

Exploring the Legacy of Redlining in California with Open Data & Open Source Tools

Investigating linkages to pollution burden and public health trends with
CalEnviroScreen data

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California Environmental Protection Agency (CalEPA)
State Water Resources Control Board
Office of Information Management & Analysis (OIMA)

Water Data Seminar Series | March 18, 2021

 bit.ly/redline-2021-03



Overview

1. Background / Context

- CalEPA Team
- Definitions & History

2. Analysis

- Data
- Results

3. Presentation Formats

- Storymap website
- Shiny App

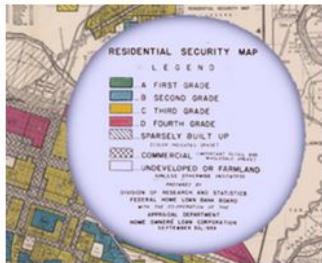
4. Tools & Methods

5. Considerations, Limitations, & Next Steps

Background / Context

Background – CalEPA Racial Equity Team

Pollution and Prejudice: Redlining and Environmental Injustice in California



[Pollution and Prejudice: CalEPA Releases Redlining StoryMap](#)

As part of its commitment to racial equity, CalEPA has released a draft StoryMap highlighting the connection between racist land use practices of the 1930s and environmental injustice, as reflected by CalEnviroScreen scores. Redlining practices systematically included both race and environmental factors as criteria in assessing the credit-worthiness of neighborhoods.

Explore the [StoryMap: Pollution and Prejudice | Contaminación y Prejuicio](#)
(Download [English](#), [español](#)) (02/01/21)

Storymap released February 1, 2021

 bit.ly/pollutionandprejudice

Project Team:

- Greg Gearheart, State Water Resources Control Board
- Beti Girma, State Water Resources Control Board
- Jaimie Huynh, CalRecycle
- Maraid Jimenez, State Water Resources Control Board
- Charles Lee, USEPA Office of Environmental Justice
- Jennifer McGovern, State Water Resources Control Board
- Kevin Olp, Bay Area Air Quality Management District
- Deldi Reyes, California Air Resources Board
- Amy Schwanhausser, former CalEPA Intern
- Walker Wieland, Office of Environmental Health Hazard Assessment
- Angie Ye, former CalEPA Intern

Background – What is Redlining?

Some Standard Definitions:

- Wikipedia: “the systematic denial of various services or goods by federal government agencies, local governments, or the private sector either directly or through the selective raising of prices” ¹
- Google / Oxford Languages: “refuse (a loan or insurance) to someone because they live in an area deemed to be a poor financial risk (example: ‘banks have redlined loans to buyers’)” ²

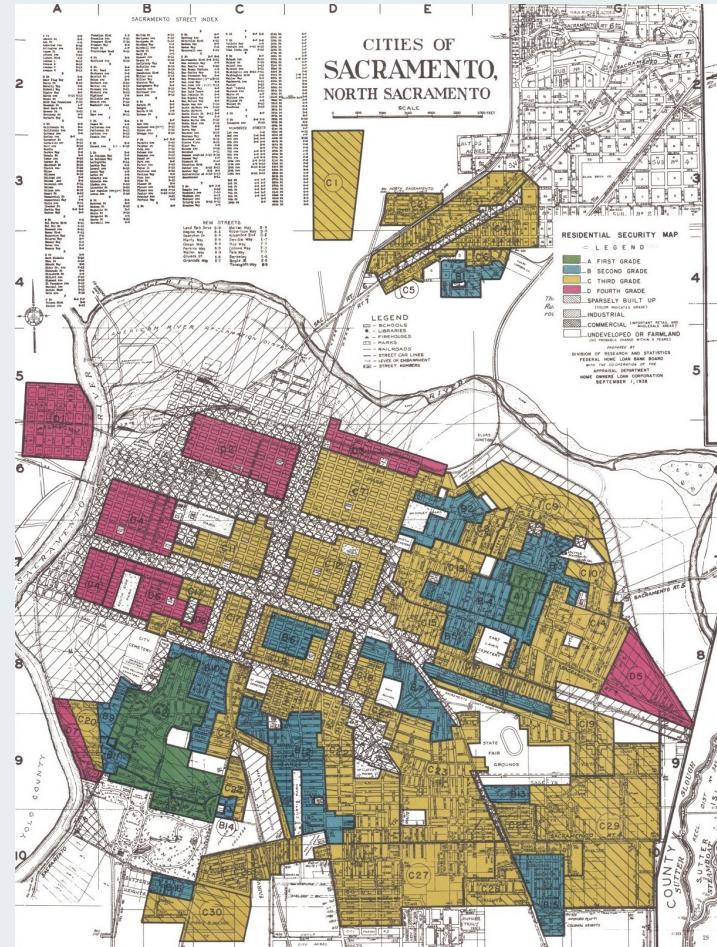
In the context of this project, “redlining” refers to a specific, well documented practice...

