299	-1.4994	-0.1129	-0.6317	0.2010
TRANSPORTATION PERFORMANCE¹⁶							
Walkability	Walk Score [®] rating	-2.5432*	0.6428	0.6266	1.6730	-0.6344	N/A
Bike friendliness	Bike Score [™] rating	-0.7538	0.0010	-3.5308***	1.1121	1.0768	N/A
	Locations of bike share stations	1.8659	2.8535**	-2.4982*	2.7472**	-0.3030	2.8451**
Transit accessibility	Transit Score [®] rating	-0.5328	2.0062*	1.5486	2.5002*	1.3081	N/A

16 Regression models for Walk Score[®], Bike Score[™], and Transit Score[®] measures excluded the use of Transit Score[®] metric as a control measure.

VALUES OF *t*-STATISTICS FOR COMPOSITE SCORE AND OTHER INDEPENDENT VARIABLES - WASHINGTON, D.C.

WASHINGTON, D.C.					
		Built Fabric Composite ¹⁷	Private Investment	Median Income	Transit Score [®] rating
SOCIAL PERFORMANCE					
Characteristics of residents	Median age of residents	-5.9838***	-2.9807**	6.8722***	-1.3026
	Resident Age Diversity Index	4.3795***	1.0271	1.1863	-9.0767***
	Racial and Ethnic Diversity Index	0.8479	5.0409***	6.5330***	7.3364***
	Income Diversity Index	-1.5848	0.0084	N/A	0.7348
Population density	Households per acre	5.2426***	4.8506***	-2.0770*	3.5662***
	Housing units per acre	5.4941***	4.9216***	-2.1242*	3.6300***
	Persons per sq mile	7.3277***	5.2746***	-2.8563**	3.1216**
Residential rents	Median rent	0.7854	-0.5668	7.0831***	9.2014***
	Standard deviation (diversity) of rents	0.5740	1.0287	4.0375***	9.9558***
ECONOMIC PERFORMANCE					
Density of businesses	Number of businesses	-4.3370***	7.8295***	1.5321	4.2454***
	Logged number of businesses per commercial square foot	11.3669***	0.2968	4.8857***	-8.0889***
Density of jobs	Number of jobs	-5.5752***	1.9235	1.9519	7.0394***
	Logged number of jobs per commercial square foot	4.7200***	-1.7672	4.9526***	6.7692***
Density of creative jobs	Number of creative jobs	-3.5819***	2.4693*	0.9594	4.5164***

17 Asterisks indicate level of significance associated with each variable. * < .05, ** < .01, *** < .001

WASHINGTON, D.C.					
		Built Fabric Composite ¹⁷	Private Investment	Median Income	Transit Score [®] rating
ECONOMIC PERFORMANCE (cont.)					
	Logged number of creative jobs per commercial square foot	4.0105***	-1.7299	4.4177***	0.8945
Jobs in small businesses	Percent of jobs in businesses with fewer than 20 employees	5.9812***	-0.9184	2.0510**	-7.6977***
New businesses	Number of new businesses	-0.6810	7.5638***	-1.1291	2.7372**
	% of businesses that were newly opened in 2012	-0.1514	3.2609**	-5.5125***	-3.2983***
New businesses	Logged number of new businesses per commercial square foot	8.6676***	-4.1470***	-2.7703**	-10.7175***
Local businesses	Percent of non-chain businesses	6.867***	-0.447	-0.726	0.902
Women or minority-owned businesses	% of businesses that are women or minority-owned	3.3122***	1.4255	-4.4834***	-2.6983**
	Number of women or minority-owned businesses	0.3194	3.6784***	-1.7253	0.1129
Employment	Employment rate	1.4569	4.8455***		4.6615***
Property values	Average annual change in property values (1999 - 2012)	6.3925***	1.6964	-4.3415***	1.8818
Vacancies	% of lots that are vacant	1.046	1.106	-3.508***	-1.227
CULTURAL PERFORMANCE					
Business hours of operation	% businesses open on Sunday at 4 p.m.	1.620	-3.942***	0.9230	-0.421
	% businesses open on Wednesday at 10 a.m.	-0.9008	-3.5886***	-0.9766	-1.6703
	% businesses open on Friday at 10 p.m.	1.120	-1.083	1.399	-0.496
Intensity of cellphone usage	Intensity of cellphone usage on Sunday at 4 p.m.	-2.4954*	2.4767*	4.4007***	8.8283***
	Intensity of cellphone usage on Wednesday at 10 a.m.	-8.8276***	4.3821***	2.3935*	9.9344***

WASHINGTON, D.C.					
		Built Fabric Composite ¹⁷	Private Investment	Median Income	Transit Score [®] rating
CULTURAL PERFORMANCE (cont.)					
	Intensity of cellphone usage on Friday at 10 p.m.	0.0681	3.8488***	1.9564	7.5631***
Outdoor seating	Number of outdoor café permits	0.3336	3.8754***	2.6157**	4.5385***
Locations of photos available on Flickr	Number of photos	-1.3671	1.5571	2.1855*	8.7335***
Cultural non-profit organizations	Locations of cultural non-profits	-0.174	0.180	1.478	1.978
Farmers' markets	Locations of farmers' markets	-1.254	0.464	-0.153	1.101
TRANSPORTATION PERFORMANCE¹⁸					
Walkability	Walk Score [®] rating	1.9419	0.8920	0.6308	N/A
Bike friendliness	Bike Score [™] rating	2.4281*	3.2255**	2.0957*	N/A
	Locations of bike share stations	-1.3986	3.1565**	0.5807	1.8723
Transit accessibility	Transit Score [®] rating	1.2880	0.4190	-7.9827***	N/A

18 Regression models for Walk Score[®], Bike Score[™], and Transit Score[®] measures excluded the use of Transit Score[®] metric as a control measure.

VALUES OF *t*-STATISTICS FOR COMPONENT MEASURES OF BUILDING FABRIC AND OTHER INDEPENDENT VARIABLES – WASHINGTON, D.C.

WASHINGTON, D.C.							
		Median Building Age ¹⁹	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
SOCIAL PERFORMANCE							
Characteristics of Residents	Median age of residents	0.3935	-3.8909***	-5.1586***	-2.6318**	-1.3818	0.3935
	Resident Age Diversity Index	0.2201	0.1689	6.9849***	0.3665	1.0379	-8.940***
	Racial and Ethnic Diversity Index	-0.3542	-0.1257	1.1568	4.9125***	6.4875***	7.3763***
	Income Diversity Index	0.5546	-1.9937**	0.1267	-0.0478	N/A	0.7513
Population density	Households per acre	3.2106**	5.2353***	7.5594***	3.8048***	-2.4076*	3.5134***
	Housing units per acre	3.0806**	5.4217***	7.6365***	3.8787***	-2.4505*	3.5859***
	Persons per sq mile	2.2990*	5.1739***	10.1259***	4.1077***	-3.2714**	3.2121**
Residential rents	Median rent	-0.5929	-0.1954	0.4349	1.0279	4.0237***	9.9672***
	Standard deviation (diversity) of rents	0.3416	2.2210*	-0.6614	-0.5183	7.1913***	9.3654***

19 Asterisks indicate level of significance associated with each variable. * < .05, ** < .01, *** < .001

WASHINGTON, D.C.							
		Median Building Age ¹⁹	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
ECONOMIC PERFORMANCE							
Density of businesses	Number of businesses	3.2345**	1.7825	-2.3328*	7.6383***	1.3148	3.2396**
	Logged number of businesses per commercial square foot	-3.0109**	1.2890	9.9376***	-0.1243	5.0261***	-6.6154***
Density of jobs	Number of jobs	4.2115***	0.0360	-1.7321	1.6737	1.8138	6.4277***
	Logged number of jobs per commercial square foot	-2.8734**	0.4778	2.8679**	-1.7674	4.9551***	7.0312***
Density of creative jobs	Number of creative jobs	1.9297	-0.2826	-1.5740	2.3624*	0.8194	4.0273***
Jobs in small businesses	Percent of jobs in businesses with fewer than 20 employees	-1.3944	-0.7207	7.6733***	-1.4383	1.9548	-6.9061***
New businesses	Number of new businesses	2.0228*	3.6756***	-0.5625	7.2866***	-1.3405	1.6380
	% of businesses that were newly opened in 2012	1.2408	1.2817	0.4901	3.0556**	-5.5518***	-3.4833***

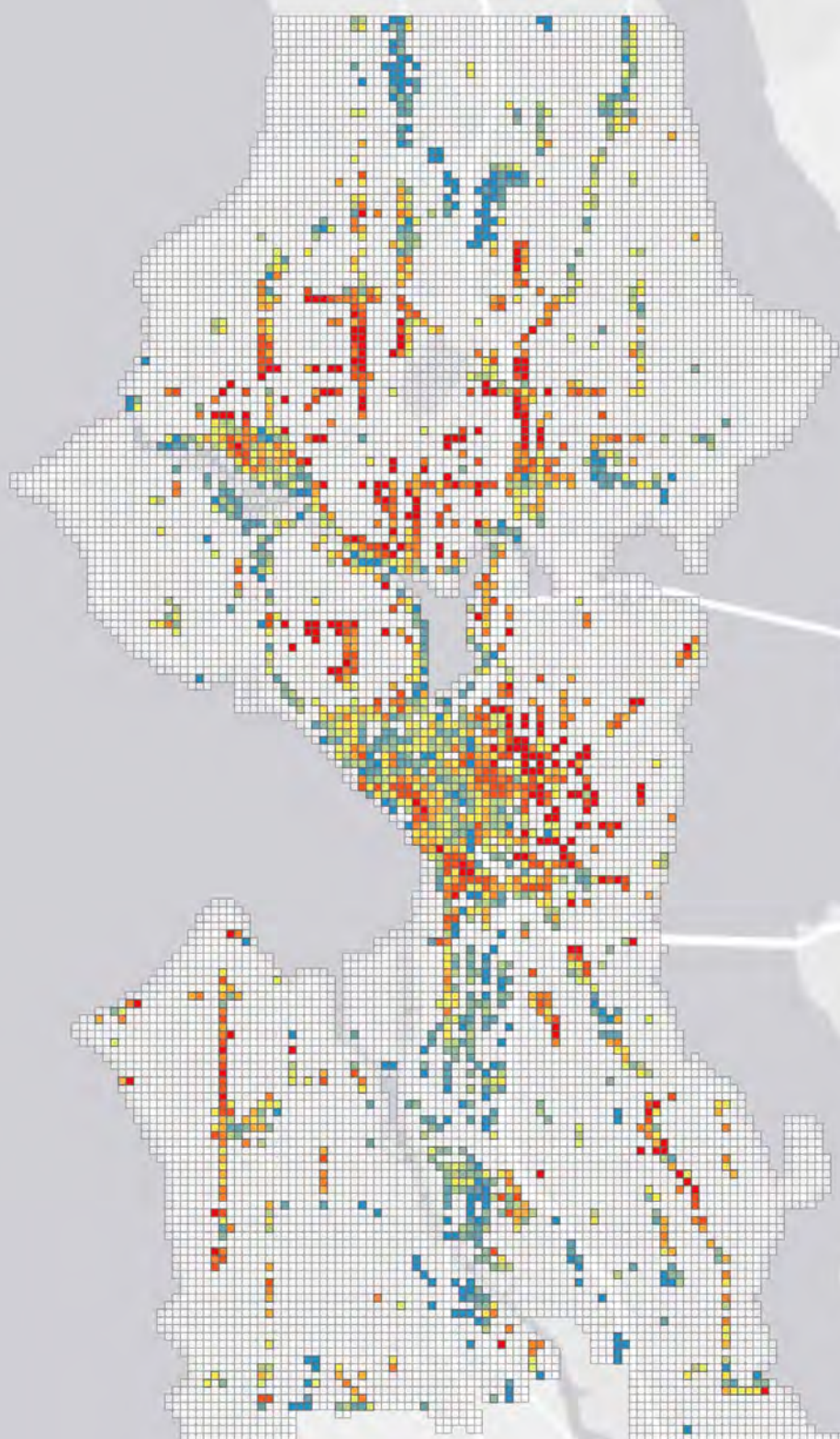
WASHINGTON, D.C.							
		Median Building Age ¹⁹	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
ECONOMIC PERFORMANCE (cont.)							
	Logged number of new businesses per commercial square foot	-1.6203	-0.6215	8.9342***	-4.6150***	-2.9996**	-8.6603***
Local businesses	Percent of non-chain businesses	-2.740**	-0.741	4.817***	-0.506	-0.479	2.567*
Women or minority-owned businesses	% of businesses that are women or minority-owned	-1.3641	0.0601	2.1046*	1.4265	-4.4291***	-2.1364*
	Number of women or minority-owned businesses	-0.9051	-0.0804	-0.5965	3.7123***	-1.7126	0.0945
Employment	Employment rate	0.3998	1.9666*	0.9152	4.6664***	18.7427***	4.5185***
Property values	Average annual change in property values (1999-2012)	-4.1619***	5.0661***	-0.0669	1.9865*	-4.2730***	1.3549
Vacancies	% of lots that are vacant	-3.762***	-0.772	-2.576*	1.596	-3.432***	-1.156
CULTURAL PERFORMANCE							
Business hours of operation	% businesses open on Sunday at 4 p.m.	-0.930	-0.085	0.741	-3.813***	0.976	-0.116

WASHINGTON, D.C.							
		Median Building Age ¹⁹	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
CULTURAL PERFORMANCE (cont.)							
	% businesses open on Wednesday at 10 a.m.	-0.8008	-1.9463	-0.8009	-3.3063***	-0.8699	-1.1594
	% businesses open on Friday at 10 p.m.	-0.098	1.602	0.225	1.319	-0.861	-0.098
Intensity of cellphone usage	Intensity of cellphone usage on Sunday at 4 p.m.	0.6070	4.1238***	-4.3786***	2.7477**	4.4255***	7.3180***
Intensity of cellphone usage	Intensity of cellphone usage on Wednesday at 10 a.m.	4.0082***	2.0264*	-9.3096***	5.9593***	3.4190***	14.3522***
	Intensity of cellphone usage on Friday at 10 p.m.	0.9349	5.2774***	-1.7696	3.8907***	1.8068	6.1512***
Outdoor seating	Number of outdoor café permits	0.4946	3.3212***	-0.9467	3.7530***	2.4978*	3.5476***
Locations of photos available on Flickr	Number of photos	-1.7567	1.6105	-4.4057***	1.9508	2.1732*	7.8678***
Cultural non-profit organizations	Locations of cultural non-profits	-1.019	-0.255	-1.173	0.339	1.493	1.844
Farmers' markets	Locations of farmers' markets	0.946	0.449	-0.677	0.520	-0.137	0.945

WASHINGTON, D.C.							
		Median Building Age ¹⁹	Diversity of Building Age	Granularity	Private Investment	Median Income	Transit Score [®] rating
TRANSPORTATION PERFORMANCE ²⁰							
Walkability	Walk Score [®] rating	-0.8890	2.4622*	-0.4949	0.9994	0.7107	N/A
Bike friendliness	Bike Score [™] rating	-2.2081*	0.1755	1.7774	3.2255**	2.0485*	N/A
	Locations of bike share stations	1.0558	3.4475***	-2.2313*	3.5478***	0.6092	1.1547
Transit accessibility	Transit Score [®] rating	0.1037	0.5170	1.8708	0.2081	-8.0534***	N/A

20 Regression models for Walk Score[®], Bike Score[™], and Transit Score[®] measures excluded the use of Transit Score[®] metric as a control measure.

