Redlining and Beyond: Development Within and Outside HOLC Spaces in Los Angeles County

September 08, 2023

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Acknowledgments

We thank the UCLA Ziman Center for Real Estate's Rosalinde and Arthur Gilbert Program in Real Estate, Finance and Urban Economics for generous funding in supporting this research. The authors would also like to thank Chloe Rios and Briana Soriano for assisting with GIS mapping. Lastly, we would like to thank Christine Dunn for reviewing and copyediting the report. The authors are solely responsible for the content.

The UCLA Center for Neighborhood Knowledge acknowledges the Gabrielino/Tongva peoples as the traditional land caretakers of Tovaangar (the Los Angeles basin and Southern Channel Islands). As a land grant institution, we pay our respects to the Honuukvetam (Ancestors), 'Ahiihirom (Elders), and 'Eyoohiinkem (our relatives/relations) past, present, and emerging.

Abstract

This research project examines the role of the Home Owners' Loan Corporation (HOLC) "redlining" maps in shaping today's spatial structure along race and economic class lines, compared with the development of places not categorized by HOLC. It is well documented that redlining, the practice of designating marginalized neighborhoods as being risky for mortgage lending, is associated with today's geography of inequality, but many locations were not ranked by HOLC. Because many parts of contemporary Los Angeles were unranked, this region provides a useful case study of the differences and similarities between the HOLC-graded and -ungraded spaces. The research draws on multiple data sources to compare outcomes along several dimensions. The analysis finds support for the redlining-legacy hypothesis. The comparison of graded and ungraded areas finds noticeable differences in land use and in homeownership, but similarities in racial/ethnic and socioeconomic segregation. The finding that geographic disparities and hierarchical stratification exist in both the graded and ungraded areas indicates that there are fundamental societal factors and dynamics beside redlining that geographically stratify the urban landscape.

Introduction

The Redlining-Legacy Hypothesis

This research project examines the role of the Home Owners' Loan Corporation (HOLC) "redlining" maps in shaping today's spatial structure along race and economic class lines, compared with the development of places not categorized by HOLC. In 1933, Congress established the HOLC to assist homeowners who had mortgages in default or foreclosure. It purchased and refinanced these mortgages from financial institutions and provided better terms to struggling homeowners. The HOLC introduced a new appraisal process that evaluated mortgage lending risk based on neighborhood-level characteristics, including economic class and employment status of residents, and the race/ethnicity of residents in the area. Together with input from thousands of local brokers and appraisers, the HOLC codified the new appraisal process into residential security maps for 239 cities between 1935 and 1940. Neighborhoods were graded on a scale from A for least risky/most stable to D for most risky/least stable. These grades coincided with a color code where red shading indicated the lowest D ranked neighborhoods, which became known as "redlining." Green indicated the most desirable (A), blue the second most desirable (B), and yellow the second least desirable (C). Redlining established geographic lending patterns that directly limited access to homeownership and business development in predominantly non-White neighborhoods and increased residential segregation.[1]

Many have argued that the grading of urban space by HOLC is not just a historical phenomenon but instead a practice that has institutionalized and perpetuated discriminatory

[1] La-Brina Almeida, "A History of Racist Federal Housing Policies," *Mass. Budget and Policy Center* (blog), August 6, 2021, https://massbudget.org/2021/08/06/a-history-of-racist-federal-housing-policies/. Accessed August 10, 2023 David Aaronson, Daniel Hartley, and Bhashkar Mazumder, "The Effects of the 1930s HOLC 'Redlining' Maps (Revised August 2020): Federal Reserve Bank of Chicago" (Federal Reserve Bank of Chicago, 2020), https://www.chicagofed.org/publications/working-papers/2017/wp2017-12. Accessed August 10, 2023

practices that continue to contribute to housing segregation, unequal opportunities for wealth inequality, and racial injustices. There is an extensive literature on these and other impacts, often under the rubric of the legacy of redlining.[2] Redlining is not simply about the neighborhoods colored red, but instead is about the creation of disparate neighborhoods, marginalized places relative to privileged ones, and a hierarchically stratified geographic system of economically, socially, politically, and environmentally constructed spaces.[3] Studies have documented how places classified as the least creditworthy (colored red) are linked to contemporary disparities in higher interest rates, lower homeownership and wealth, housing segregation, more crime, greater climate-change and environmental risks, and poorer health.[4] For example, the African American population has become more evenly distributed across all HOLC-graded neighborhoods over the past 30 years since federal policies have passed aimed at preventing discriminatory housing and financial practices. Yet, the impact of living in redlined areas with limited access to affordable credit has led to African Americans having the lowest homeownership rate among all racial and ethnic groups in the country.[5] In one study in Milwaukee neighborhoods, greater historic redlining was associated with current lending

[2] Richard Rothstein, *The Color of Law: A Forgotten History of How Our Government Segregated America* (Liveright Publishing, 2017).

[3] For detailed discussion about system, see Paul M. Ong and Silvia R. Gonzalez, *Uneven Urbanscape: Spatial Structures and Ethnoracial Inequality* (Cambridge University Press, 2019).

[4] Brian An, Anthony W. Orlando, and Seva Rodnyansky, "The Physical Legacy of Racism: How Redlining Cemented the Modern Built Environment," available at SSRN 3500612, 2019; Stefano Bloch and Susan A. Phillips, "Mapping and Making Gangland: A Legacy of Redlining and Enjoining Gang Neighbourhoods in Los Angeles," *Urban Studies* 59, no. 4 (2022): 750–70; Jeremy S. Hoffman, Vivek Shandas, and Nicholas Pendleton, "The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas," *Climate* 8, no. 1 (2020): 12; Emily E. Lynch et al., "The Legacy of Structural Racism: Associations between Historic Redlining, Current Mortgage Lending, and Health," *SSM-Population Health* 14 (2021): 100793; Elizabeth McClure et al., "The Legacy of Redlining in the Effect of Foreclosures on Detroit Residents' Self-Rated Health," *Health & Place* 55 (2019): 9–19; Kevin A. Park and Roberto G. Quercia, "Who Lends beyond the Red Line? The Community Reinvestment Act and the Legacy of Redlining," *Housing Policy Debate* 30, no. 1 (2020): 4–26.