1 - Wikipedia

2 - Google / Oxford Languages

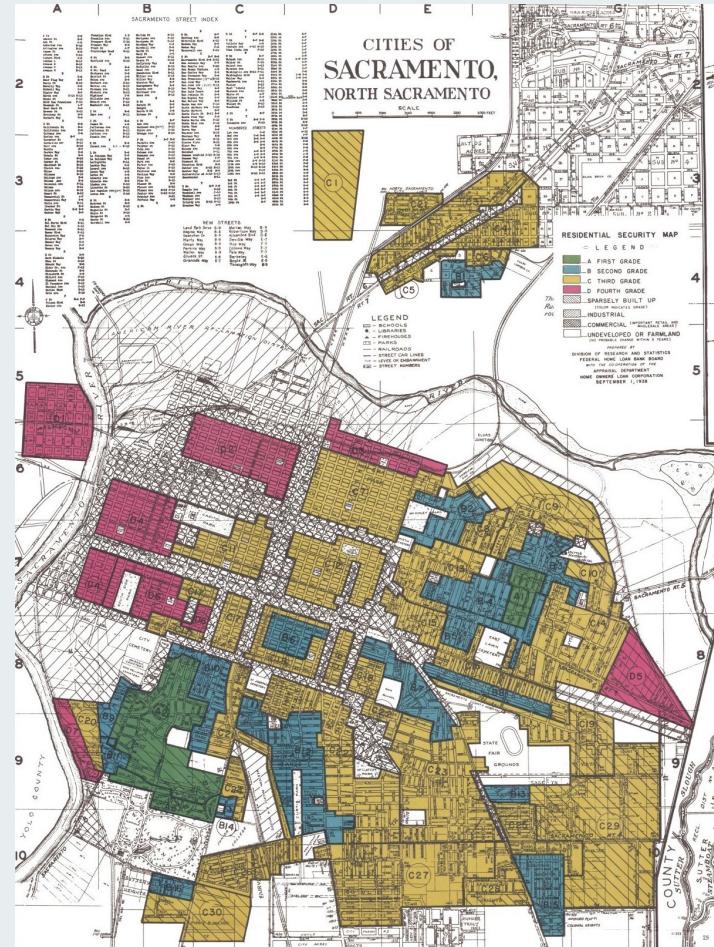
Background – History

- 1930s “Residential Security” maps of major cities across the country (population >40,000), including 8 in California:
 - Fresno
 - Los Angeles
 - Oakland
 - Sacramento
 - San Diego
 - San Francisco
 - San Jose
 - Stockton



Background – History

- 1930s “Residential Security” maps of major cities across the country (population >40,000)
 - Created by a federal government agency — Home Owners’ Loan Corporation (HOLC)
 - HOLC bought mortgages at risk of default, re-issued loans on more favorable terms
 - Evaluated mortgage lending risk by neighborhood - A (green) to D (red) scale