APPENDIX D: CITY ATLAS



CHARACTER SCORE, SEATTLE



Newer, larger,
built at one time



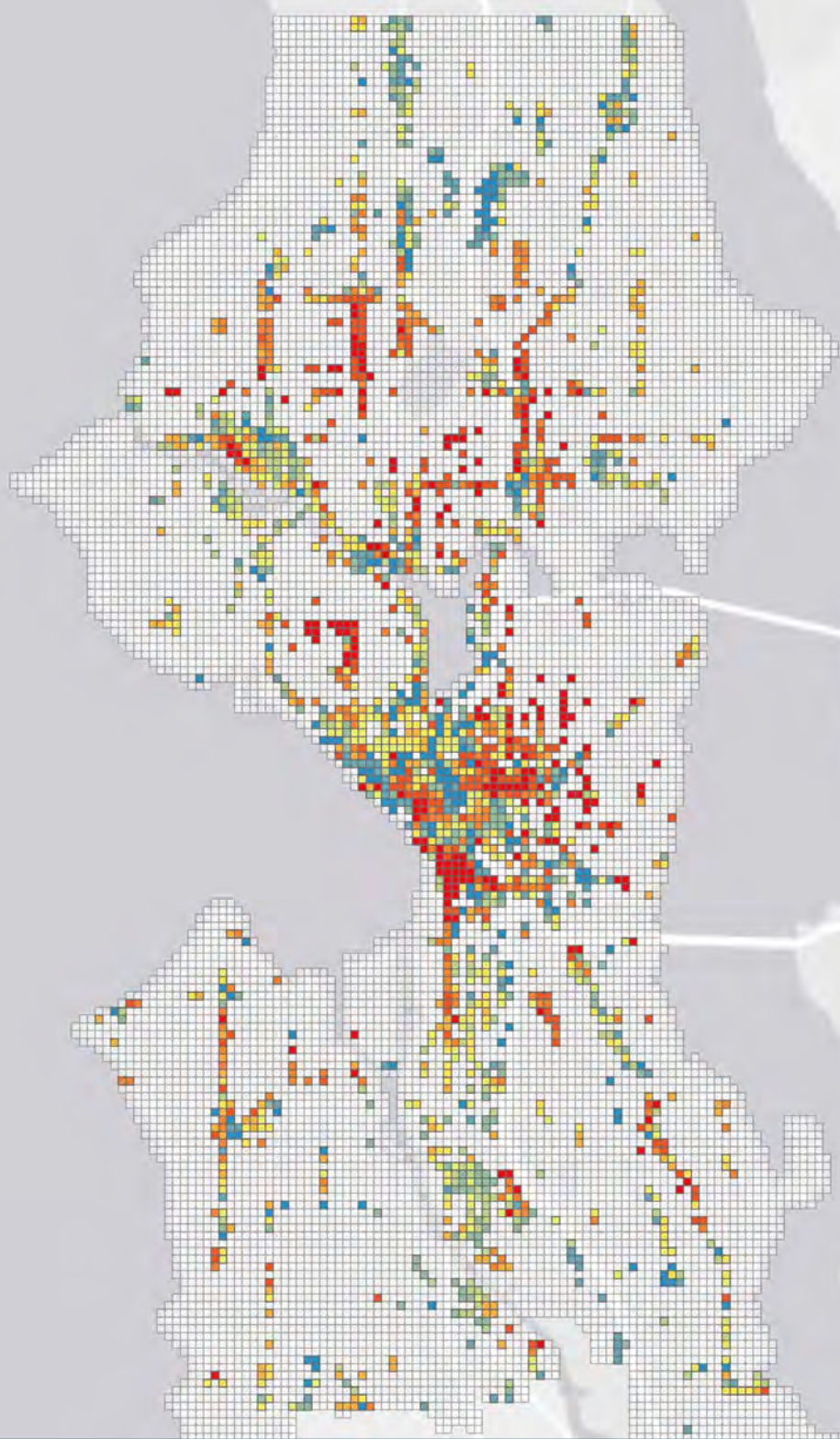
Older, smaller,
mixed-vintage



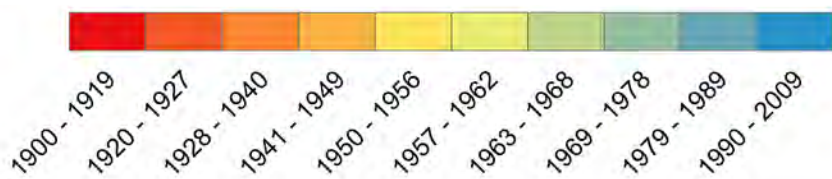
Commercial and mixed
use grid squares:

2,127 out of 12,675

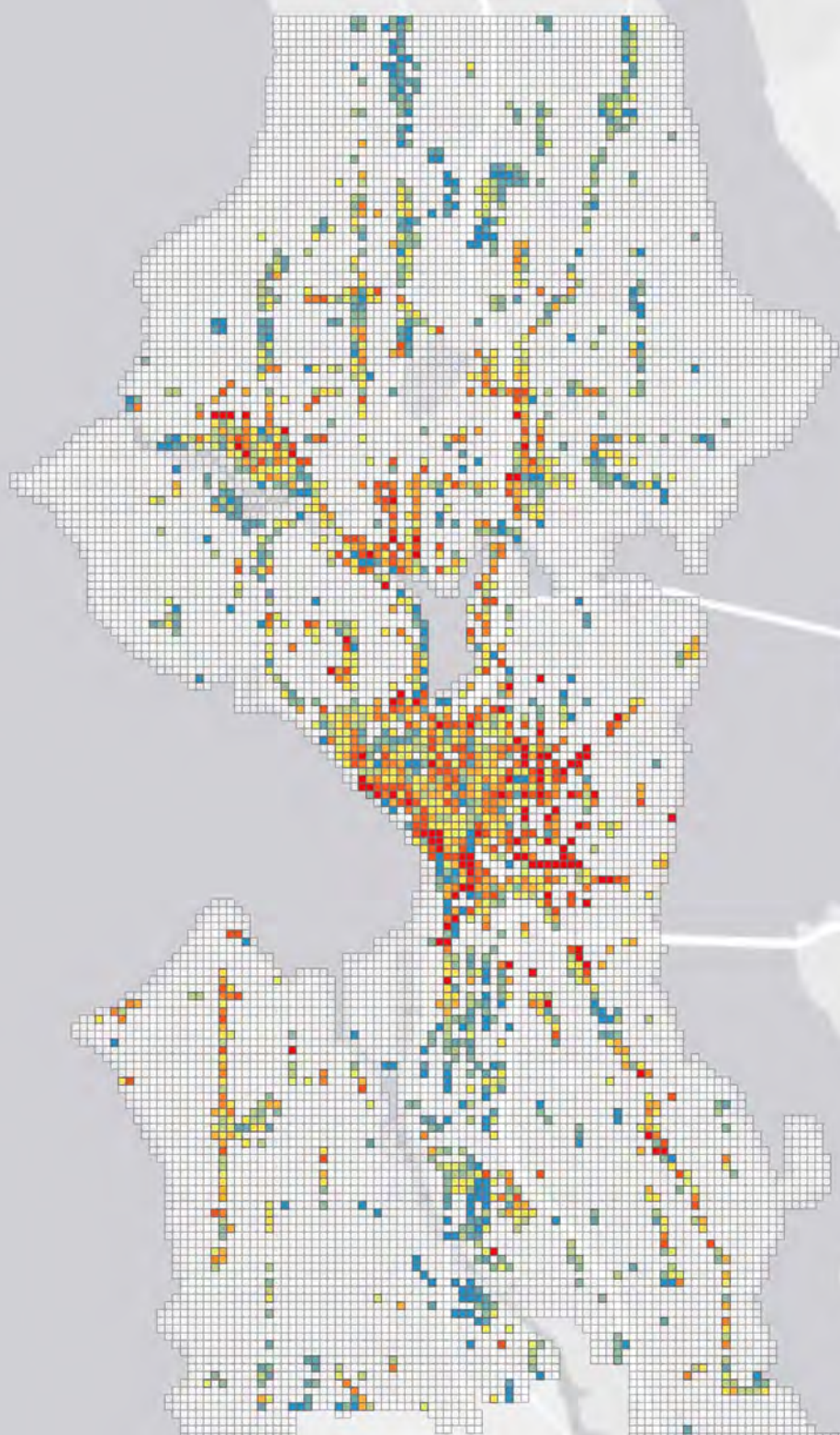




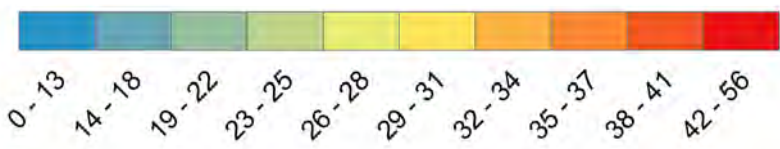
MEDIAN BUILDING AGE, SEATTLE



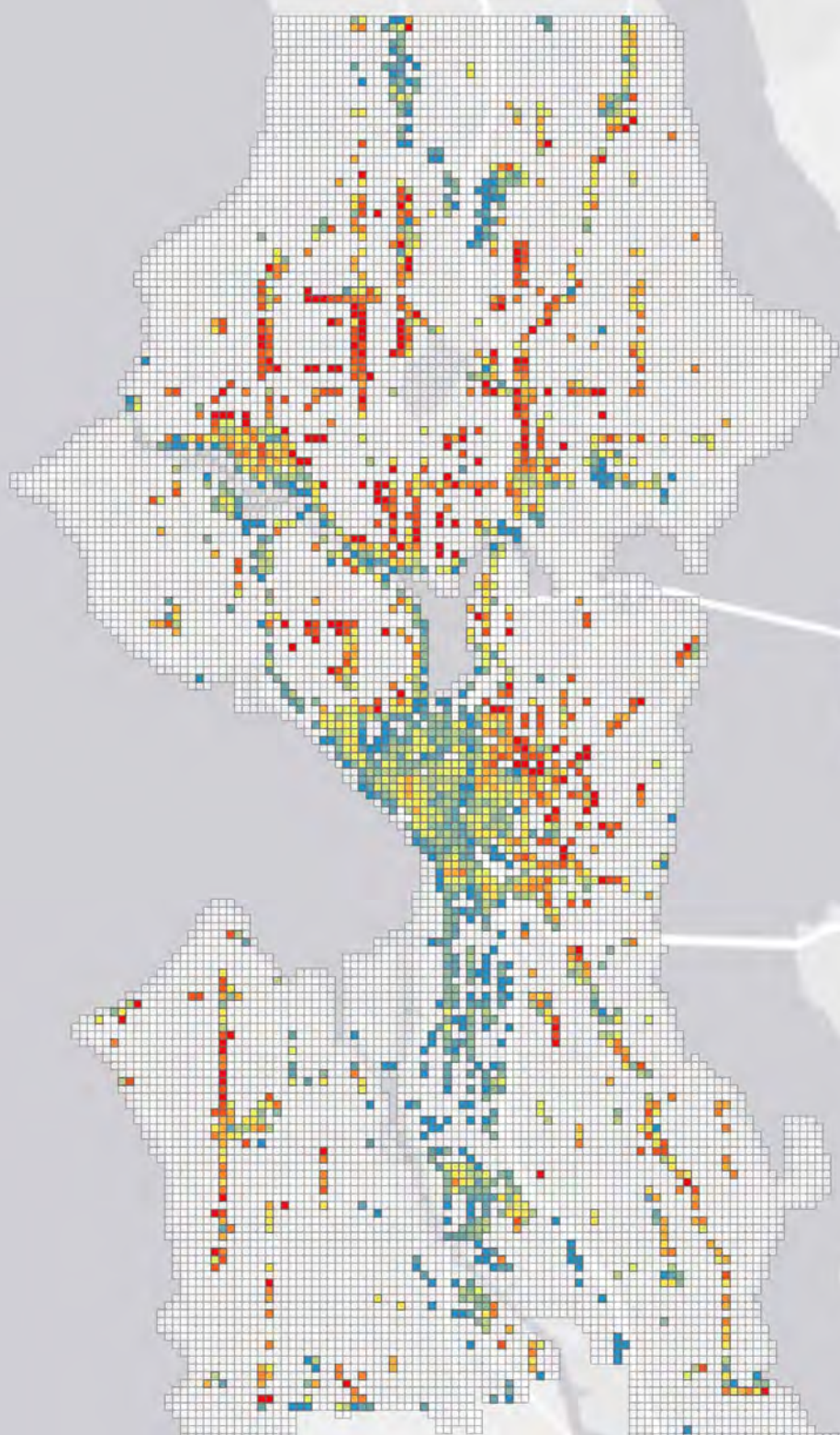
Commercial and mixed use grid squares:
2,127 out of 12,675



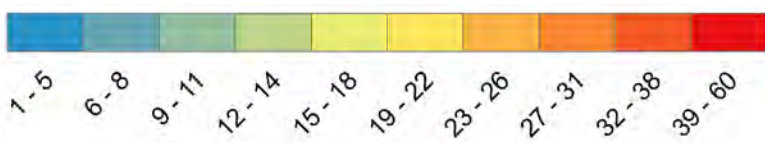
DIVERSITY OF BUILDING AGE, SEATTLE
Standard Deviation in Years



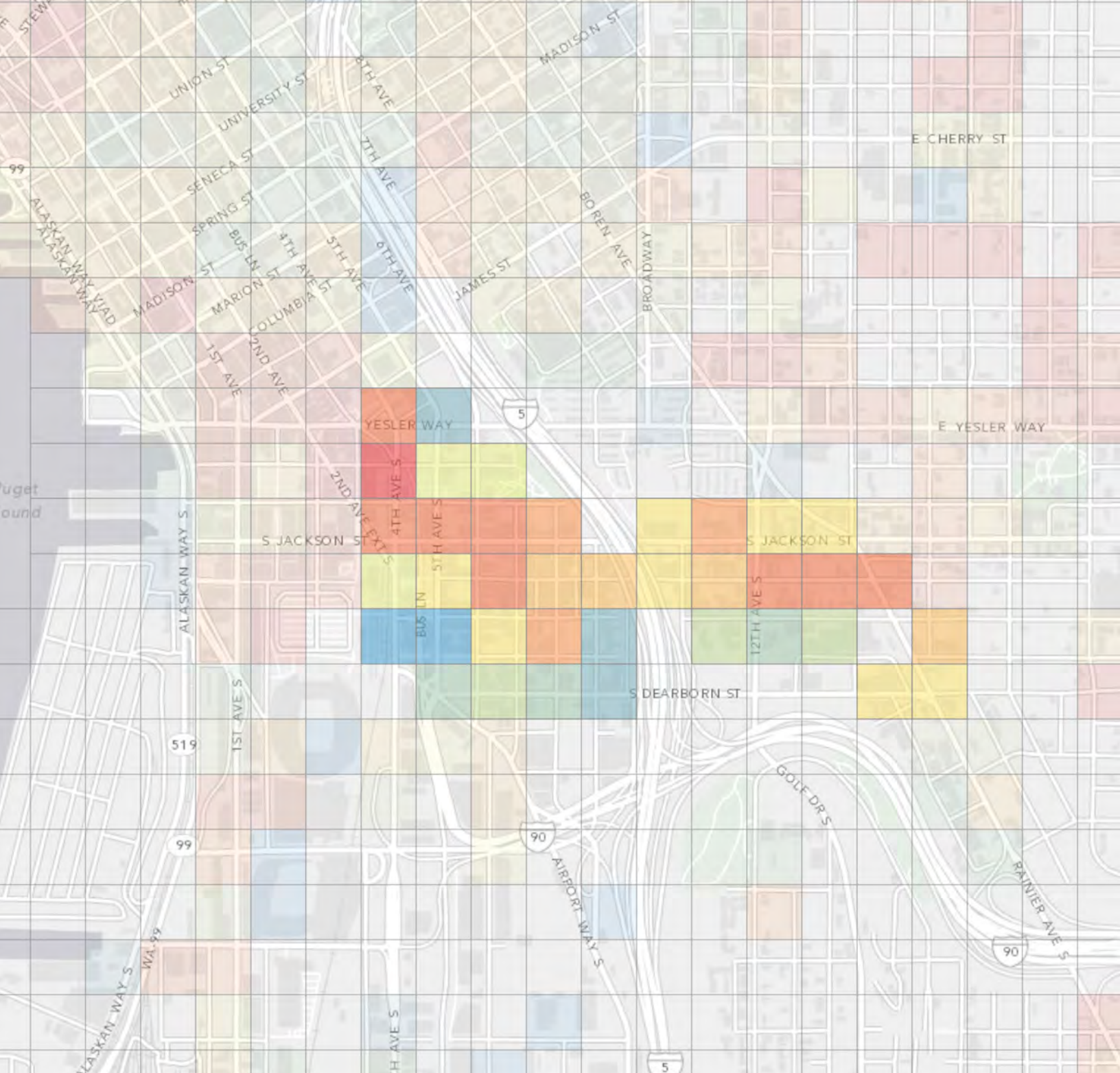
Commercial and mixed use grid squares:
2,127 out of 12,675



GRANULARITY, SEATTLE
 Parcels per Grid Square



Commercial and mixed use grid squares:
 2,127 out of 12,675



CHINATOWN INTERNATIONAL DISTRICT, SEATTLE CHARACTER SCORE



Newer, larger,
built at one time



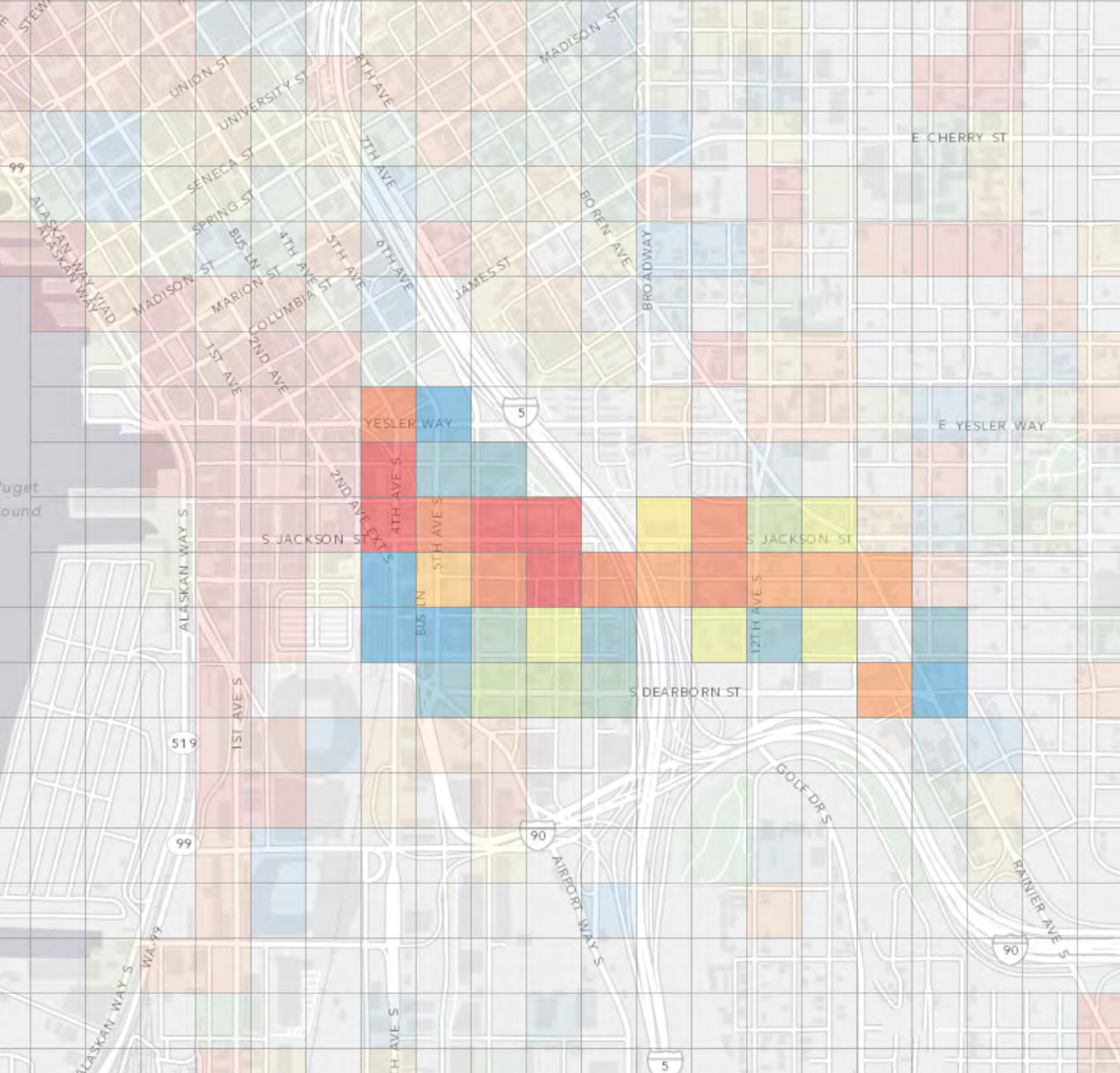
Older, smaller,
mixed-vintage



Commercial and mixed
use grid squares:

38



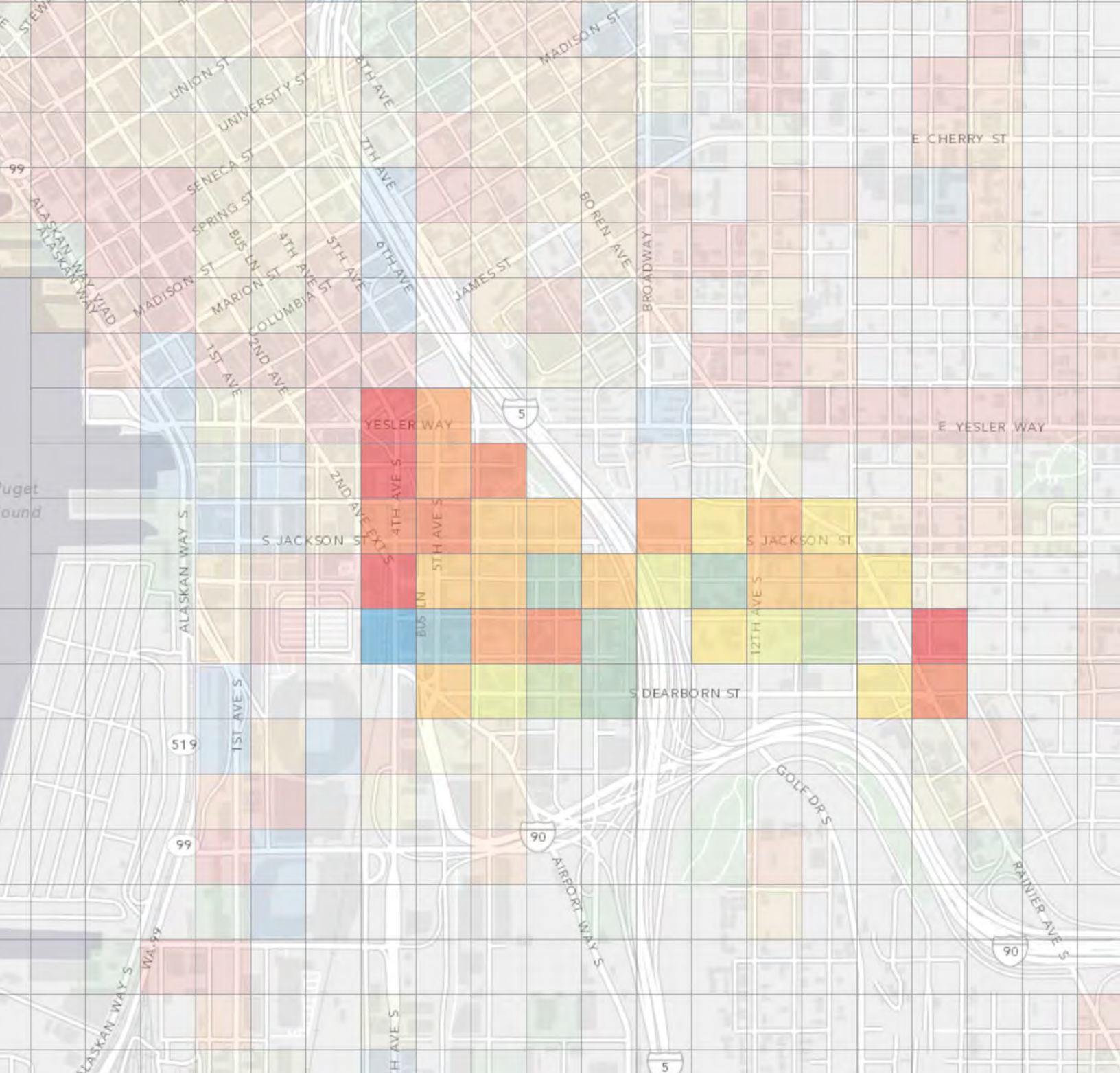


CHINATOWN INTERNATIONAL DISTRICT, SEATTLE MEDIAN BUILDING AGE

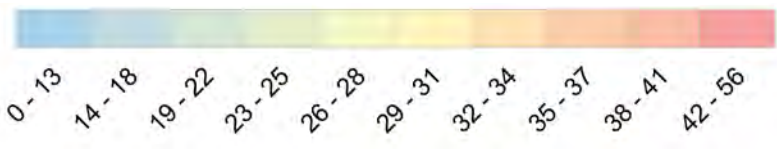


Commercial and mixed use grid squares:

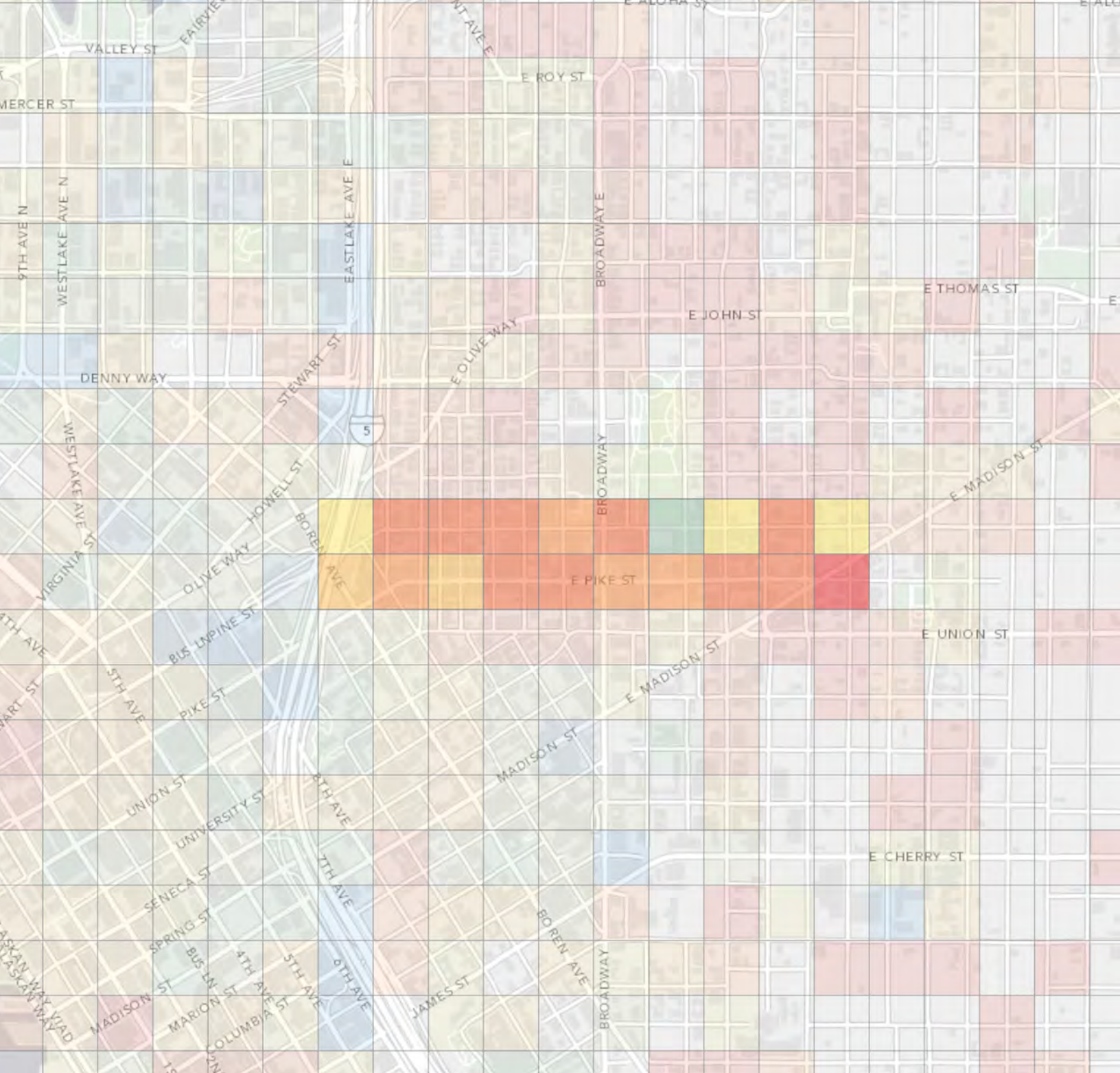
38



CHINATOWN INTERNATIONAL DISTRICT, SEATTLE
DIVERSITY OF BUILDING AGE (Standard Deviation in Years)



Commercial and mixed use grid squares: 38



**PIKE/PINE, SEATTLE
CHARACTER SCORE**



Newer, larger,
built at one time

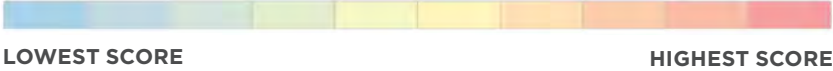


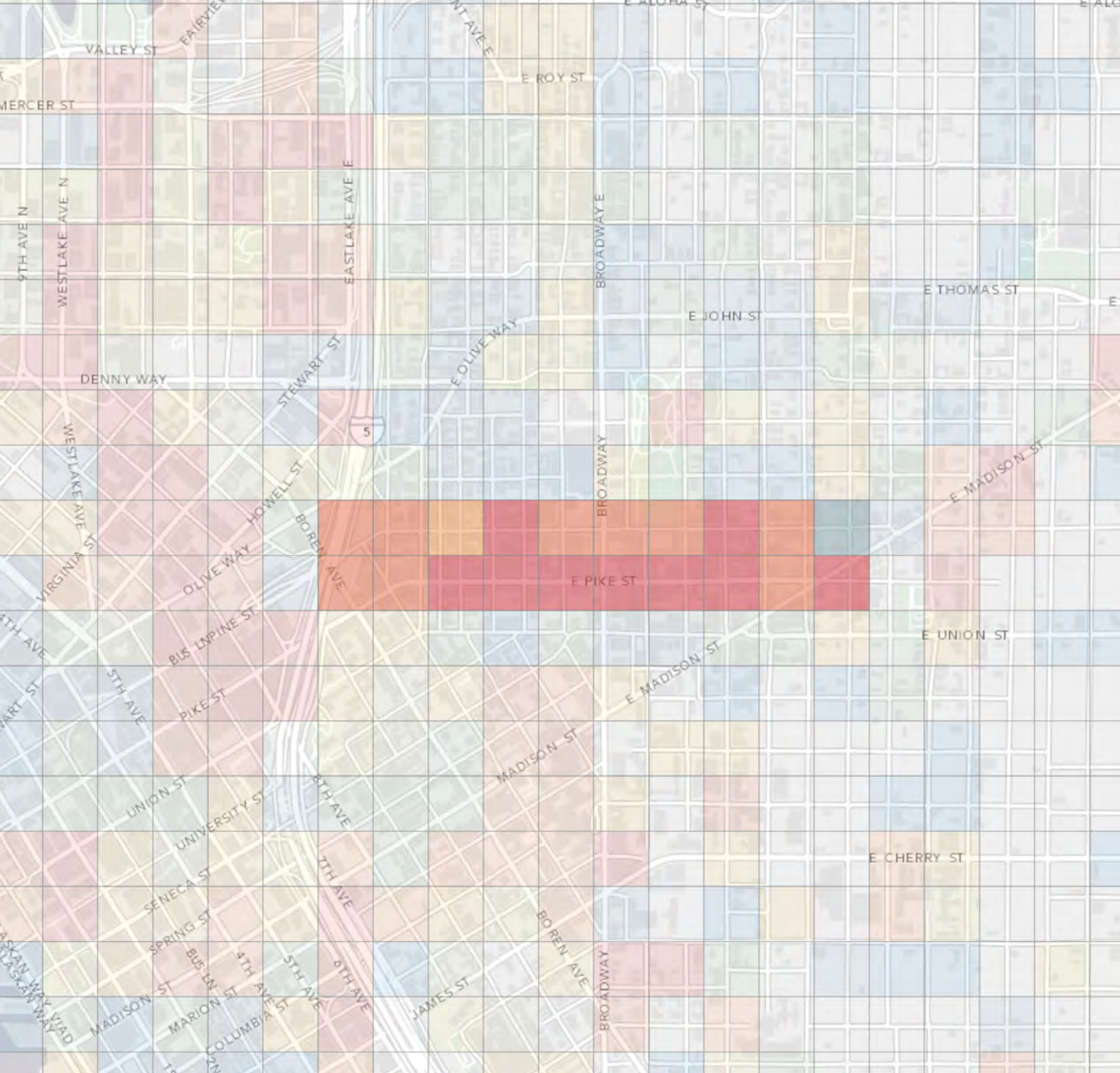
Older, smaller,
mixed-vintage



Commercial and mixed
use grid squares:

20

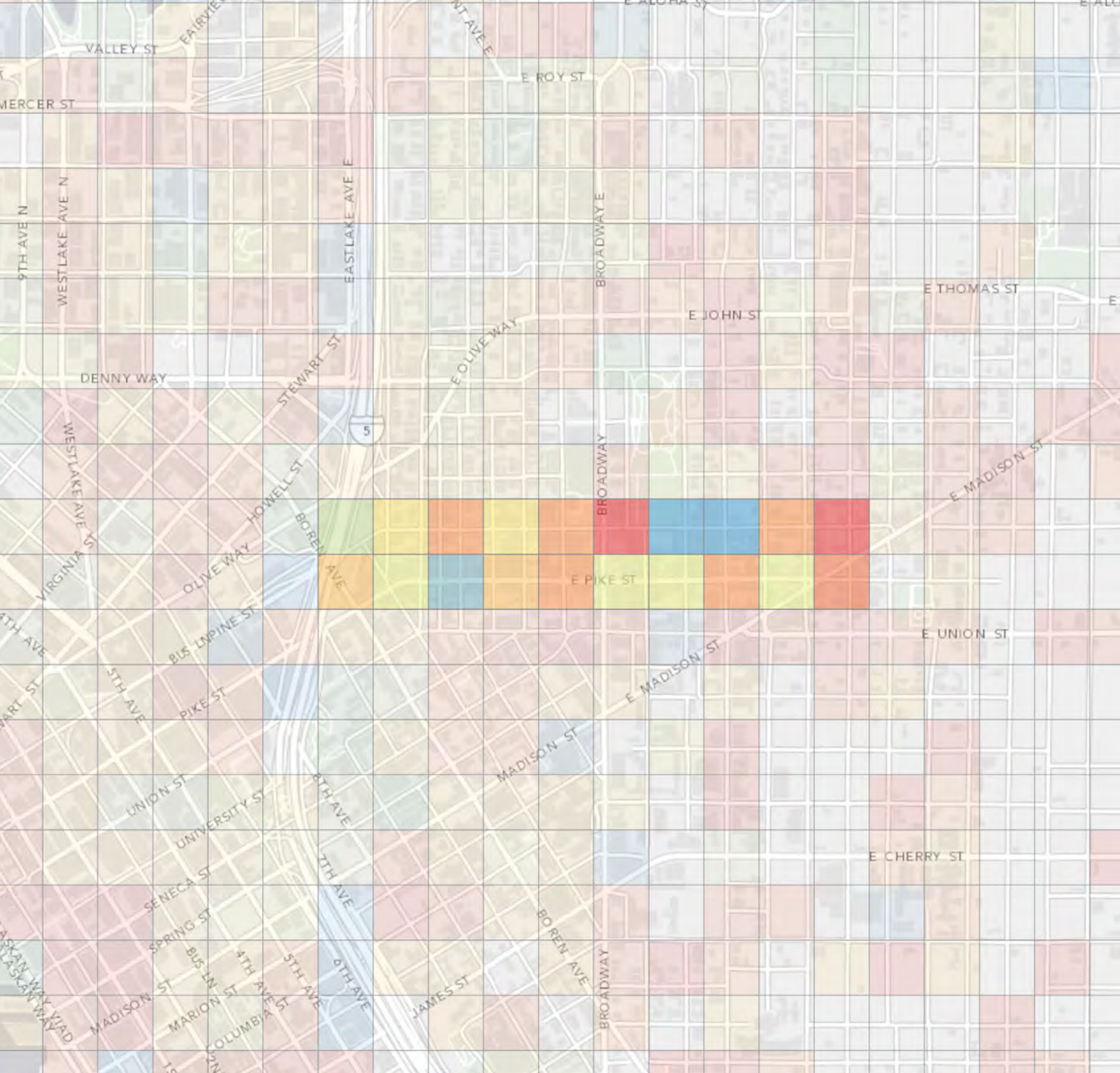




**PIKE/PINE, SEATTLE
MEDIAN BUILDING AGE**



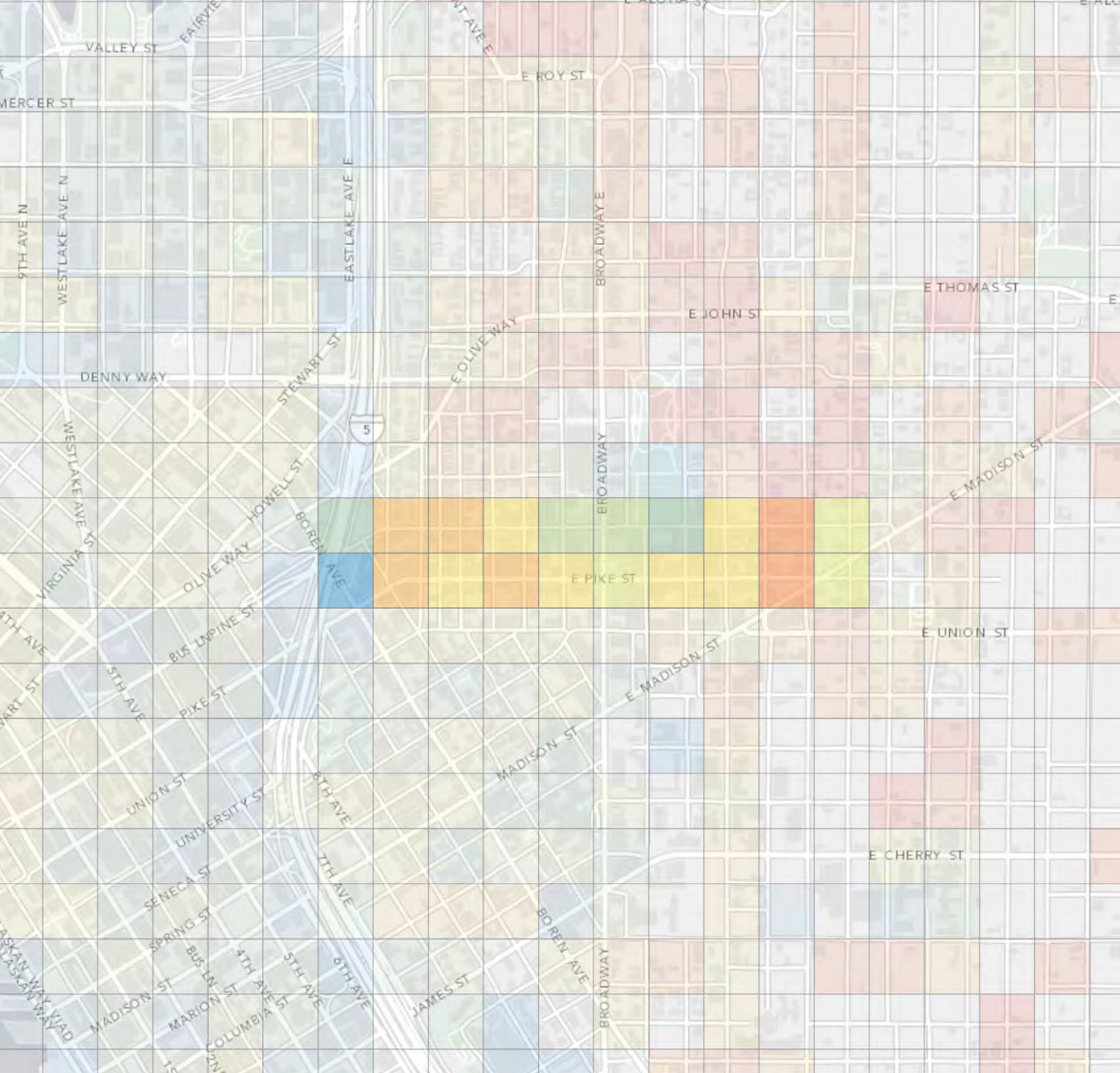
Commercial and mixed use grid squares:
20



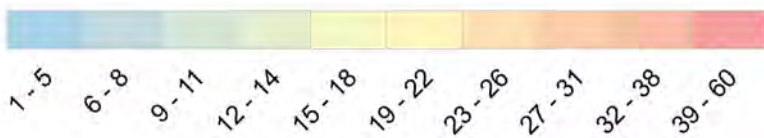
PIKE/PINE, SEATTLE
DIVERSITY OF BUILDING AGE (Standard Deviation in Years)



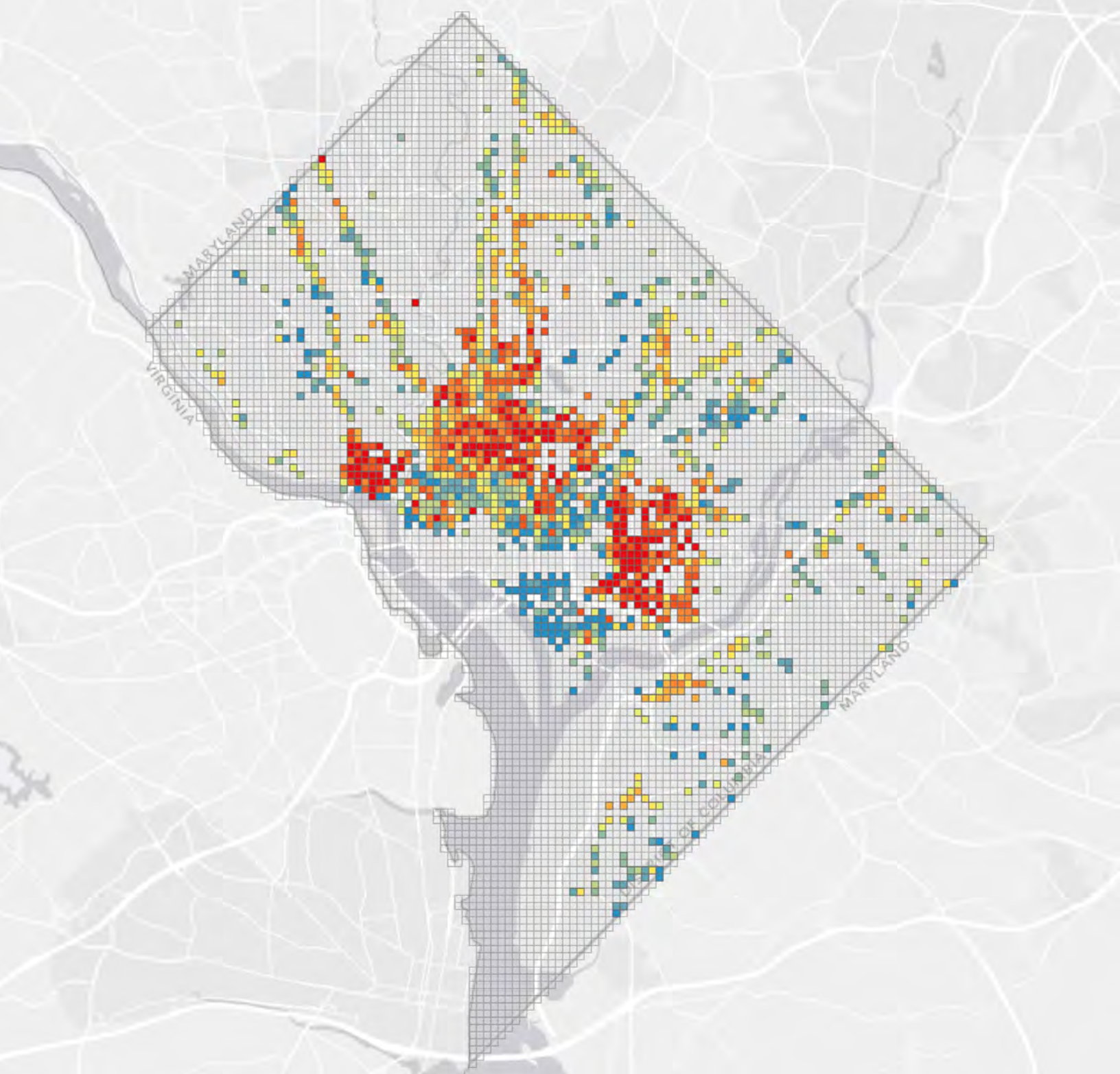
Commercial and mixed use grid squares:
 20



PIKE/PINE, SEATTLE
GRANULARITY (Parcels per Grid Square)



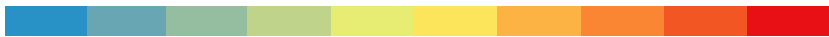
Commercial and mixed use grid squares:
 20



CHARACTER SCORE, WASHINGTON, D.C.



Newer, larger,
built at one time



LOWEST SCORE



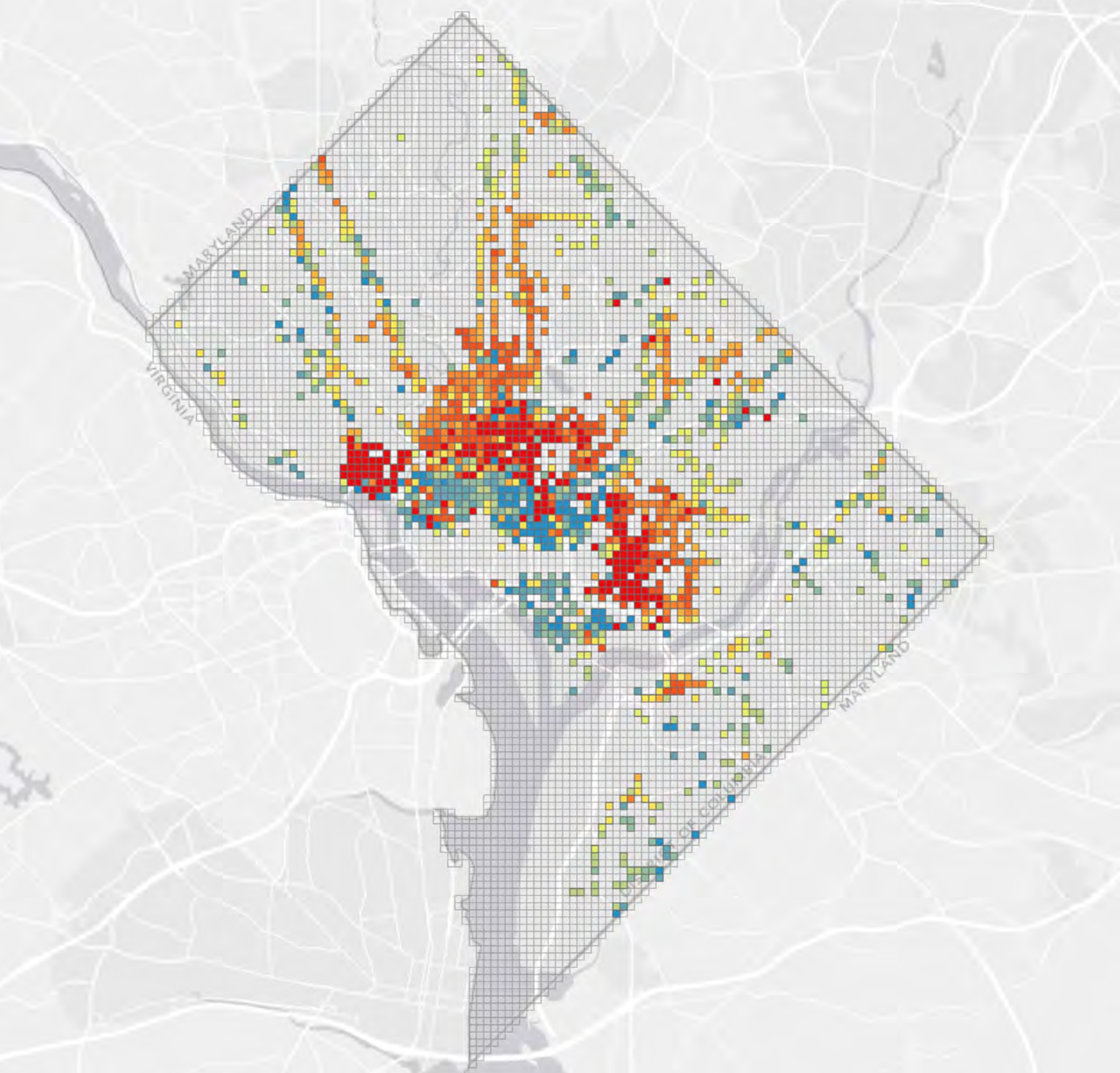
Older, smaller,
mixed-vintage

HIGHEST SCORE

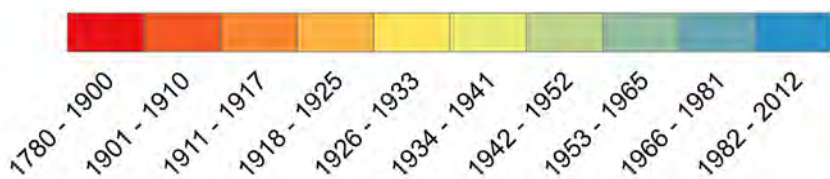


Commercial and mixed
use grid squares:

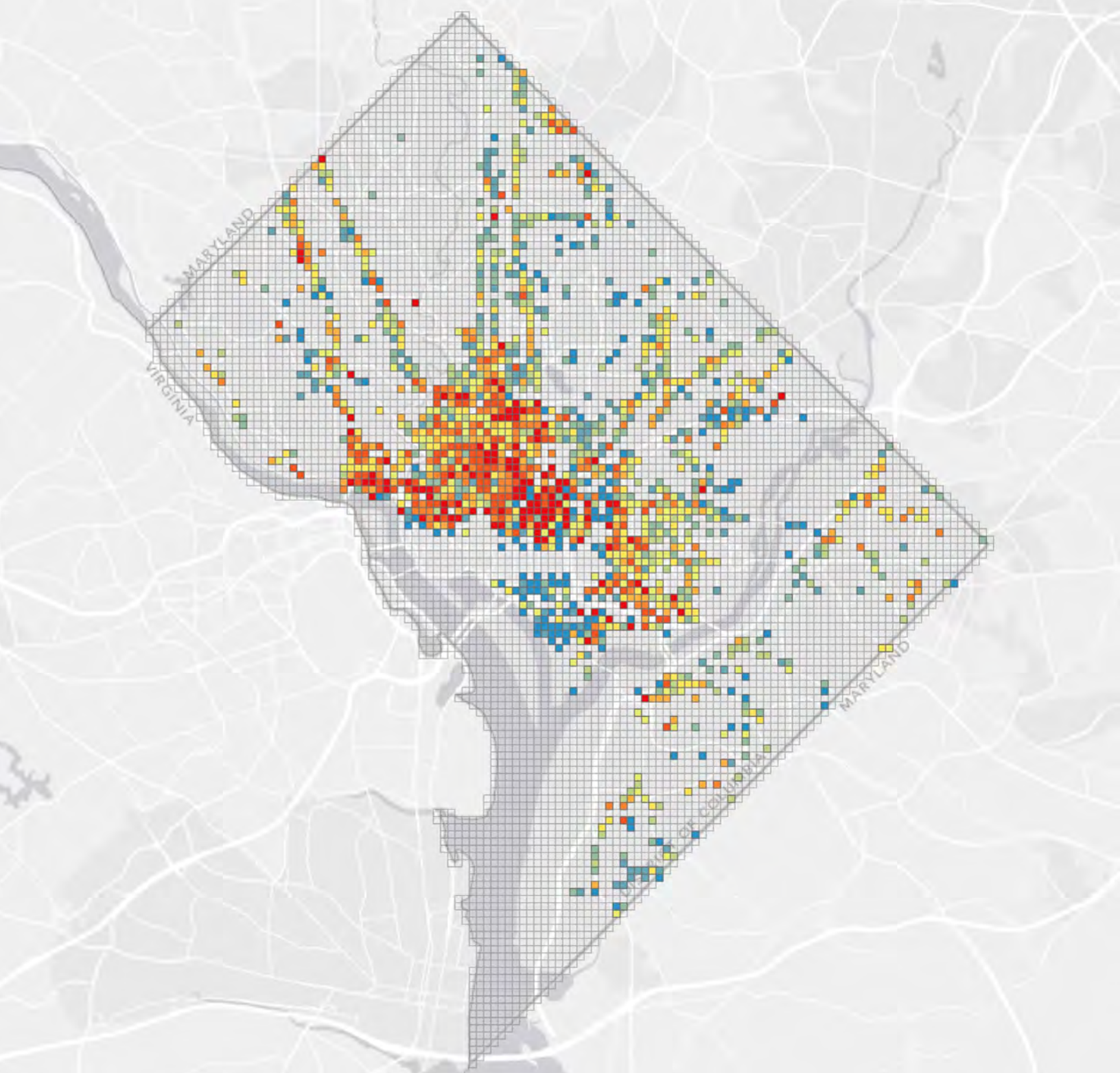
1,609 out of 7,625



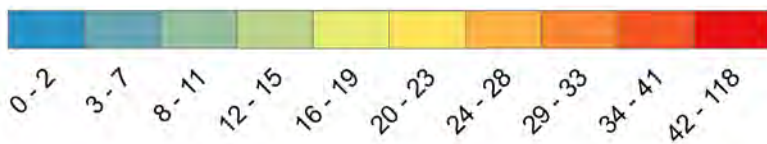
MEDIAN BUILDING AGE, WASHINGTON, D.C.