[5] Diego Mendez-Carbajo, "Neighborhood Redlining, Racial Segregation, and Homeownership," accessed August 10, 2023, https://research.stlouisfed.org/publications/page1-econ/2021/09/01/neighborhood-redlining-racial-segregation-and-homeownership

discrimination and increased prevalence of poor physical health and poor mental health.[6] Another study reveals that the historic legacy of redlining may be directly responsible for disproportionate exposure to current heat events. The study found that 94% of studied areas show consistent city-scale patterns of elevated land surface temperatures in formerly redlined areas relative to their non-redlined neighbors by as much as 7 °C.[7]

The redlining-legacy thesis has been embraced in public policy discourse. For example, a staff member of the LA Neighborhood Council argued that "[t]he crises of high rents, displacement, homelessness, budget shortages, and other failures and injustices … can be attributed in part to the legacy of redlining."[8] According to a former LA County Supervisor, "government policy going back to the 1930s, known as 'redlining,' created racial segregation and disinvestment that, in some communities, persist to this day."[9]

Assessing the Redlining-Legacy Hypothesis

While incredibly important and compelling, there is a major gap in the literature regarding redlining. A significant part of today's urban and suburban landscape was not graded by HOLC, thus has not been subject to HOLC classification scheme. Unfortunately, researchers have not paid much attention to places that were not categorized by HOLC, which can today comprise a sizable share of the population in many cities and regions that experienced significant growth after the 1930s. By comparing the way contemporary spaces are stratified along racial and economic lines can make an innovative contribution to the substantial and growing literature on the legacy of historical redlining.

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[6] Emily E. Lynch et al., "The Legacy of Structural Racism: Associations between Historic Redlining, Current Mortgage Lending, and Health," *SSM-Population Health* 14 (2021): 100793.

[7] Jeremy S. Hoffman, Vivek Shandas, and Nicholas Pendleton, "The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas," *Climate* 8, no. 1 (2020): 12.

[8] Jamie Tijerina, *The Legacy of Redlining in Los Angeles: Disinvestment, Injustice, and Inefficiency Finding a Path Forward in 2019 and Beyond*, Los Angeles City Clerk, 2019.

[9] Supervisor Mark Ridley-Thomas, "Undesign the Redline," 2019, https://ridley-thomas.lacounty.gov/index.php/redline/

Los Angeles County is a primary example of later growth. The region had only 1.2 million residents in 1930, but has 9.8 million today. Examining the 1933 HOLC maps shows that they did not rank most of the San Fernando Valley and North County, a majority of the San Gabriel Valley and the South Bay, and even parts of the Westside. These areas became populated with the growth of defense contracting during World War II, and continued to grow in subsequent decades as a part of suburbanization. The emerging neighborhoods in the ungraded areas were "untainted" by HOLC's colors, so they have not suffered from the institutionalized racism associated with redlining.

The research project examines the relationship between the legacy of HOLC coverage and long-term development of neighborhoods in Los Angeles stratified along racial and socioeconomic lines. The study compares changes in areas where unequal home lending practices have been institutionalized and changes in areas without those practices. We do this by comparing areas ungraded by HOLC (lacking institutionalized unequal practices) to graded areas. The study utilizes a quantitative comparative approach by examining the differences between and within graded and ungraded areas.

This study utilizes multiple data sources. These data sources include the digitized HOLC maps, the 1940 tract-level census data, the 2015–19 American Community Survey, and the recent land-use information from the Southern California Association of Government (SCAG) and the LA County Assessor's parcel files. We constructed several metrics to compare unranked and ranked places. Such a comparison should be interpreted carefully because unranked areas are more likely to be suburban and the ranked areas are more likely to be in the older urban core. Nonetheless, the comparison can yield insights into the regional development process.

Summary of Key Findings

1. The HOLC graded and ungraded regions have had very different growth trajectories. Driven by suburbanization, the ungraded areas accounted for nearly two-thirds of the region's population increase between 1940 and the late 2010s, increasing its share from less than a third to more than a half of the residents. The ungraded region fared better than the graded areas along some dimensions, but also fared similarly along other dimensions. Contemporary homeownership rate is higher in the non-HOLC region, a higher share of land zoned for non-residential uses, lower residential density, and a slightly lower relative number of non-Hispanic whites. However, both regions have roughly the same proportion of low-income people.
2. Disaggregating the graded region by HOLC grades and ungraded region by COG-based (Council of Governments) subregions, we find spaces and places are differentiated both in terms of land use and housing. Not surprisingly the non-HOLC subregions tend to be less dense given the role of suburbanization, and tend to have higher ownership rates. However, non-HOLC subregions are as geographically differentiated along these dimensions as HOLC grades.
3. The analysis also finds that there are spatial disparities in racial/ethnic and income class/poverty composition for the disaggregated ungraded subregions and the HOLC graded areas. In other words, places and spaces become demographically segregated and economically stratified regardless of whether HOLC grading is present.

These findings provide insights into the nature and pattern of economically stratified and racialized spaces in regional development. Historical HOLC grades are highly correlated with contemporary spatial racial/ethnic and economic disparities, consistent with the redlining-legacy thesis that these institutionalized categories have replicated past geographic inequalities over

generations. But correlation is not causality. The ungraded areas of Los Angeles, which account for the majority of the post-HOLC growth, are also spatially differentiated. The ungraded areas have distinctively different land-use and housing patterns, due largely to suburban development. However, subregions of the ungraded areas are currently economically stratified and racially/ethnically segregated places, with differences at least equal to what is observed for HOLC-graded places. This indicates that there are fundamental societal processes that produce and reproduce spatialized inequality even in the absence of historically institutionalized practices created by HOLC.

Report Organization

The rest of the report is organized into three major parts. The first compares the total graded area with the total ungraded study area. We examine the growth between 1940 and the period just prior to the COVID-19 pandemic, recent housing characteristics, and population characteristics. The second part disaggregates the graded areas by HOLC categories and the ungraded areas into subregions. We compare land-use and housing characteristics—the share of land use zoned for residential use, housing density, and tenure. The third part compares the demographic and socioeconomic characteristics of the disaggregated areas. In particular, we examine the spatial patterns by race/ethnicity and by income class. We conclude with a discussion about what the findings mean for our conceptual understanding of the role of institutionalized racial practices that influence how regions evolve.

Research Design, Data, and Methodology

This section examines the research design, data analysis, and methods used to compare the spatial structure of areas with HOLC designations and those without. The analysis is cross-sectional, with a focus on the contemporary patterns. The contemporary era (also used interchangeably with current era) refers to the years prior to the COVID-19 pandemic, which eliminates any confounding effects of the once-in-a-century event health crises with enormous economic impacts. While not a longitudinal study, we do provide some comparison of conditions in 1940 and current. The basic approach is comparing the housing, demographic, socioeconomic, and housing patterns of the areas graded and not graded by HOLC, both at an aggregated and disaggregated level. Aggregated means examining the graded areas as a whole and the ungraded areas as a whole. Disaggregated involves examining outcomes for each of the four HOLC categories and for several subregions for the ungraded areas.