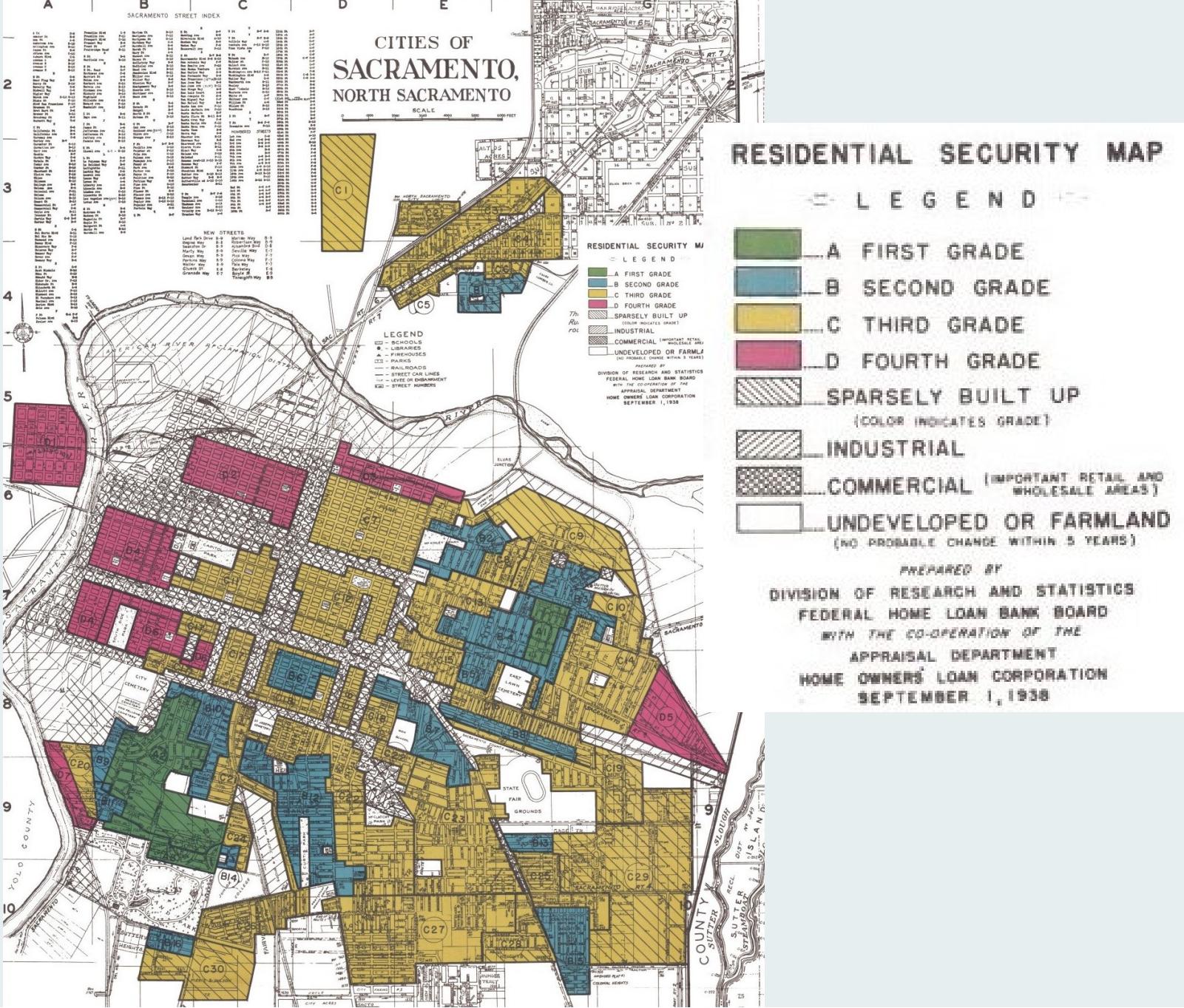


Image Source:
Mapping Inequality

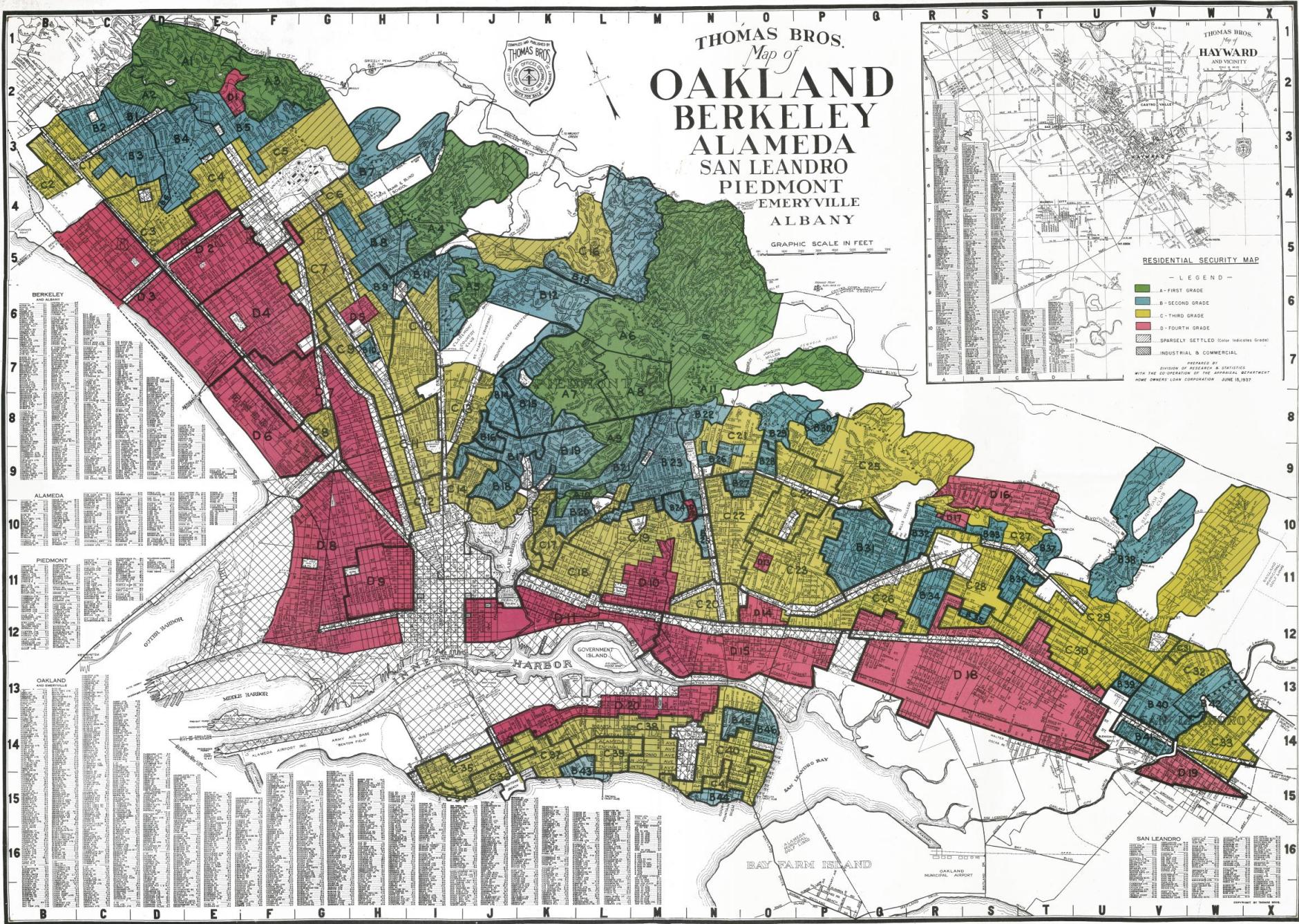


Image
Source:
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 - Evaluated mortgage lending risk by neighborhood - A (green) to D (red) scale
 - Explicitly considered racial and ethnic makeup of neighborhoods

A neighborhood earned a red color if African Americans lived in it, even if it was a solid middle-class neighborhood of single family homes.”