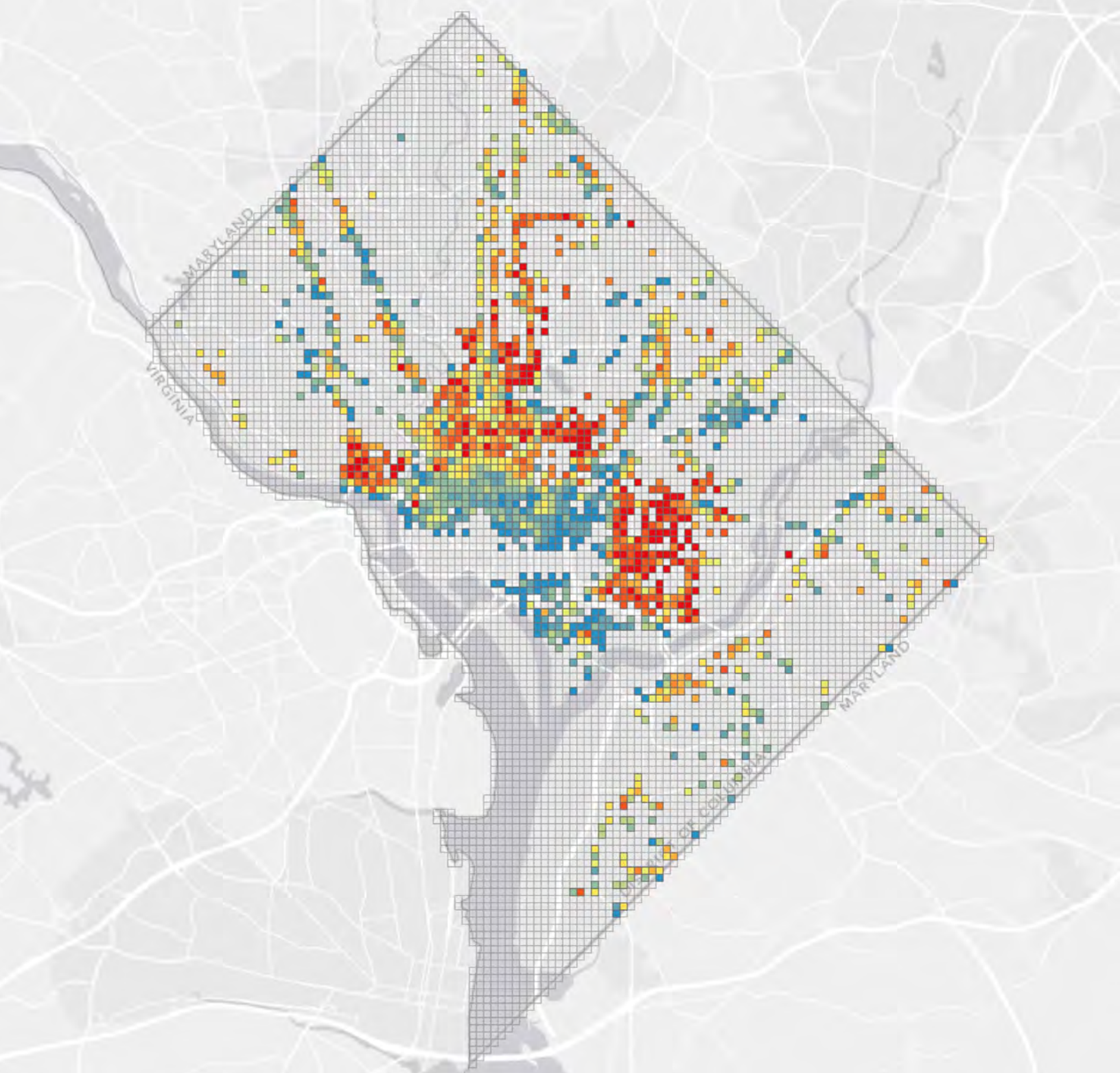
Commercial and mixed use grid squares:
1,609 out of 7,625



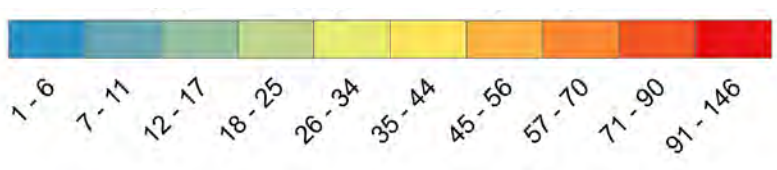
DIVERSITY OF BUILDING AGE, WASHINGTON, D.C.
Standard Deviation in Years



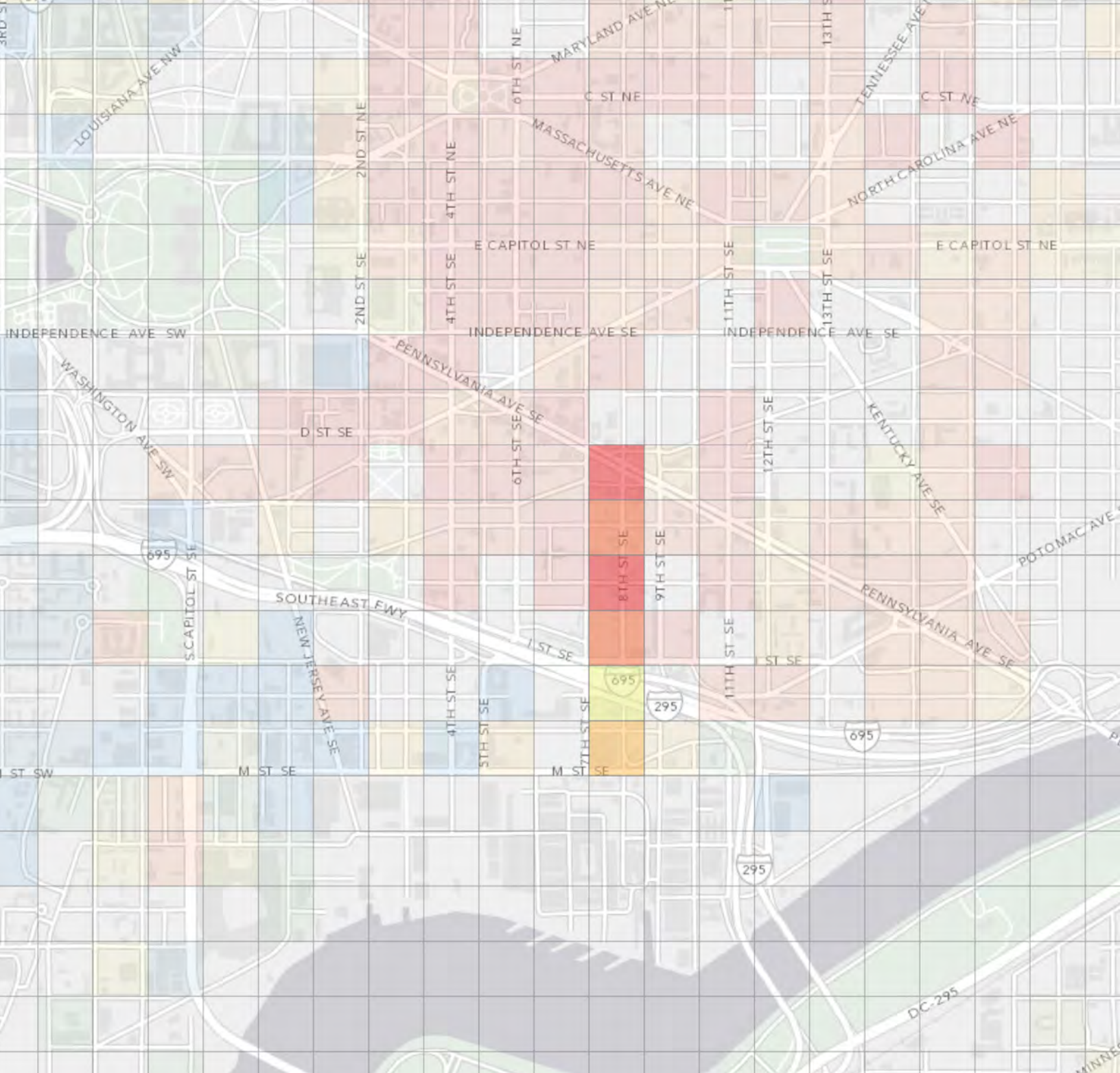
Commercial and mixed use grid squares:
1,609 out of 7,625



GRANULARITY, WASHINGTON, D.C.
Buildings per Grid Square



Commercial and mixed use grid squares:
 1,609 out of 7,625



BARRACKS ROW, WASHINGTON, D.C. CHARACTER SCORE



Newer, larger,
built at one time



Older, smaller,
mixed-vintage



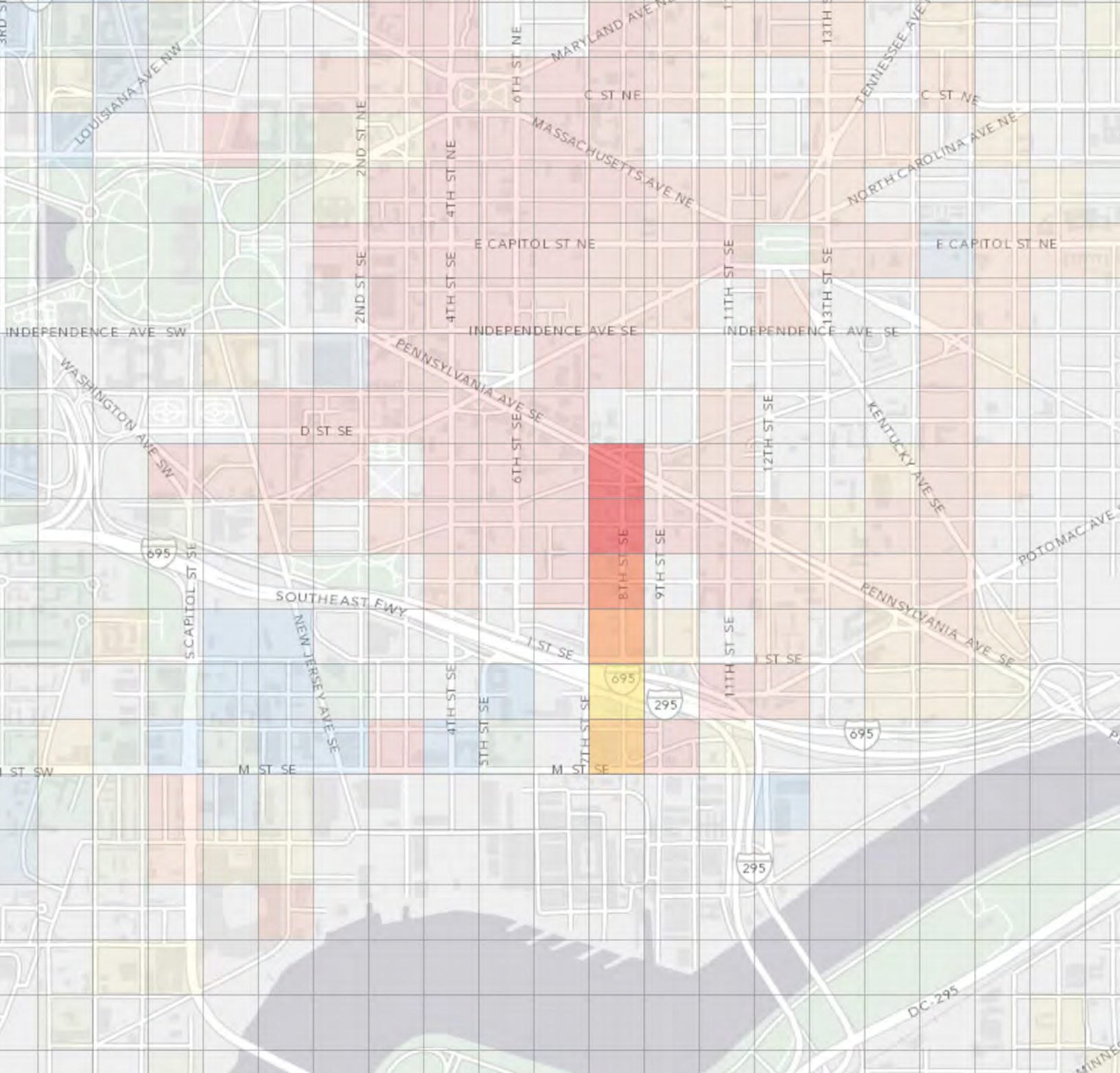
Commercial and mixed
use grid squares:

6



LOWEST SCORE

HIGHEST SCORE

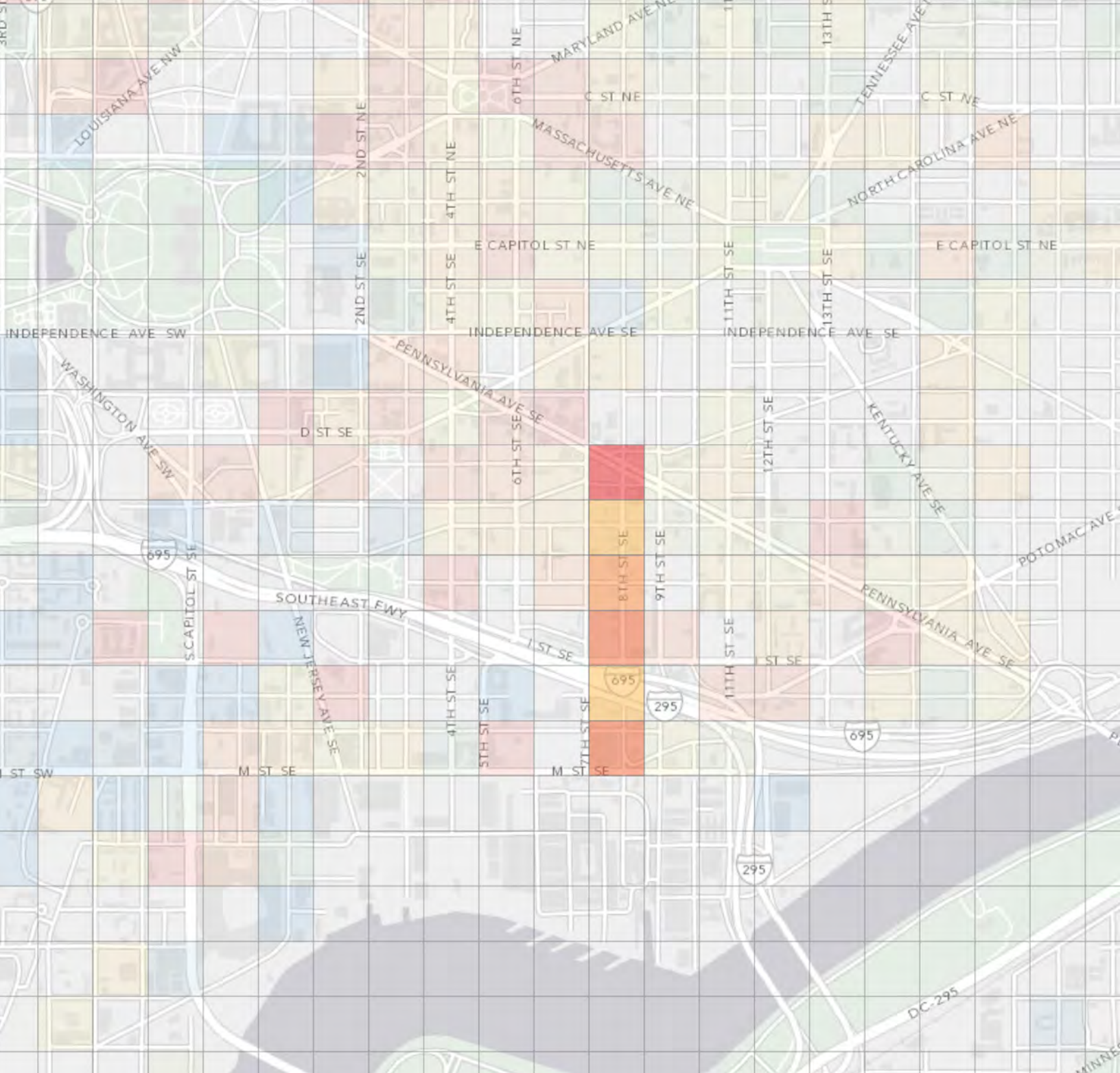


**BARRACKS ROW, WASHINGTON, D.C.
MEDIAN BUILDING AGE**

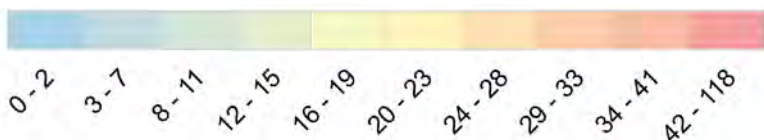


Commercial and mixed use grid squares:

6

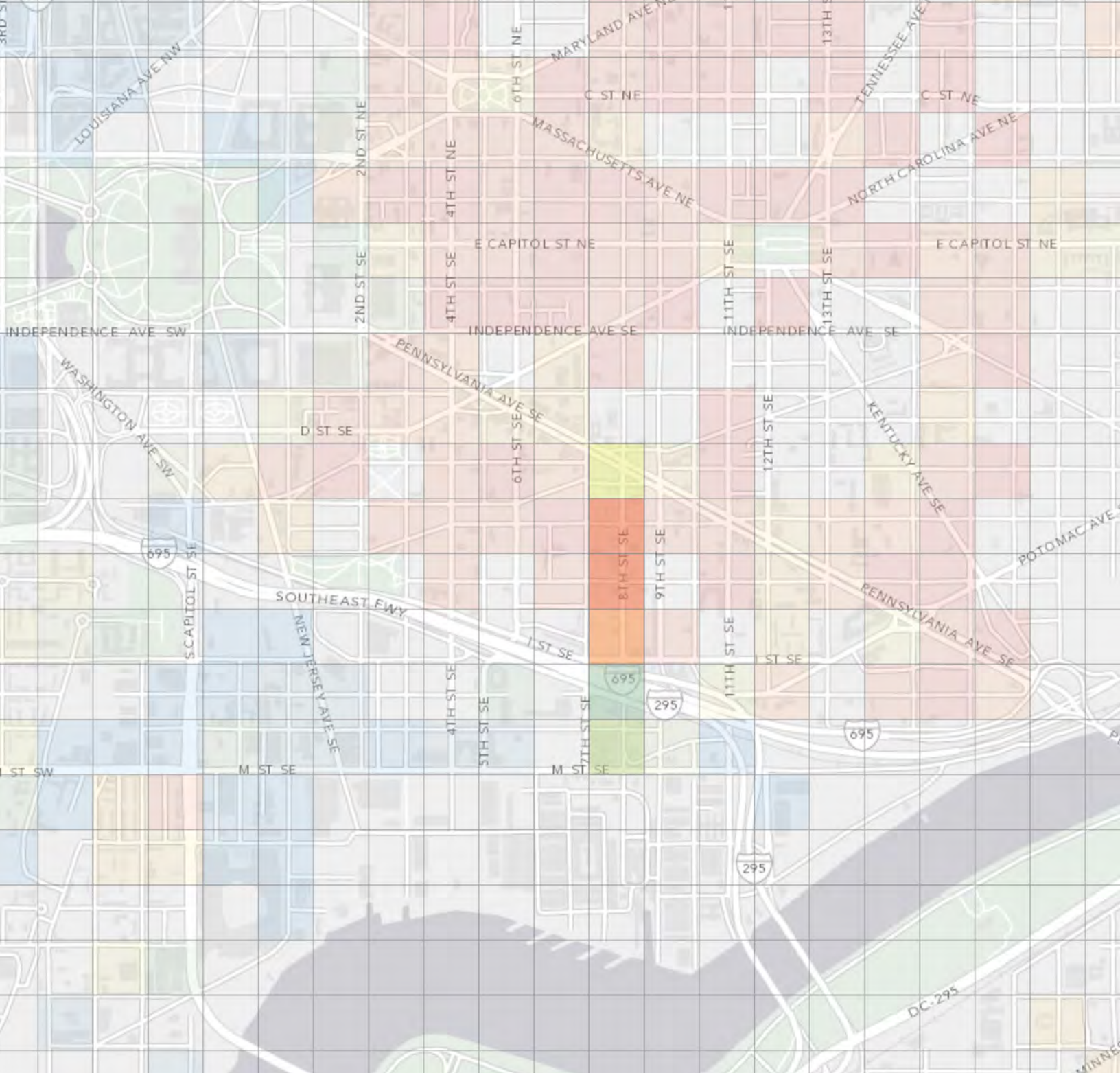


BARRACKS ROW, WASHINGTON, D.C.
DIVERSITY OF BUILDING AGE (Standard Deviation in Years)