Data Sources and Key Variables

This study uses multiple data sources. The second data source is the tract-level counts from the 1940 Decennial Census Enumeration. The enumeration is a once-in-ten-years count of the population mandated by the Constitution to allocate congressional seats, and additional information is collected by the government to assist in the development of legislation, policies, and programs.[10] We access both the data and shapefiles from Social Explorer. For more recent years, we use socioeconomic, demographic, and housing information from the US Census Bureau: the 2015–19 American Community Survey (ACS). ACS is a continuous survey conducted by the U.S. Census Bureau to collect demographic, economic, and housing

[10] US Census Bureau, “About the Decennial Census of Population and Housing,” December 16, 2021, accessed August 11, 2023, https://www.census.gov/programs-surveys/decennial-census/about.html.

information from about 2.5% of households per year. We use census tract–level statistics from the 2015–19 ACS for a pre-pandemic assessment to remove the potential for the impacts of the pandemic to confound the analysis. Land-use and zoning information comes from the SCAG (Southern California Association of Government) and Los Angeles County Assessor Office. Zoning information includes whether a parcel designated for residential, commercial, and other uses.

For this project, we use data on housing, race and ethnicity, and income class. We use race and ethnic categories as reported by the census, which are socially constructed.[11] Ethnicity is different from race and is collected by the census only according to whether or not a person is of Hispanic origin.[12] For the purposes of our study, race categories include Hispanic, non-Hispanic (NH) White, NH Asian, NH Black, and NH Other. The 1940 Hispanic population was estimated using the counts of persons born in Mexico.

We use two indicators for the economic status of a neighborhood: the relative number of persons with income below the federal poverty line and the distribution of persons into income categories constructed specifically for the income class. The federal poverty line (FPL) is measured by comparing a family's income to poverty thresholds or minimum amount of income needed to meet basic needs. The Census Bureau determines poverty status using the official poverty measure that compares pre-tax cash income against three times the cost of a minimum food diet in 1963, adjusted for family size and updated for inflation.[13] The total family income divided by the poverty threshold (federal poverty line, FPL) is the ratio used to determine

[11] Michael Omi and Howard Winant. *Racial formation in the United States* (Routledge, 2014).
[12] US Census Bureau, "About the Topic of Race," Census.gov, accessed August 10, 2023, https://www.census.gov/topics/population/race/about.html
[13] Institute for Research on Poverty, University of Wisconsin-Madison, "How Is Poverty Measured?," accessed August 10, 2023, https://www.irp.wisc.edu/resources/how-is-poverty-measured/; US Department of Health and Human Services, "Poverty Guidelines," ASPE, accessed August 10, 2023, https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines. Note, different agencies have different definitions of the federal poverty line. The different poverty line cutoffs are mainly to determine program eligibility.

poverty status, and a value below 1 means the family is considered to be in poverty. For example, the ratio for a family of five with two children and total income of $34,500 is $34,500/$35,801 = 0.96, thus designated as living in poverty.[14] In addition to poverty status, we created three income classifications: poor, middle, and upper. The poor population is defined as individuals below 200% of the FPL, the upper-income population is defined as the estimated proportion of individuals residing in households with annual income more than $100,000, and the middle-income population is the residual population (without the poor and rich populations).[15] Each of the three categories contains roughly a third of the population.

We use housing as a key indicator of the physical development of the graded and ungraded areas. Specifically, we assess the proportion and density of housing units by type and tenure/occupancy. We use three housing types: single housing building (detached and attached combined), multifamily building (two or more units in building), and a residual other (mobile home, boat, RV, van, etc.). We also use occupied housing units by tenure and occupancy status that includes owner occupied, renter occupied, and vacant.

Geographies

The project uses several overlapping geographic systems. The first is based on the HOLC maps, which identifies ranked areas, and is reproduced in Figure 1.[16] These graded areas were developed at a time when only part of LA County was developed, mostly in and around the central business districts of Los Angeles and several small cities (e.g., Pasadena, Long Beach, and Santa Monica). Most of the red places are around downtown Los Angeles and

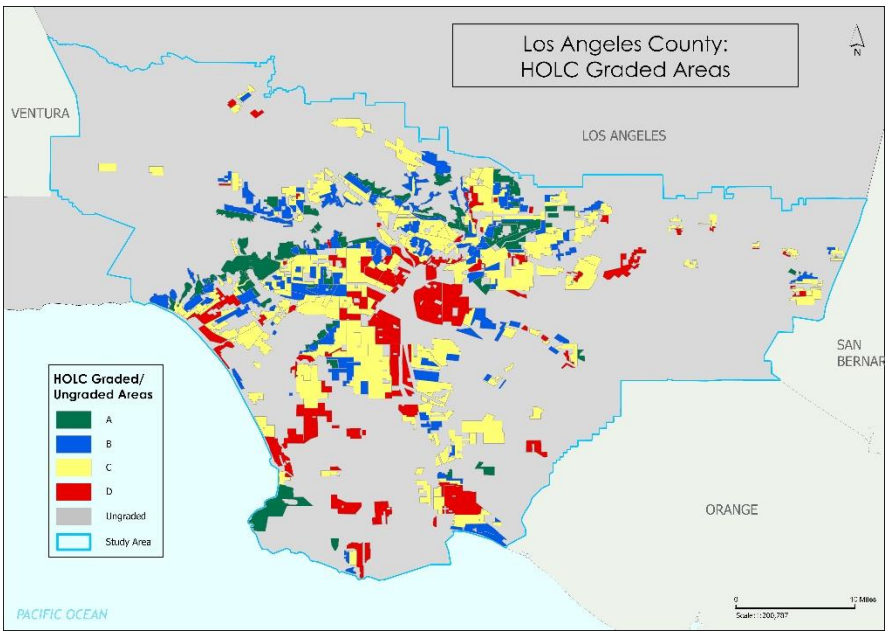
[14] Example taken from: US Census Bureau, "How the Census Bureau Measures Poverty," Census.gov, accessed August 10, 2023, https://www.census.gov/topics/income-poverty/poverty/guidance/poverty-measures.html

[15] The relevant population includes only the people for whom the poverty status is determined.