—Richard Rothstein, *The Color of Law: A Forgotten History of How Our Government Segregated America* (2017)

AREA DESCRIPTION - SECURITY MAP OF Sacramento, Cal.

1. AREA CHARACTERISTICS:
a. Description of Terrain. Level with favorable grade and no construction hazards.

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AREA DESCRIPTION - SECURITY MAP OF Sacramento, Cal.

1. AREA CHARACTERISTICS:

- a. Description of Terrain. Level with favorable grade and no construction hazards.

b. Favorable Influences. Convenience to transportation, schools, churches, trading and amusement areas. Nearness to city center. Proximity to centers of commercial and industrial employment.

c. Detrimental Influences. Highly congested population whose density greatly exceeds city's average. Presence in large numbers of subversive racial elements. Encroachment of commerce and business.

d. Percentage of land improved 95%; e. Trend of desirability next 10-15 yrs. Declining

2. INHABITANTS: All groups from relief to

a. Occupation Oriental business and professional men & executives b. Estimated annual family income \$ Relief to 3600

c. Foreign-born families 75%; Latin and Japanese predominating; d. Negro Yes; 10%

e. Infiltration of Orientals has occurred; f. Relief families Many

g. Population is increasing: activity new; decreasing old; static Yes

a. AVAILABILITY OF MORTGAGE FUNDS: a. Home purchase Limited; b. Home building Limited

5. CLARIFYING REMARKS: This old area is the "melting pot" of Sacramento. It contains the principal Japanese colony and the greatest concentration of Negroes in the city. There are no deed restrictions, and zoning is for general commercial uses. Dwellings are very cheap to medium construction. The quality of maintenance, for a district of this character, is much above the average. It is stated that many buildings in the area violate the State Housing Act and city housing ordinances, and Grand Jury investigation is under way at the present time. Heterogeneity, age and obsolescence of improvements, and predominance of subversive racial elements are the area's chief hazards. Rated "low risk" grade.

6. NAME AND LOCATION Part of Old City SECURITY GRADE D AREA NO. 4

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 - Evaluated mortgage lending risk by neighborhood - A (green) to D (red) scale
 - Explicitly considered racial and ethnic makeup of neighborhoods
 - Resulting disparities in pathways to home ownership, community development, and other economic and social opportunities

“Although the HOLC did not always decline to rescue homeowners in neighborhoods colored red on its maps (i.e, redlined neighborhoods), the maps had a huge impact and **put the federal government on record as judging that African Americans, simply because of their race, were poor risks.**”

—Richard Rothstein, *The Color of Law: A Forgotten History of How Our Government Segregated America* (2017)

Background – Other Studies

Economic Impacts

FEDERAL RESERVE BANK of CHICAGO

Banking Research & Policy Markets Publications Events Education Region People

Working Paper, No. 2017-12, 2017

The Effects of the 1930s HOLC "Redlining" Maps (REVISED August 2020)

By Daniel Aaronson , Daniel Hartley , Bhash Mazumder

We study the effects of the 1930s-era HOLC "redlining" maps on the long-run trajectories of neighborhoods. Using a boundary design and propensity score methods, we find that the maps led to reduced home ownership rates, house values, and rents and increased racial segregation in later decades. We also compare cities on either side of a population cutoff that determined whether maps were drawn and find broadly similar results. We conclude that the HOLC maps had meaningful and lasting effects on the development of urban neighborhoods through reduced credit access and subsequent disinvestment.