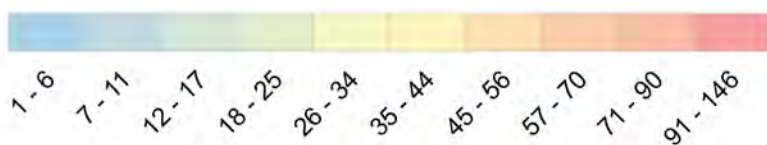


Commercial and mixed use grid squares:

6

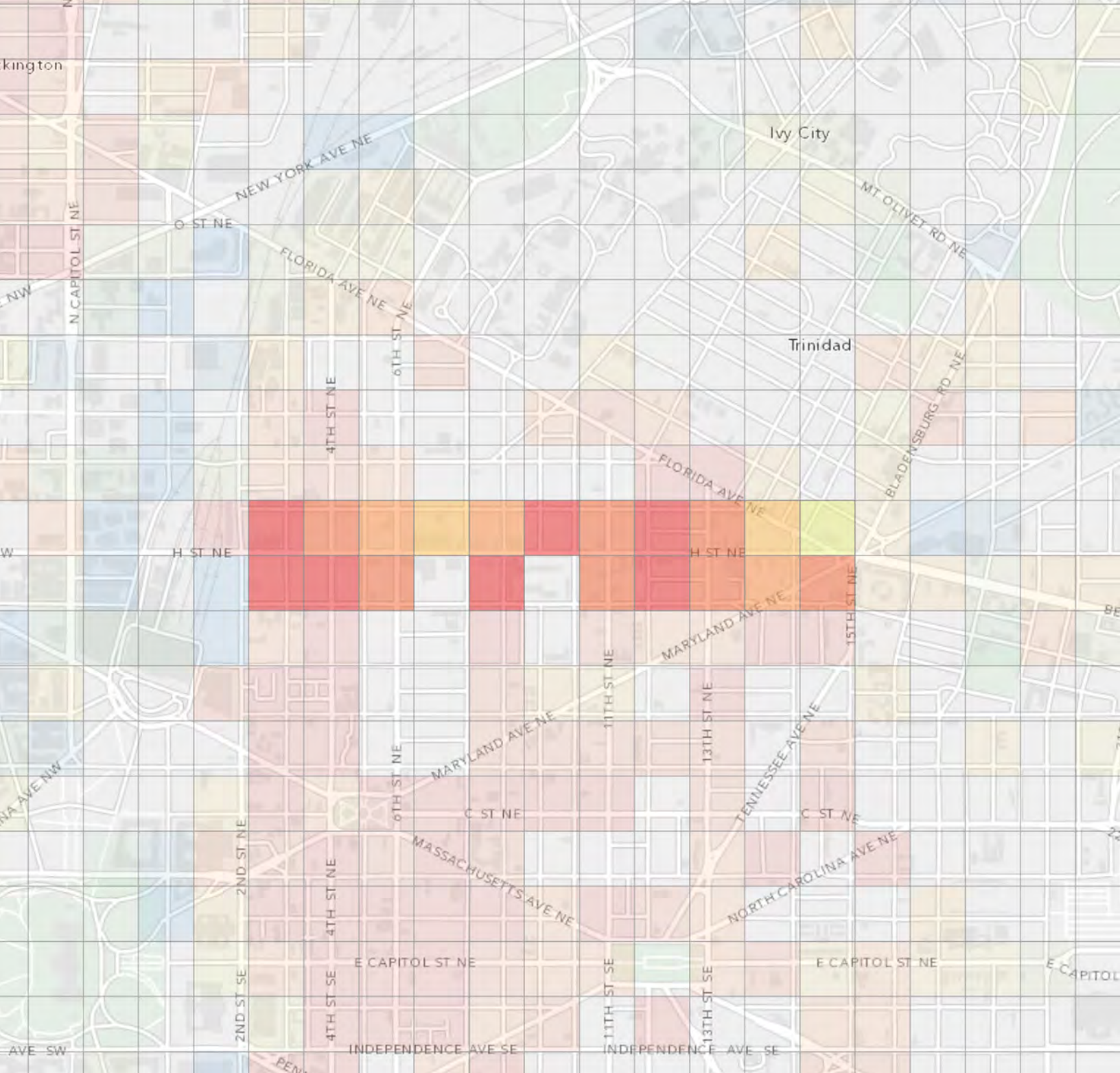


BARRACKS ROW, WASHINGTON, D.C.
GRANULARITY (Buildings per Grid Square)



Commercial and mixed use grid squares:

6



H STREET NE, WASHINGTON, D.C. CHARACTER SCORE



Newer, larger,
built at one time

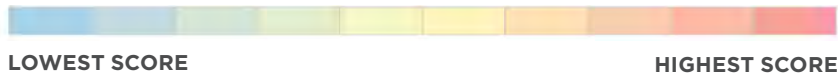


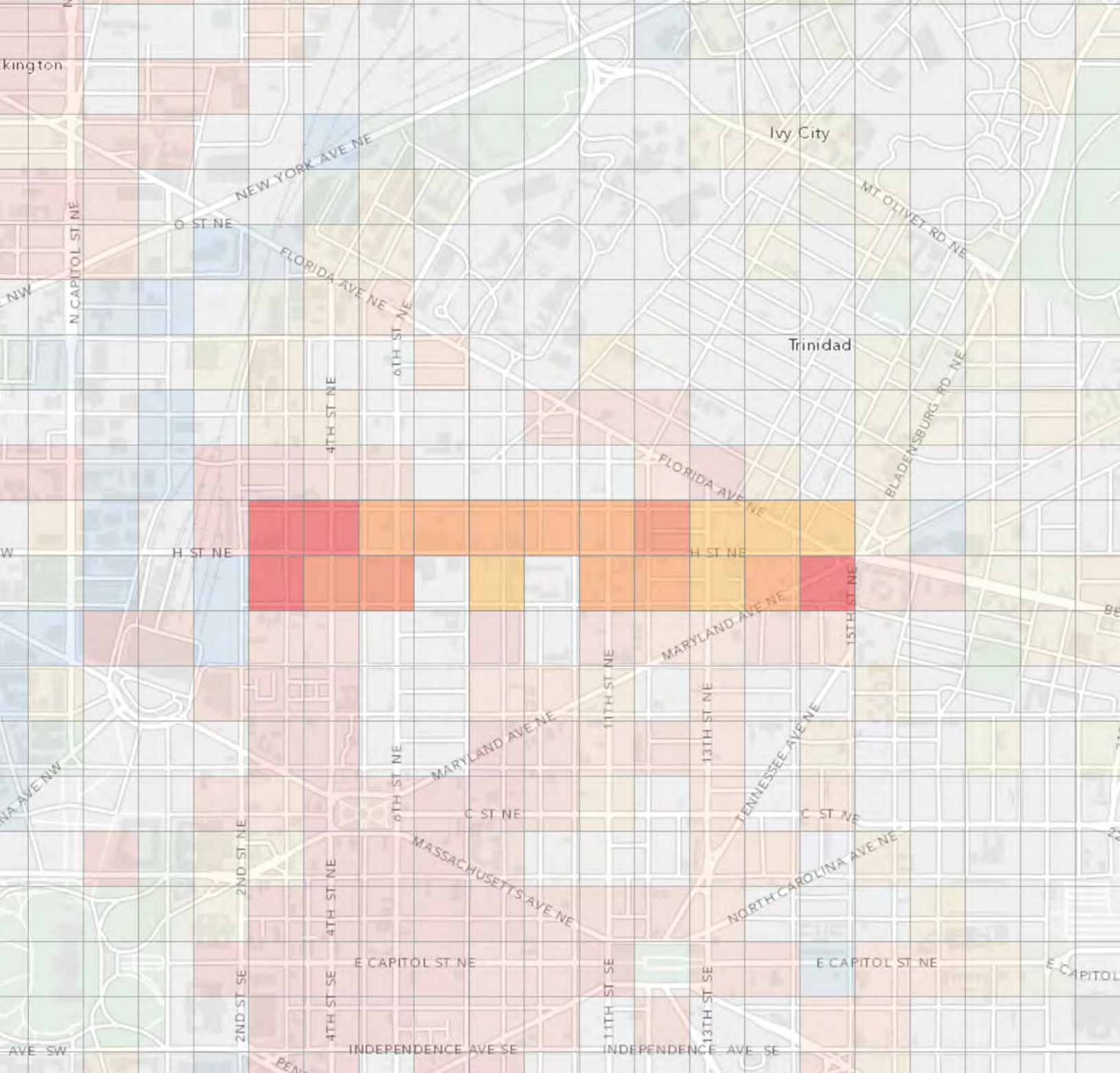
Older, smaller,
mixed-vintage



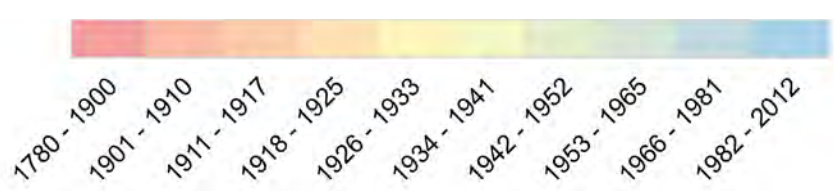
Commercial and mixed
use grid squares:

20

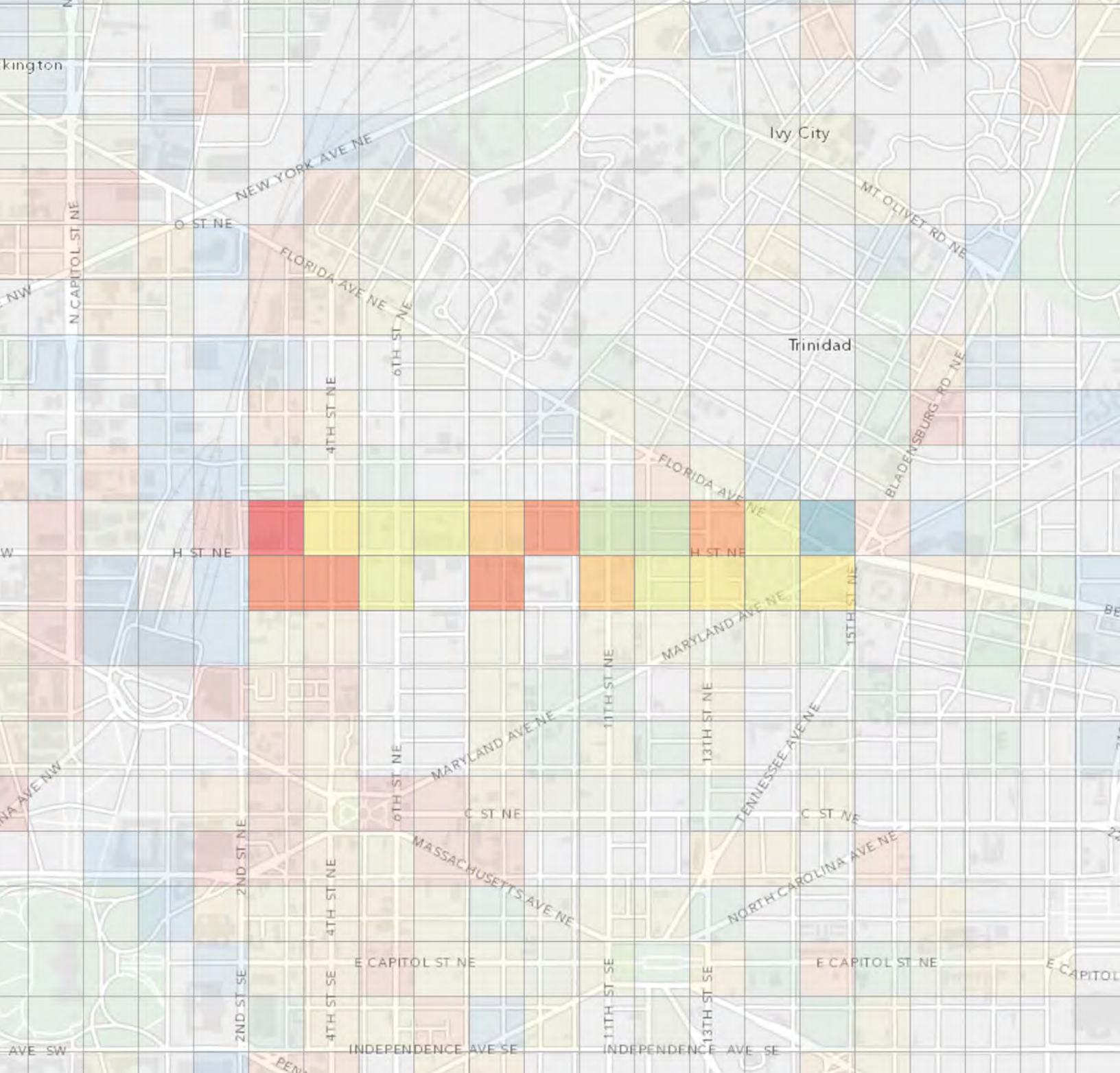




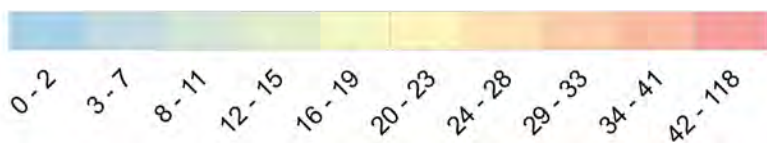
**H STREET NE, WASHINGTON, D.C.
MEDIAN BUILDING AGE**



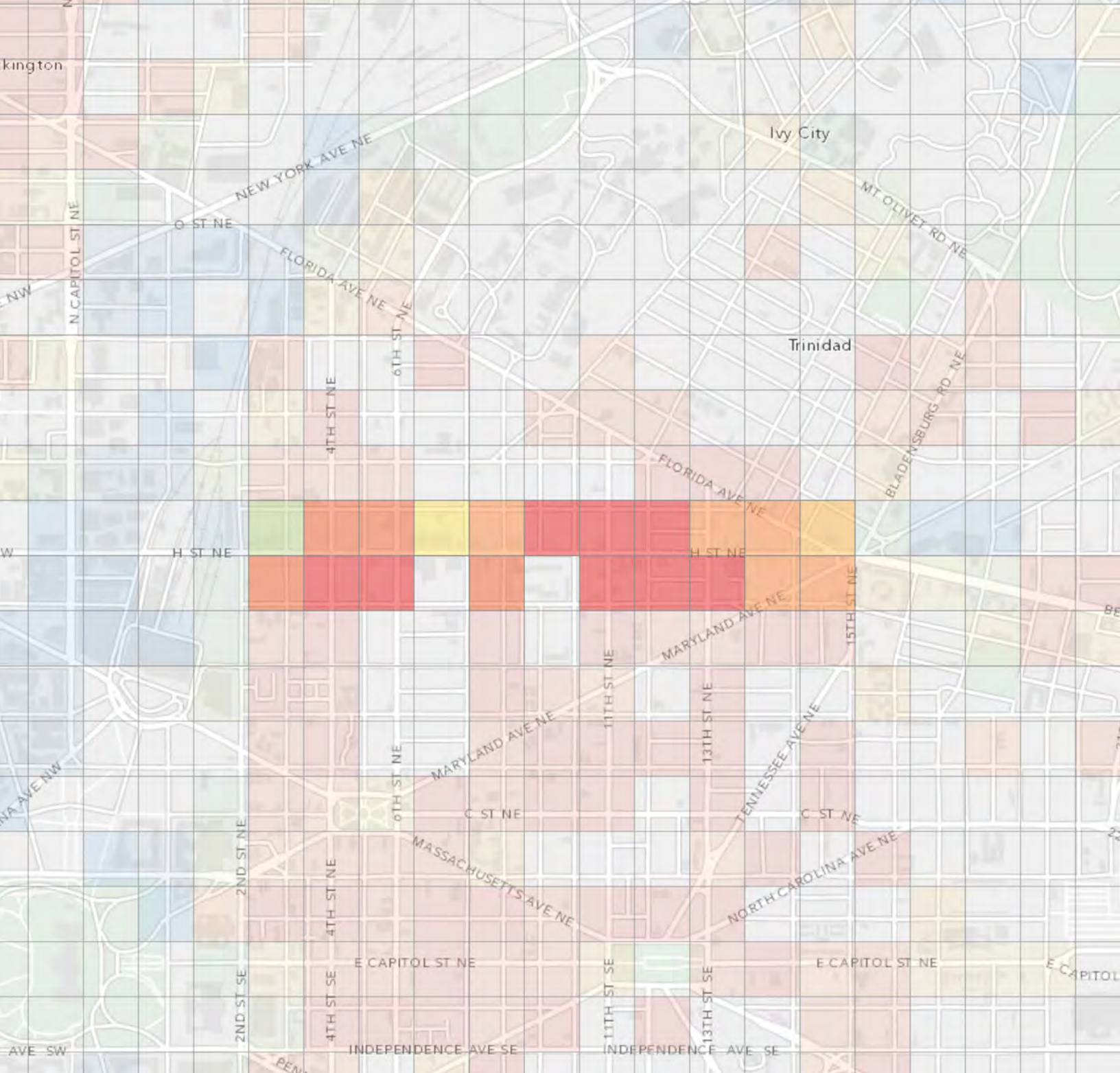
Commercial and mixed use grid squares:
20