[16] Robert K. Nelson, LaDale Winling, Richard Marciano, Nathan Connolly et al., "Mapping Inequality," *American Panorama*, ed. Robert K. Nelson and Edward L. Ayers, accessed August 10, 2023, https://dsl.richmond.edu/panorama/redlining/. We rely on the GIS (geographic information system) shapefiles created by the Digital Scholarship Lab at the University of Richmond.

Long Beach, East Los Angeles, parts of South Central, and surprisingly along parts of the coastal areas. The green areas buttress along the Santa Monica Hills and coastal edge of Palos Verdes.

Figure 1: HOLC Graded Areas, LA County



Source: Map created by authors using GIS shapefile from Nelson et al., "Mapping Inequality"; Investing in Place, and authors' reconstruction of map developed by Investing in Place, "Council of Governments (COGs) and Subregions in Los Angeles County."

The study analyzes the ungraded HOLC areas by subregions that are partially based on Council of Governments (COGs) boundaries as reported in Metro's 2009 Long Range Planning Document.[17] Given the large geography and population of the Los Angeles County, the metropolis has nine subregions that operate under a joint-powers authority or official memorandum of understanding for the purposes of planning and developing shared regional priorities.[18] Each subregion has associated members that typically are cities and parts of county

[17] Investing in Place, "Council of Governments (COGs) and Subregions in Los Angeles County," 2018, https://investinginplace.org/wp-content/uploads/2019/08/IIP-COG2018-July2019-1.pdf. Accessed August 10, 2023

[18] Ibid.

supervisorial districts. Figure 2 is based on a stylized representation of those subregions. We exclude Malibu and North Los Angeles County subregions from our analysis as these areas were not impacted by redlining and have experienced little residential development given the regions' mountain ranges.

Figure 2: Los Angeles County Subregions

Source: Map created by authors using census tracts. Subregion boundaries roughly align with map developed by Investing in Place, "Council of Governments (COGs) and Subregions in Los Angeles County."

The third geography system consists of census tracts. Tracts are small, relatively permanent statistical subdivisions of a county with the primary purpose of providing consistent geographic units for presenting statistical data. Census average 4,000 people with a minimum of 1,200 and maximum of 8,000 people.[19] The 1940 decennial census has 589 tracts and the 2014–19 ACS has 2,343 tracts. Census tracts are important because the Census Bureau provides small-area information on the housing, demographic, and economic characteristics for

[19] U.S. Census Bureau, "Glossary," Census.gov, accessed August 10, 2023, https://www.census.gov/programs-surveys/geography/about/glossary.html

neighborhoods.[20] All contemporary indicators are reported at the census-tract-level (2010 vintage boundaries).

Spatial Allocations

Because the geographic units across sources do not geographically align, we used spatial allocation to estimate the proportion of each tract that is not covered by HOLC (ranging between 0 and 1, with most likely to fall at the two ends of the range). Spatial allocation quantifies the percentage one geography overlaps with another. This allows us to "allocate" a specific percent of one variable in one geography proportionally to another by the percent they overlap. For tracts overlapping with HOLC, we estimated the proportion in each of the four HOLC categories. For land-use and zoning, we made precise parcel-level assignments to each tract. The spatial allocations enable us to develop statistical profiles for the aggregated and disaggregated graded and ungraded areas. Comparing those profiles enables us to uncover similarities and differences.[21] We used the latitude and longitude of each parcel to identify the census tract, HOLC, and COG within which they are located. We eliminated duplicate parcels (e.g., a common parcel shared by condominiums in a single building or lot). We then collapsed land-use information into three categories with a focus on comparing residential land-use patterns to commercial and a residential other category.

[20] The project also examined the use of census block groups, but utilizing these geographic units proved to be cumbersome and too resource intensive. Block groups also have greater potential for data suppression. US. Census Bureau, "American Community Survey Data Suppression," September 27, 2016, https://www2.census.gov/programs-surveys/acs/tech_docs/data_suppression/ACSO_Data_Suppression.pdf, accessed August, 11, 2023.

[21] We also measure the magnitude and pattern of the spatial segregation using the dissimilarity index and the degree of homogeneity or heterogeneity for each place using the entropy score. The results are reported in the appendix.

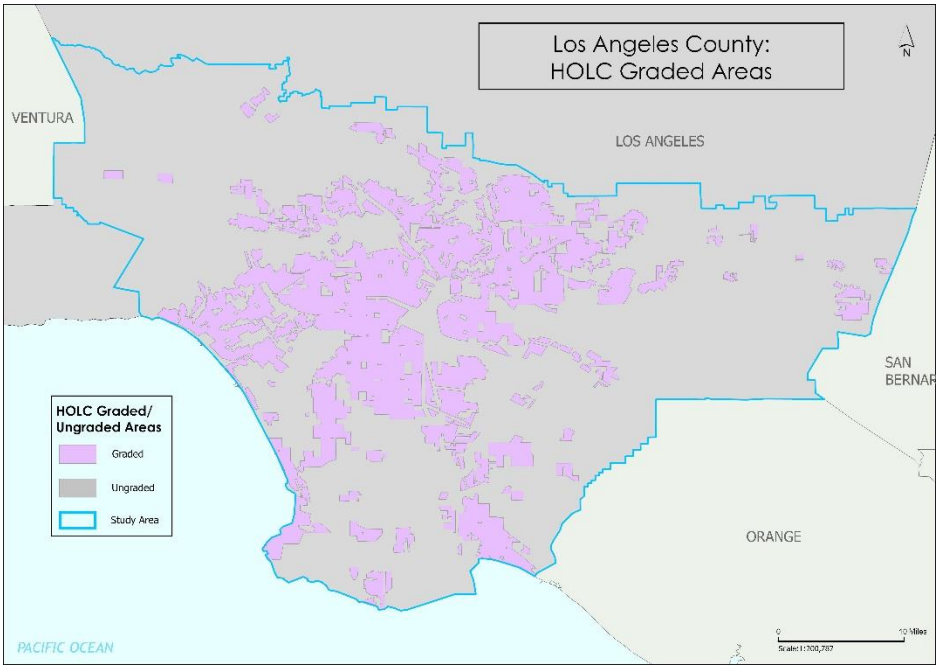
Empirical Findings

This section summarizes the empirical findings of our analysis and is organized into three parts. Part 1 compares two parts of the Los Angeles region, the section graded by HOLC, and the section not graded by HOLC within our study area (also labeled as HOLC and non-HOLC spaces). We examine the growth from 1940 to 2015–19, the contemporary (pre-pandemic) land-use and housing patterns, and recent racial/ethnic and socioeconomic characteristics. Parts 2 and 3 analyze the contemporary internal structures of the HOLC graded and ungraded areas by spatially disaggregating them into HOLC categories and subregions, respectively. Part 2 compares land-use and housing patterns, and Part 3 compares the composition of the population by race/ethnicity and income class.