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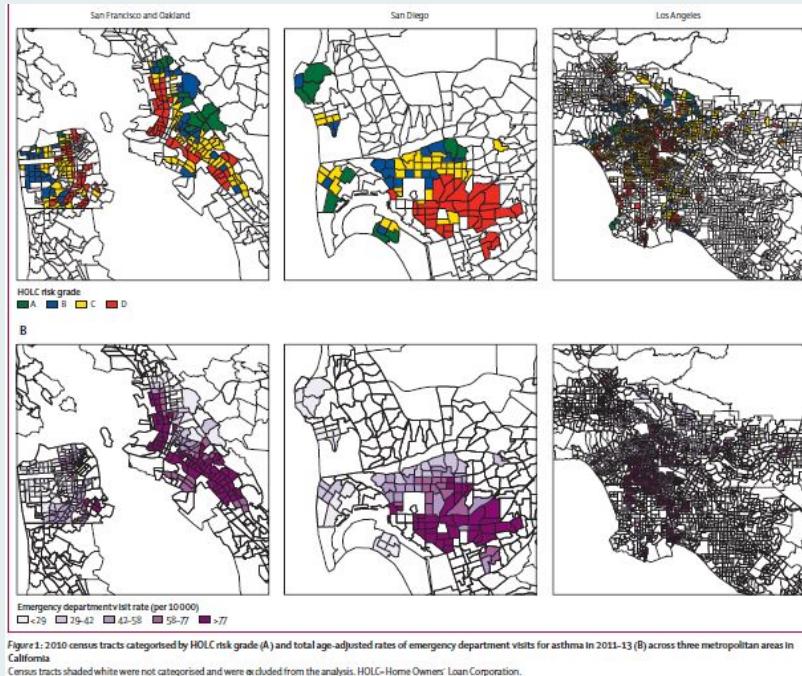
More by this Author Daniel Aaronson Potential Jobs Impacted by Covid-19: An Update Potential Jobs Impacted by Covid-19 Declining Labor Force

"Our results suggest that the **HOLC maps had an economically meaningful and lasting effect on the development of urban neighborhoods** through reduced credit access and subsequent disinvestment"¹

1 - D. Aaronson, D. Hartley, B. Mazumder. **The Effects of the 1930s HOLC "Redlining" Maps (Revised August 2020)**. Federal Reserve Bank of Chicago. Working Paper, No. 2017-12, 2017. <https://www.chicagofed.org/publications/working-papers/2017/wp2017-12>

Background – Other Studies

Redlining & Asthma Rates¹



"Historically redlined census tracts have significantly higher rates of emergency department visits due to asthma,
 suggesting that this discriminatory practice might be contributing to racial and ethnic asthma health disparities"

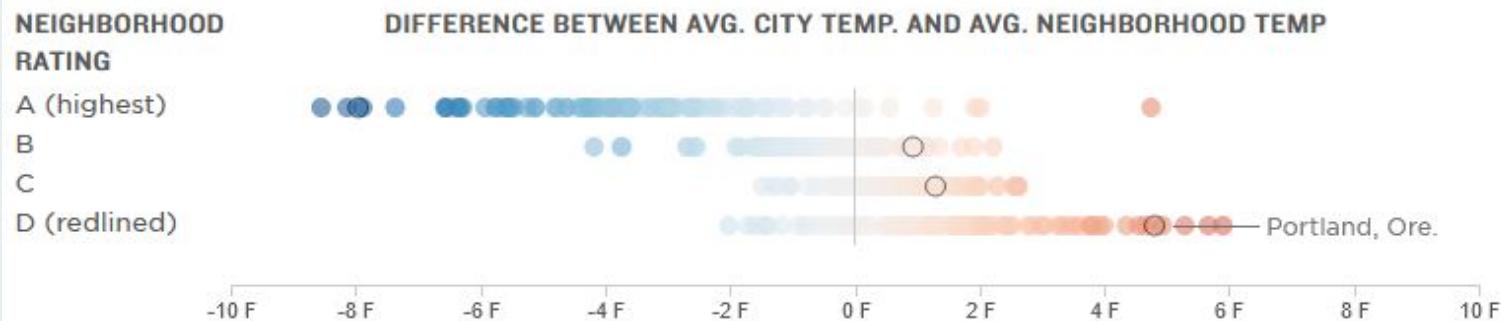
1 - A. Nardone, J.A. Casey, R. Morello-Frosch, M. Mujahid, J.R. Balmes, N. Thakur. **Associations between historical residential redlining and current age-adjusted rates of emergency department visits due to asthma across eight cities in California: an ecological study.** Lancet Planet Health, 4 (1) (2020), pp. e24-e31.
[https://doi.org/10.1016/S2542-5196\(19\)30241-4](https://doi.org/10.1016/S2542-5196(19)30241-4)