H STREET NE, WASHINGTON, D.C.
DIVERSITY OF BUILDING AGE (Standard Deviation in Years)



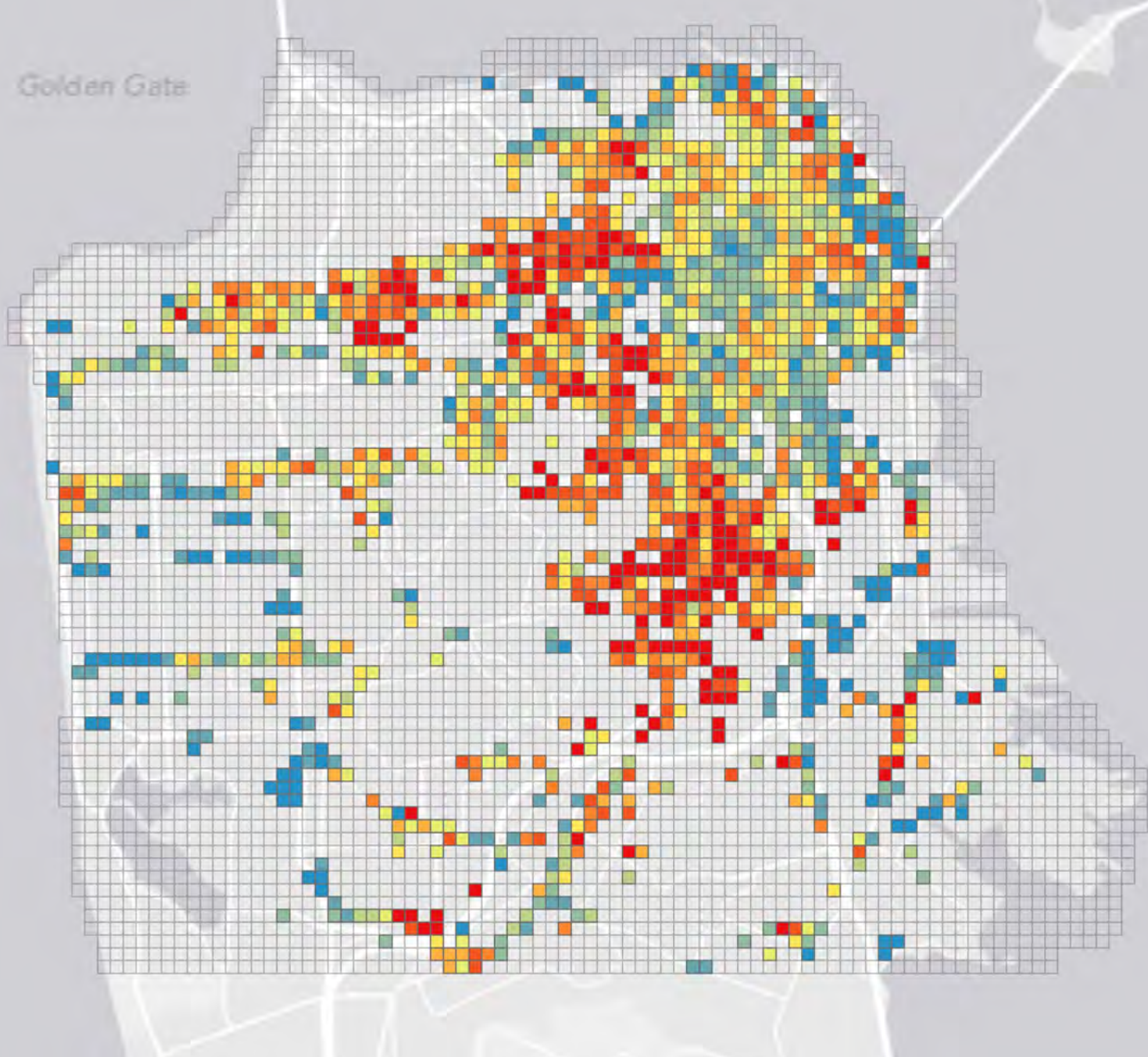
Commercial and mixed use grid squares:
 20



H STREET NE, WASHINGTON, D.C.
GRANULARITY (Buildings per Grid Square)



Commercial and mixed use grid squares:
 20



CHARACTER SCORE, SAN FRANCISCO



Newer, larger,
built at one time



LOWEST SCORE

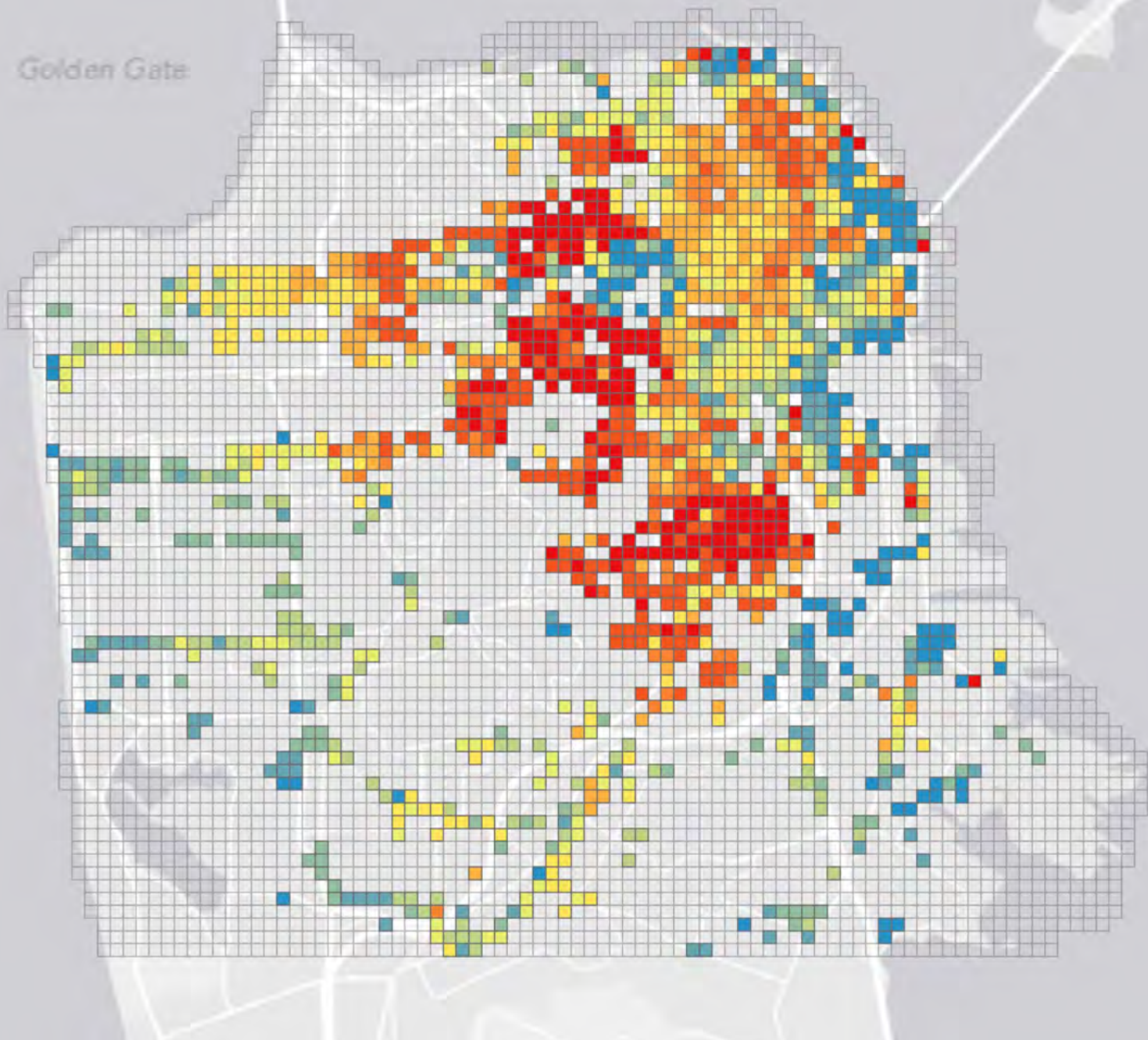


Older, smaller,
mixed-vintage

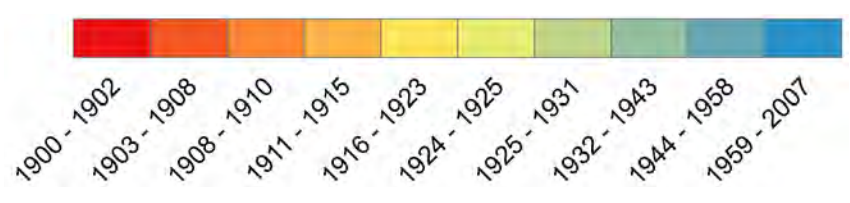
HIGHEST SCORE



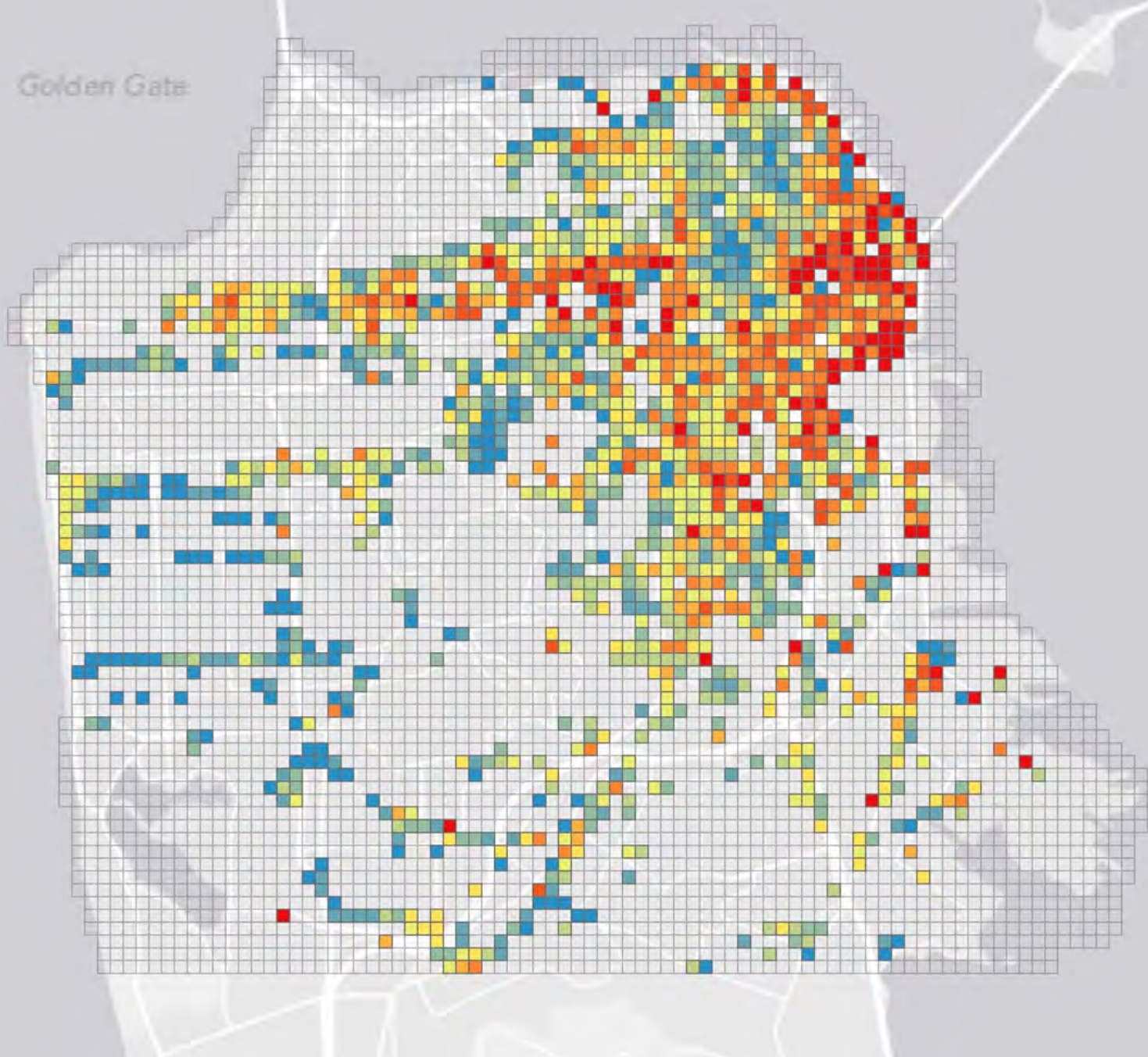
Commercial and mixed
use grid squares:
1,555 out of 5,110



MEDIAN BUILDING AGE, SAN FRANCISCO



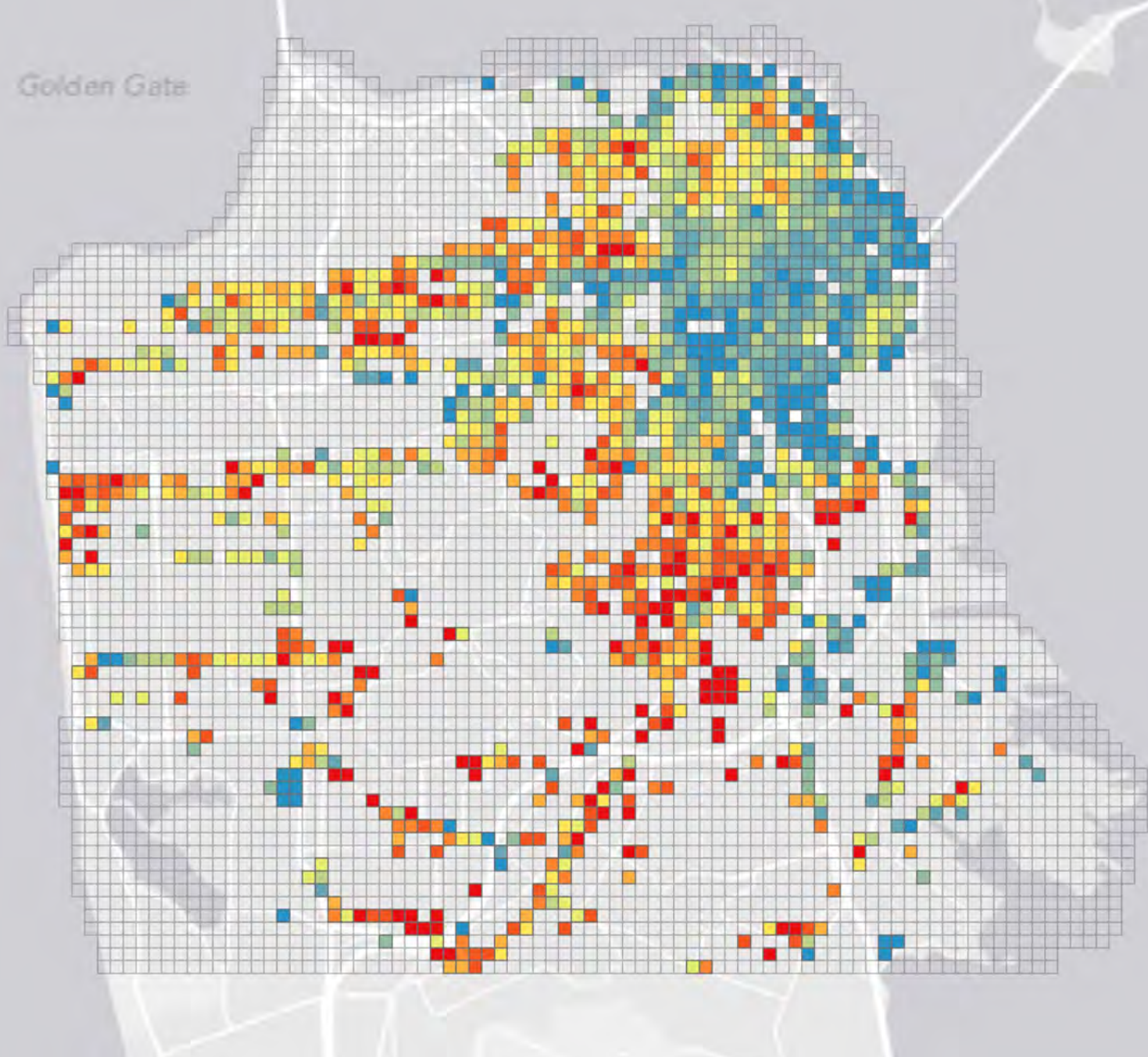
Commercial and mixed use grid squares:
1,555 out of 5,110



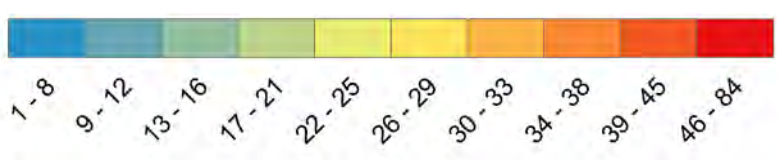
DIVERSITY OF BUILDING AGE, SAN FRANCISCO
Standard Deviation in Years