Part 1: HOLC and Non-HOLC Spaces

Figure 3 identifies the HOLC and non-HOLC areas. The study areas are bounded by the blue line, the magenta areas have HOLC grades, and the gray areas do not. The development trajectories of the two regions or geographic sections differed over the three-quarter century after initial redlining. Substantial differences in growth produced distinct land-use and housing patterns and noticeable variations in demographic and socioeconomic characteristics.

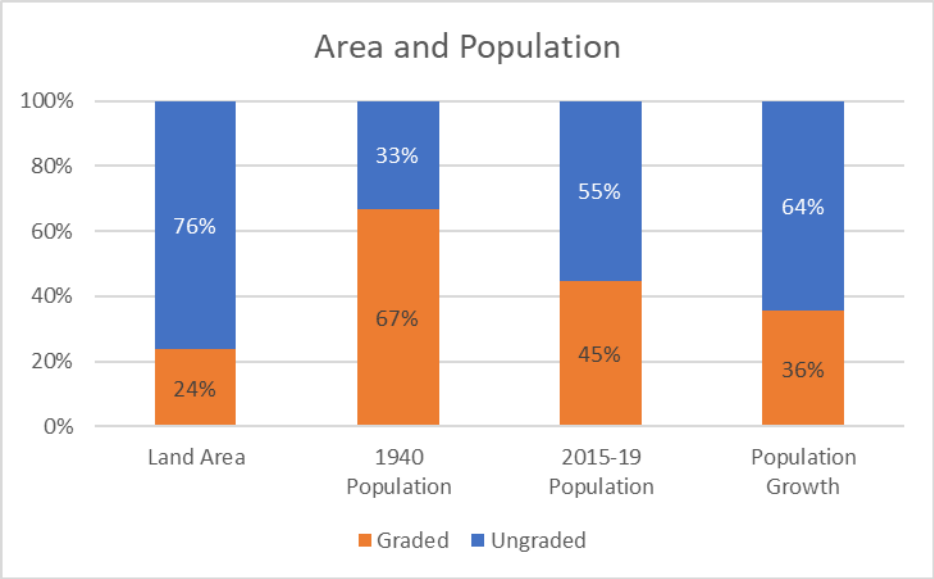
Figure 3: HOLC Graded Areas, LA County



Source: Nelson et al., "Mapping Inequality"; Investing in Place, "Council of Governments (COGs) and Subregions in Los Angeles County."

Figure 4 provides an overview of the development over time. The amount of land in the non-HOLC section is three times as large as the HOLC section. In 1940, the ungraded areas accounted for only a third of the population. The total population grew from 2.77 million in 1940 to 9.33 million by 2019, with ungraded places producing nearly two-thirds addition. Today, a majority reside in ungraded places.

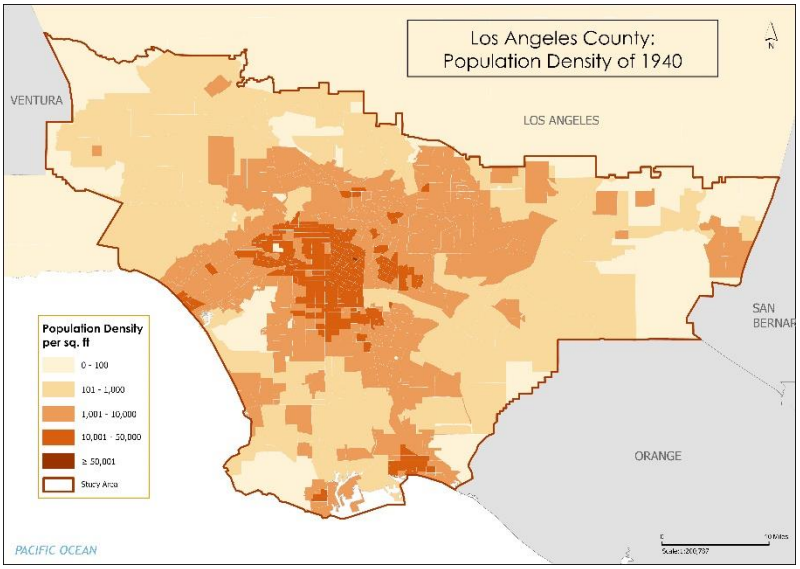
Figure 4: Land Area and Population Distribution by HOLC and non-HOLC Areas



Source: 1940 Decennial Census Enumeration; 2015–19 American Community Survey.

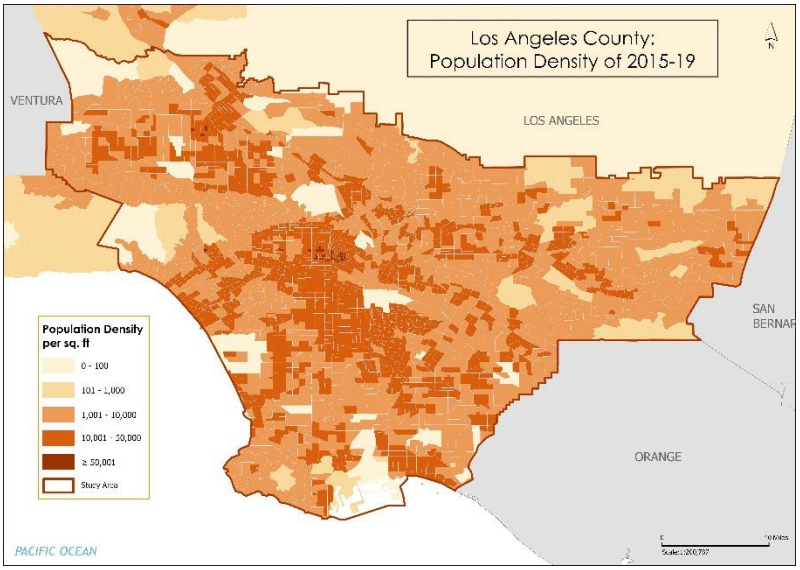
The two maps shown in figures 5 and 6 provide additional insights into the spatial pattern of the changes in population between the decades between the establishment of HOLC categories and contemporary pre-pandemic years. Figure 5 shows the population density in 1940, based on the available decennial census closest to the 1933 HOLC map. The denser tracts largely coincide with the HOLC graded areas, particularly in and around the urban core and well-established cities such as Los Angeles, Pasadena, Santa Monica, and Long Beach. Much of the lower density and less developed tracts coincide with the ungraded areas, such the future suburban areas in the San Fernando Valley, eastern sections of the San Gabriel Valley, the Gateway cities, and parts of the South Bay area. Figure 6 shows the population density in the years prior to COVID-19. What is noticeable is the development and increased density in the places not covered by HOLC categories, a filling out of the region through suburbanization.