Background – Other Studies

Redlining & Tree Cover / Urban Heat Islands¹

In Formerly Redlined Areas, Americans Live With Hotter Temperatures

In the 1930s, the federal government rated neighborhoods in urban areas to help mortgage lenders assess risk. Low ratings were determined largely by race and ethnicity. New research in 108 cities shows that today those redlined neighborhoods are often hotter than other neighborhoods in the same city, with the most drastic difference found in Portland, Ore.



Source: Portland State University, the Science Museum of Virginia and Virginia Commonwealth University

Credit: Sean McMinn/NPR

¹ - Hoffman JS, Shandas V, Pendleton N. **The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas.** Climate. 2020; 8(1):12. <https://doi.org/10.3390/cli8010012>

Background – Other Historical Policies

Zoning (Los Angeles):

“a black community became established in the South Central area of the city in the 1940s. The neighborhood had some industry, but its nonresidential character was more firmly entrenched when the city began a process of ‘spot’ rezoning for commercial or industrial facilities. Automobile junkyards became commonplace in the African American neighborhood. In 1947, an electroplating plant explosion in this newly developing ghetto killed five local residents (as well as fifteen white factory workers) and destroyed more than one hundred homes.

—Richard Rothstein, *The Color of Law: A Forgotten History of How Our Government Segregated America* (2017)

Background – Other Historical Policies

Zoning & Redlining:

"when the Federal Housing Administration (FHA) developed insured amortized mortgage as a way to promote homeownership nationwide, these zoning practices rendered African Americans ineligible for such mortgages because banks and the FHA considered the existence of nearby rooming houses, commercial development, or industry to create risk to the property value of single-family areas.