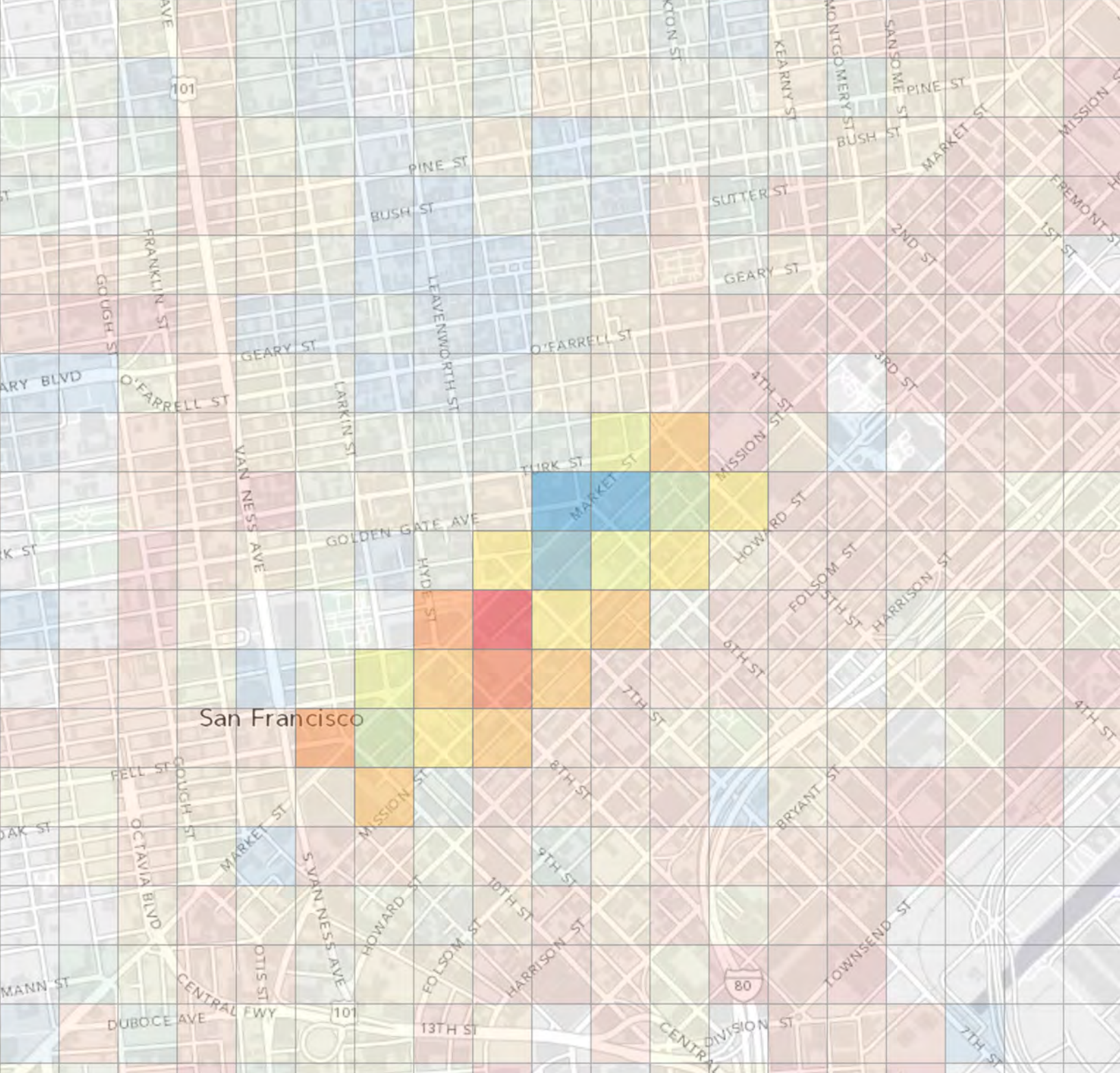
Commercial and mixed use grid squares:
1,555 out of 5,110



GRANULARITY, SAN FRANCISCO
 Buildings per Grid Square



Commercial and mixed use grid squares:
 1,555 out of 5,110



San Francisco

MID-MARKET, SAN FRANCISCO CHARACTER SCORE



Newer, larger,
built at one time



Older, smaller,
mixed-vintage



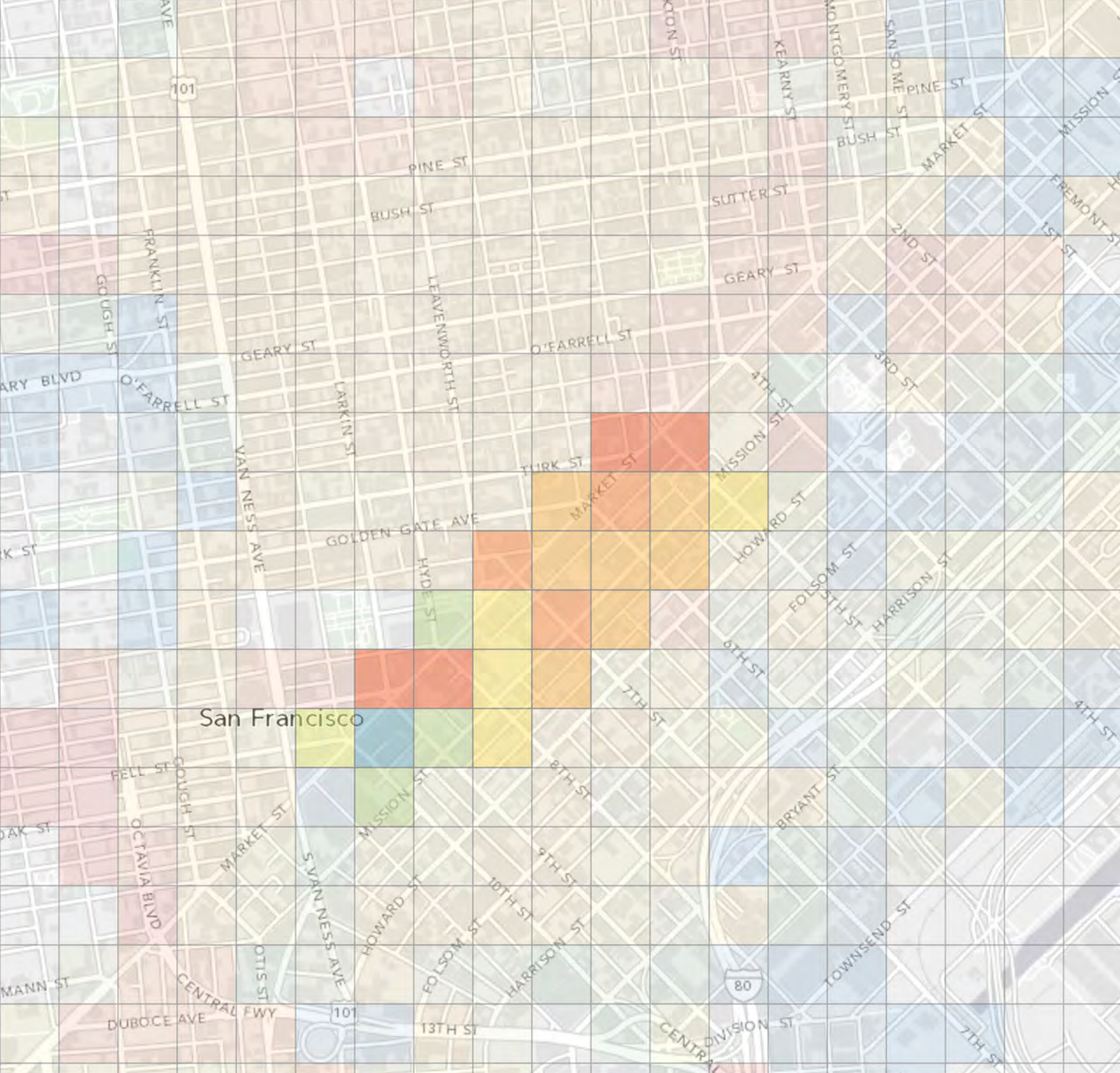
Commercial and mixed
use grid squares:

23

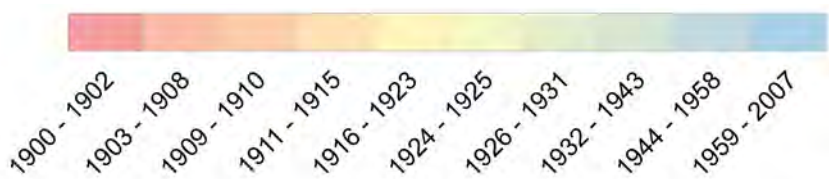


LOWEST SCORE

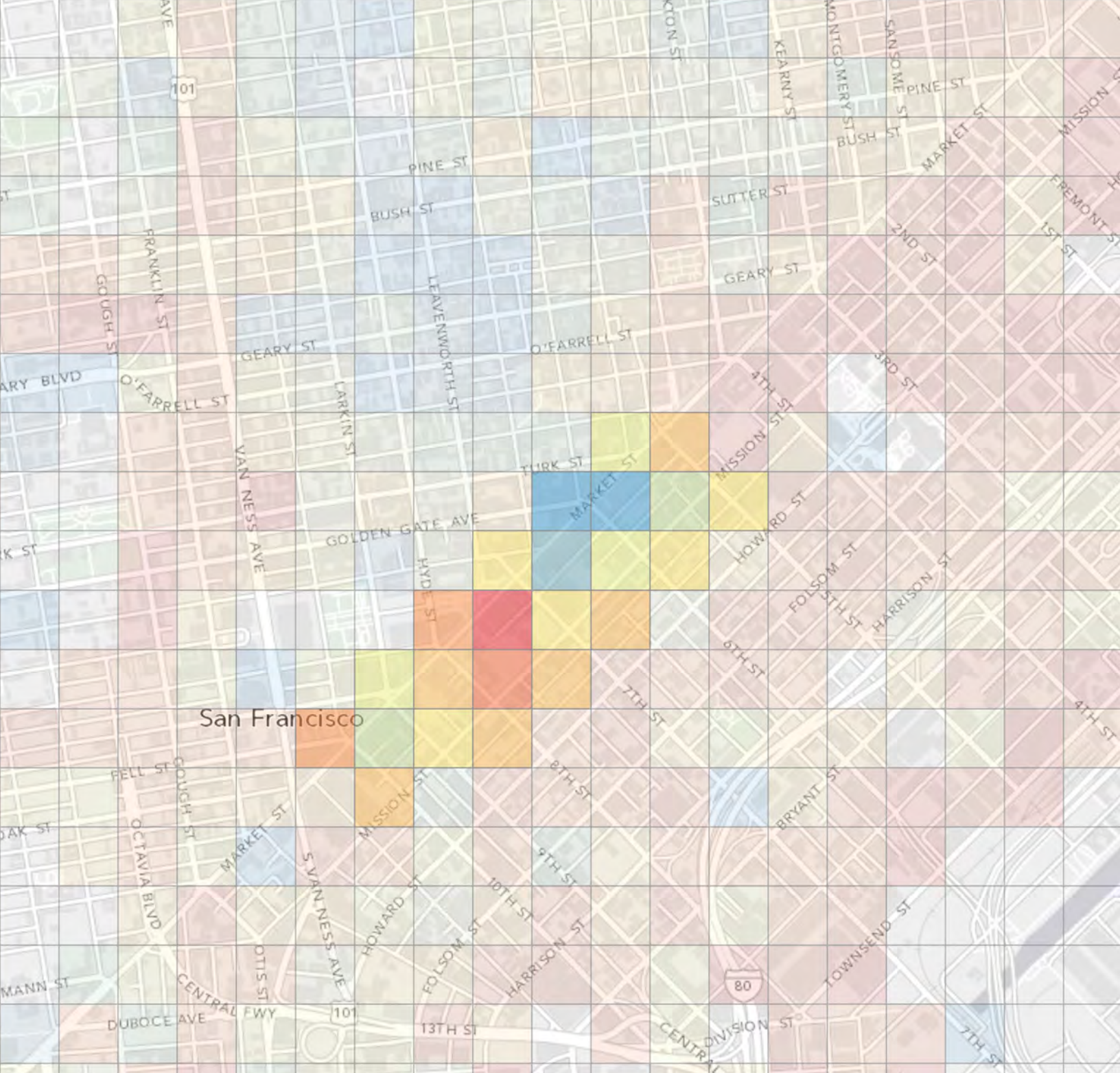
HIGHEST SCORE



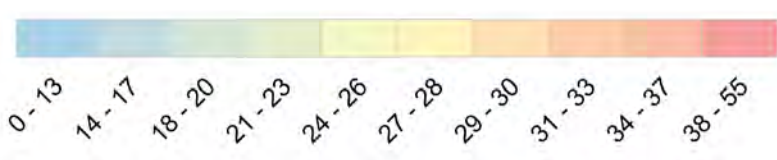
**MID-MARKET, SAN FRANCISCO
MEDIAN BUILDING AGE**



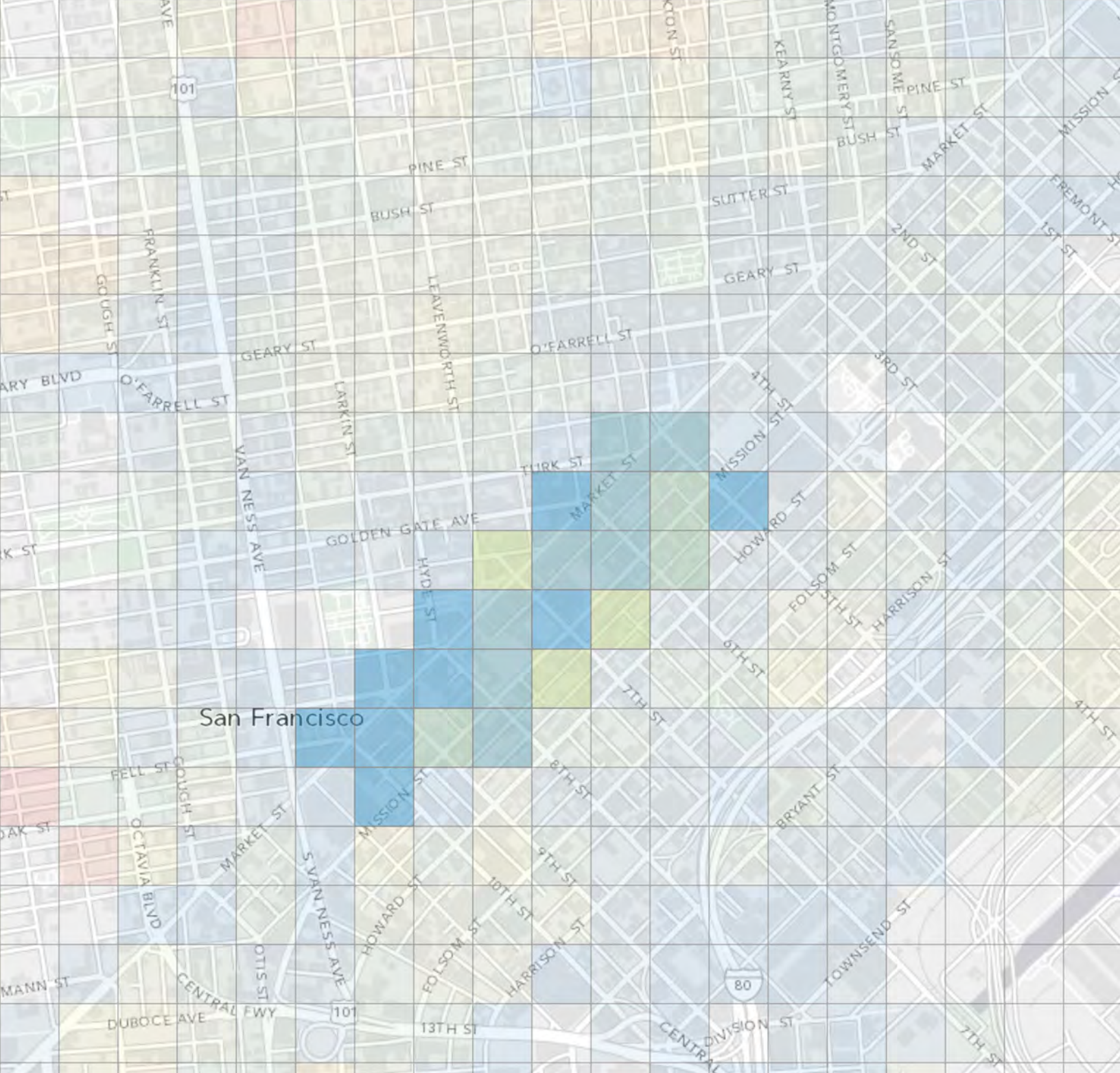
Commercial and mixed use grid squares:
23



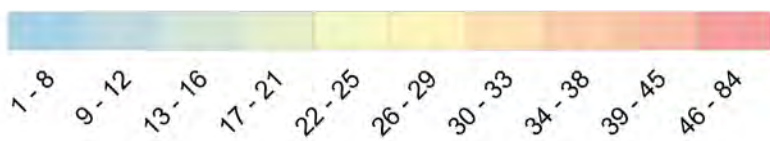
MID-MARKET, SAN FRANCISCO
DIVERSITY OF BUILDING AGE (Standard Deviation in Years)



Commercial and mixed use grid squares:
 23



**MID-MARKET, SAN FRANCISCO
GRANULARITY (Buildings per Grid Square)**



Commercial and mixed use grid squares:
23

ENDNOTES

1 The ArtPlace America Vibrancy Indicators were developed by Impresa, Inc. Information on the Vibrancy Indicators research can be found at <http://www.artplaceamerica.org/vibrancy-indicators/>

2 Anselin, L. (2005). *Exploring spatial data with GeoDa: A workbook*. Urbana, IL: Center for Spatially Integrated Social Science.

3 Select measures were normalized by commercial square foot to assess “rate of return” measure. In such instances, the original measure (e.g., number of businesses) was divided by the total commercial square footage of all buildings / parcels located in a grid square, as reported by each city’s respective county assessor.