Figure 5: Population Density in 1940 by Census Tract, LA County



Source: Map created by authors using data from Social Explorer.

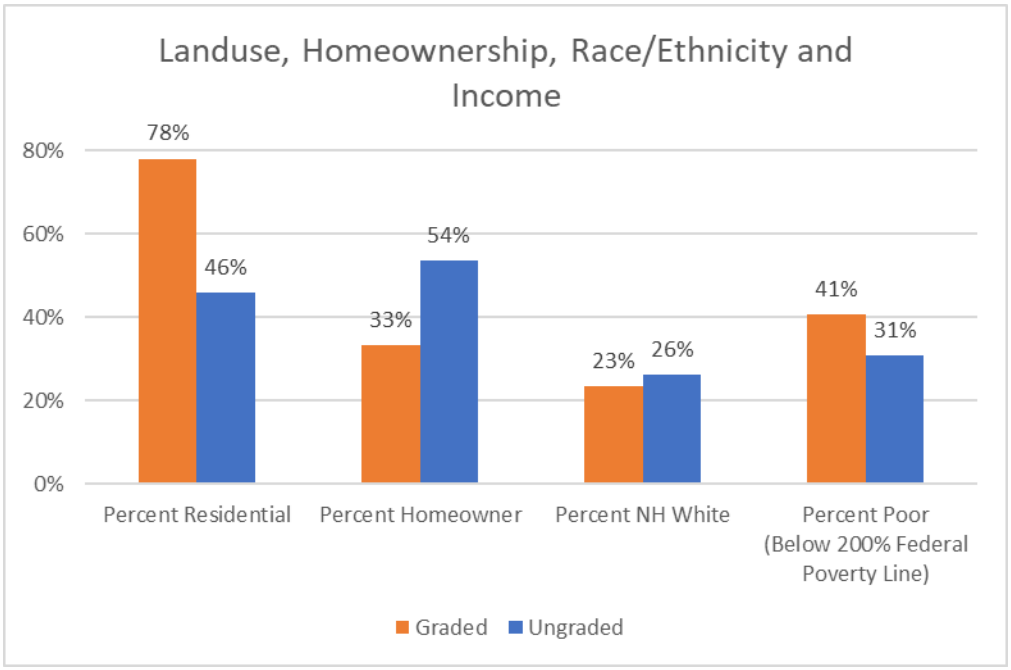
Figure 6: Population Density in 2015–19 by Census Tract, LA County



Source: Map created by authors using data from Social Explorer.

There are other differences between HOLC and non-HOLC areas in terms of contemporary land use and housing. (See Figure 7 and tables in Part 2.) A larger proportion of land in the former is zoned for residential use than in the latter. More than three-quarters of the HOLC areas are zoned residential, but less than half of the non-HOLC areas. More than half of the residents living in the ungraded areas are homeowners compared with less than a third in the graded areas.[22] Moreover, the housing density in the non-HOLC section is only half of the density in the HOLC section, due in large part to the role of post–World War II suburbanization in the ungraded areas.

Figure 7: Characteristics of HOLC and non-HOLC Areas



Source: Calculated by authors from L.A. County Parcel File, ACS, and HOLC Maps.

[22] Homeownership in ungraded areas was higher in both earlier and later periods with the difference between graded and ungraded areas growing most substantially compared to the other indicators over time.

There are also demographic and economic differences. In 1940, ungraded areas had proportionately fewer NH Whites, fewer with higher education, but higher ownership rates. Currently, the non-HOLC section has proportionately more NH Whites (albeit only slightly more), and more adults with higher education (a proxy for socioeconomic status). The relative socioeconomic position appears to have flipped, as indicated by the proportion of the contemporary population in living in a household with income less than two times the federal poverty line, 41% in the HOLC section and 31% in the non-HOLC section.

Part 2: Disaggregated Land-Use and Housing Patterns

While it is clear that HOLC-graded areas are predominantly residentially zoned, the share of zoned land uses vary widely between ungraded areas by COGs. The finding underscores both the understanding that HOLC policies not only spatially concretized existing growing residential development but also encouraged its continued trajectory decades later. Ungraded areas experience diverging land-use and housing development patterns that vary more than HOLC-graded categories.

Land Use

As mentioned previously, the graded region is by and large mostly zoned residential with almost double the housing density of the ungraded region; however, there is an uneven concentration of housing units between graded categories. As shown in Table 1, compared to 78% zoned residential in all graded areas, HOLC grades A and B are substantially more residential by 8 to 11 percentage points, respectively. While C graded areas are comparable to the overall percent of residentially zoned areas, redlined areas (grade D) developed in the opposite direction as A and B grades, with only two-thirds residential. Redlined areas in particular consisted of commercially zoned and other land uses that are well above the overall share in graded areas. While only 2% of HOLC A-graded areas are zoned commercial, one-fifth

of D-graded areas are zoned commercial. In addition, while redlined places have substantially less area zoned residential, it has almost four times the housing density as A-graded areas.

The non-HOLC subregions have varying zoning patterns. For example, Central Los Angeles has the lowest percent zoned residential compared to the other subregions, yet has the highest housing density. The San Gabriel Valley has the lowest housing density and the second to highest percent area zoned residential, indicating land-use development patterns that promote greater residential sprawl. This is particularly notable as San Gabriel Valley's ungraded area also has the greatest population with 1.3 million people, more than a quarter of the total population in ungraded areas.

While it is clear that HOLC-graded areas are predominantly residentially zoned, the share of zoned land uses vary widely between ungraded areas by COGs. In addition, the housing density range among ungraded subregions is greater than the range for the HOLC grades, with the greatest density almost five times more than the lowest compared to four times more among HOLC grades.

Table 1. Land Use Patterns of HOLC and non-HOLC Areas

LAND USE PATTERNS BY AREA				
	Percent zoned residential	Percent zoned commerical	Percent other	Housing Density
HOLC vs Non-HOLC Areas				
Graded	78%	12%	10%	2.93
Ungraded	46%	18%	36%	1.43
HOLC Grades				
A - Green	89%	2%	9%	1.04
B - Blue	86%	6%	7%	2.26
C - Yellow	77%	13%	10%	3.47
D - Red	66%	19%	15%	3.95
Ungraded Areas by COG				
Arroyo Verdugo	42%	15%	43%	1.39
Central Los Angeles	29%	23%	48%	4.76
Gateway Cities	45%	27%	28%	2.02
San Fernando Valley	57%	18%	25%	1.42
San Gabriel Valley	53%	16%	31%	1.01
South Bay Cities	33%	16%	51%	1.22
Westside Cities	49%	10%	41%	1.32

Source: Calculated by authors from L.A. County Parcel File, ACS and HOLC Maps.

Housing

With less housing density, ungraded subregions have a majority of single-unit buildings and with more than half of the units being owner occupied. Graded areas, however, are majority multifamily unit buildings and renter-occupied units. (The findings are presented in Table 2.). Together, this suggests that without HOLC policies, ungraded areas were more likely able to develop single-family homes and obtain mortgages that enabled greater rate of homeownership.

Unsurprisingly, A-graded areas have substantially greater share of single units than the other graded categories at 63% compared to the second highest within the B-graded areas at 49%. A-graded areas notably follow a similar trajectory as ungraded areas in terms of share of single units and owner occupied, but experience a high share of vacancies at 10%, suggesting a weaker rental market as also indicated by the low share of renter-occupied units. As the

HOLC legacy would suggest, redlined areas have predominantly renter-occupied units and lower vacancy rates than A- or B-graded areas.

Ungraded subregions experience substantially different housing development. Three out of the seven subregions have a greater share of single units in its ungraded areas than all A-graded areas. In addition, similar to land-use patterns, Central Los Angeles and San Gabriel Valley continue to develop in opposite directions where the former follows redlined housing development and the latter follow A-graded development. These two regions also demonstrate the extreme ends of development among the ungraded subregions that have a far greater range than between HOLC-graded categories across all housing types and tenure indicators.

Table 2. Housing Tenure of HOLC and non-HOLC Areas

SHARE BY TENURE TYPE OUT OF TOTAL HOUSING UNITS					
	Total Housing Units	**Share of Single Units**	**Share of Owner Occupied**	**Shared of Renter Occupied**	**Share Vacant**
HOLC vs Non-HOLC Areas					
Graded	1,542,869	45%	31%	62%	7%
Ungraded	1,749,797	61%	51%	44%	6%
HOLC Grades					
A - Green	82,565	63%	55%	35%	10%
B - Blue	257,584	49%	40%	53%	8%
C - Yellow	826,377	41%	28%	65%	7%
D - Red	376,344	45%	27%	66%	6%
Ungraded Areas by COG					
Arroyo Verdugo	54,321	55%	46%	49%	6%
Central Los Angeles	138,486	27%	23%	67%	10%
Gateway Cities	383,833	68%	54%	42%	4%
San Fernando Valley	451,095	58%	49%	46%	5%
San Gabriel Valley	361,768	76%	61%	34%	5%
South Bay Cities	255,970	62%	54%	40%	6%
Westside Cities	104,324	40%	39%	49%	11%

Source: Calculated by authors from ACS data and HOLC Maps.

Part 3: Disaggregated Racial and Economic Spatial Stratification

There are similar levels of demographic and economic segregation between ungraded subregions and HOLC categories. Income class and poverty rates are also similar in ranges for ungraded subregions and HOLC grades. However, the variance in the share of Black residents is particularly wide across ungraded subregions compared to HOLC grades, suggesting the potential of other policies and factors at play besides HOLC that contributes to the wider segregation patterns of Black residents between ungraded geographies.

Racial/Ethnic Composition

The racial/ethnic compositions of graded region and ungraded region are similar as shown in Table 3. Hispanics comprise a majority, followed by NH White, Asian, and Black as the smallest share. Compared to the overall racial composition of graded areas, there is clear divergence between HOLC grades across racial groups, particularly when it comes to the share of NHW and Hispanic population. Grade A areas are more than half NHW, followed by B, C, and D at 15%. The direct opposite pattern is true for Hispanics. Grade A areas have a population that is 14% Hispanic, with the share increasing to grade D at 65%. Blacks consistently make up between 8% to 10% of the population across each HOLC grade. Asians comprise between 10% to 18% with the greatest share among HOLC A grade. When comparing the range in share between HOLC and ungraded subregions, Blacks among ungraded COG areas is particularly wide, from 2% in Arroyo Vergudo to 17% in Central Los Angeles. Overall, the results indicate similar processes of racial/ethnic segregation within the housing market, both within the graded region and the ungraded region.

Table 3. Racial and Ethnic Composition of HOLC and non-HOLC Areas

RACE/ETHNIC COMPOSITION				
	NH White	**Black**	**Asian**	**Hispanic or Latino**
HOLC vs Non-HOLC Areas				
Graded	23%	9%	13%	52%
Ungraded	26%	7%	16%	47%
HOLC Grades				
A - Green	55%	8%	18%	14%
B - Blue	38%	10%	13%	36%
C - Yellow	21%	9%	15%	52%
D - Red	15%	8%	10%	65%
Ungraded Areas by COG				
Arroyo Verdugo	59%	2%	17%	18%
Central Los Angeles	20%	17%	15%	44%
Gateway Cities	17%	7%	10%	63%
San Fernando Valley	35%	4%	11%	48%
San Gabriel Valley	18%	3%	27%	49%
South Bay Cities	27%	14%	21%	33%
Westside Cities	61%	5%	15%	14%

Source: Calculated by authors from ACS data and HOLC Maps.

Poverty/Income Class Composition

When observing the distribution of people across income classes and as presented in Table 4, people in the lowest income class make up a noticeable plurality of the graded region compared to ungraded regions where the composition of income classes are generally evenly distributed. These differences may be due to the fact that HOLC geographies mapped onto existing urban development with concentrations of people in poverty in the urban core that continue to exist today. The legacy of HOLC grades also persist where, unsurprisingly, grade A areas are composed mostly of the upper income class at 55% and only 17% in the poor income class. Grade A proportion of upper-class income is almost 18 percentage points more than the next greatest share at 37% among B-graded areas. Grade C and D areas generally reflect

overall graded distribution of income classes. The poverty rate for grade C and D areas is almost twice as high as that of grade A areas.

Each ungraded subregion generally reflects the income distributions of the overall ungraded areas except for Central Los Angeles and Westside Cities. Westside Cities reflect grade A patterns, whereas Central Los Angeles reflects redlined patterns. It is worth noting that Westside Cities has the greatest share of NHW whereas Central Los Angeles has the greatest share of Blacks, underscoring correlation between race and class. Poverty rates across ungraded COG areas are fairly consistent, making up 10% to 13% of the population, except for Central Los Angeles, where the share of people in poverty is almost double the overall ungraded share at 23%. Comparing the differences in income class and poverty ranges between HOLC-graded areas and ungraded subregions, they are almost equal suggesting that when it comes to income/poverty, HOLC and ungraded subregions as a whole developed similarly.

Table 4. Poverty Levels of HOLC and non-HOLC Areas

POVERTY/INCOME CLASS				
	Poverty	*Income Class*		
	Below Federal Poverty Line	**Poor**	**Middle**	**Upper**
HOLC vs Non-HOLC Areas				
Graded	18%	41%	33%	27%
Ungraded	13%	31%	33%	36%
HOLC Grades				
A - Green	8%	17%	28%	55%
B - Blue	12%	29%	34%	37%
C - Yellow	19%	43%	33%	24%
D - Red	21%	47%	31%	22%
Ungraded Areas by COG				
Arroyo Verdugo	11%	25%	32%	43%
Central Los Angeles	23%	45%	30%	26%
Gateway Cities	13%	33%	35%	32%
San Fernando Valley	13%	33%	32%	35%
San Gabriel Valley	11%	29%	34%	38%
South Bay Cities	11%	25%	34%	41%
Westside Cities	10%	18%	28%	53%

Source: Calculated by authors from ACS data and HOLC Maps.

Conclusion

The empirical findings provide insights into the nature and pattern of economically stratified and racialized spaces in regional development. There is support for the redlining-legacy claim. HOLC grading institutionalized preexisting racial and economic patterns of spatial inequality, and subsequently contributed to the reproduction of geographic stratification, albeit not perfectly. The neighborhoods with the lowest grade (red) generally fare significantly worse than the highest grade (green) in terms of housing and socioeconomic status. There are, of course, some notable exceptions, such as the redlined areas along the coast in the South Bay. Over time, proximity to the beaches became desirable enough that these neighborhoods are

now among the most desirable locations, with very expensive real estate. Nonetheless, historical HOLC grades are highly correlated with contemporary spatial racial/ethnic and economic disparities, consistent with the redlining-legacy thesis that these institutionalized categories have replicated past geographic inequalities over generations. Correlation, however, is not causality, and additional research is needed to separate the influence of HOLC grading from other factors, such as those influencing real estate market practices, housing and land markets, and government policies.

The development of the areas not graded by HOLC in the Los Angeles metropolis strongly suggests that many more forces beyond redlining have created unequal neighborhoods. These places were residentially undeveloped or commercial spaces in the 1930s, but they account for the majority of the post-HOLC growth. Today, they house the majority of the region's population. Compared with the HOLC-graded areas, the ungraded areas are distinctively different in land-use and housing patterns, due largely to suburban development. However, the population in the ungraded areas are, in many ways, as demographically and economically diverse as the population in the graded areas. As with the graded areas, the subregions of the ungraded areas are currently economically stratified and racially/ethnically segregated, with geographic differences at least equal to what is observed for the variation among HOLC-graded places.

The results show that the ungraded places became racially and socioeconomically stratified even in the absence of redlining (HOLC grading). This indicates that there are fundamental societal processes that produce and reproduce spatialized inequality. Again, this is not to deny the redlining legacy. Instead, one plausible reinterpretation is that HOLC tends to perpetuate the pattern of inequality among older neighborhoods, thus significantly anchoring the geographic locations of marginalized and privileged communities and populations. As mentioned, there are some exceptions, which are worth examining in future research. The

ungraded areas are also worth further study, which would provide insights into the societal factors and dynamics that generated differentiated unequal development.

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Appendix

Table A1: Characteristics of HOLC-Graded Categories

Characteristics, 2015–19				
	HOLC Grade			
Indicators	Green	Blue	Yellow	Red
Share of Area	12%	20%	46%	22%
Share of Population	4%	15%	54%	27%
Population Density	4.6	9.6	15.0	15.4
Non-residential Areas	11%	14%	23%	34%
Adjusted Density	5.1	11.1	19.5	23.5

Source: Calculated by authors from ACS data, L.A. County Parcel File and HOLC Maps.

Table A2: Characteristics of Ungraded Areas by COGs

Row Labels	Area	1940 Population	2015–19 Population	Pop. Growth
Arroyo Verdugo	3%	6%	3%	2%
Central Los Angeles	4%	25%	6%	2%
Gateway Cities	17%	22%	25%	25%
San Fernando Valley	21%	10%	26%	29%
San Gabriel Valley	25%	16%	23%	24%
South Bay Cities	24%	12%	14%	14%
Westside Cities	6%	9%	4%	3%
Grand Total	100%	100%	100%	100%

Source: Calculated by authors from 1940 Decennial Census, 2015–19 ACS, L.A. County Parcel File and HOLC Maps.

Dissimilarity and Entropy

We use the dissimilarity index (DI) to measures the evenness or unevenness in the geographic distribution of two groups and has values ranging from 0 (complete integration) to 100 (complete segregation). This index's main advantage is its intuitive interpretation—the index value represents the percent of a population that would have to move away from

segregated areas to achieve full integration. Table A3 reports the racial/ethnic and income-class DIs for the study area, the HOLC-graded area, and the ungraded area. We complement the analysis by examining the degree of racial/ethnic homogeneity/heterogeneity in each of the areas by calculating the multigroup entropy score (ES). The score measures the degree of diversity and segregation for a given place. Lower ES values indicate less diversity, and higher ES values indicate more diversity (more racially mixed). The range of the ES depends on the number of groups included in the calculation. The calculated entropy scores reveal little differences in the degree of heterogeneity/homogeneity for the graded area (1.27) and the ungraded area (1.29), while the areas outside of the study area had a lower score (1.26).

Table A3: DI Scores of HOLC and non-HOLC Areas

Populations	Study Area	Graded	Ungraded
Race			
NHW & Black	0.66	0.71	0.61
NHW & Asian	0.50	0.53	0.48
NHW & Hispanic	0.63	0.69	0.58
NHW & Other	0.33	0.33	0.32
Income Class			
Poor-Middle	0.26	0.25	0.25
Middle-Upper	0.24	0.25	0.23
Poor-Upper	0.43	0.43	0.40

Source: Calculated by authors from 2015–19 ACS data.