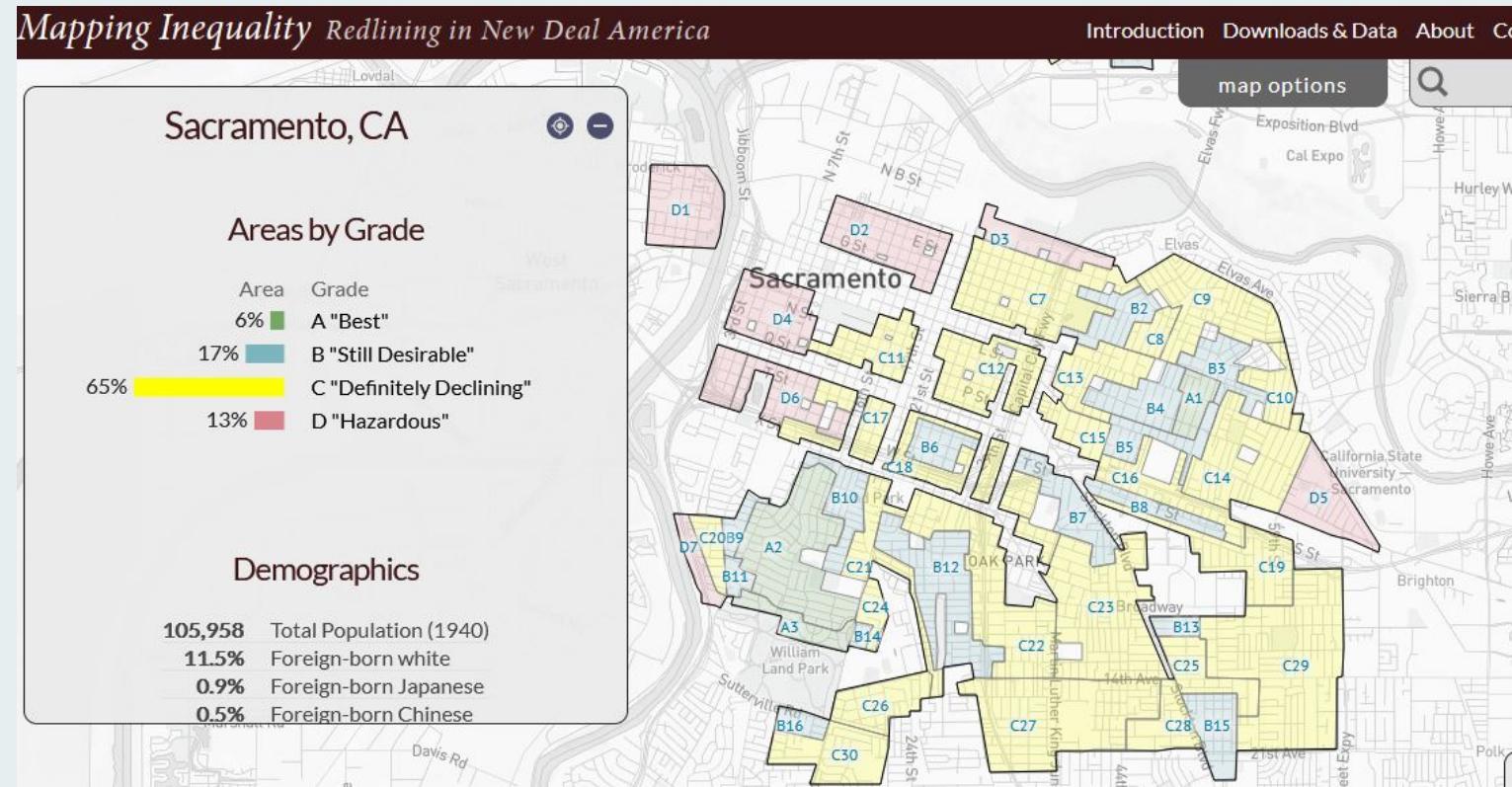
Without such mortgages, the effective cost of African American housing was greater than that of similar housing in white neighborhoods, leaving owners with fewer resources for upkeep. African American homes were then more likely to deteriorate, reinforcing their neighborhoods' slum conditions."

"zoning... attempted to protect white neighborhoods from deterioration by ensuring that few industrial or environmentally unsafe businesses could locate in them. Prohibited in this fashion, polluting industry had no option but to locate near African American residences."

—Richard Rothstein, *The Color of Law: A Forgotten History of How Our Government Segregated America* (2017)

Analysis

Digitized Redlining Maps



Robert K. Nelson, LaDale Winling, Richard Marciano, Nathan Connolly, et al., "Mapping Inequality," American Panorama, ed. Robert K. Nelson and Edward L. Ayers.
<https://dsl.richmond.edu/panorama/redlining/>

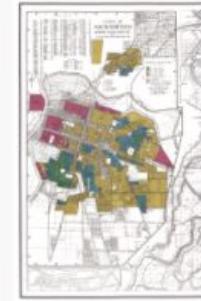
Digitized Redlining Maps

ty Redlining in New Deal America

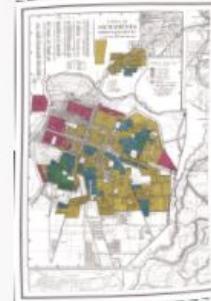
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Sacramento

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[Shapefile or GeoJSON](#)



[Area Description Images](#)



San Diego

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[Shapefile or GeoJSON](#)

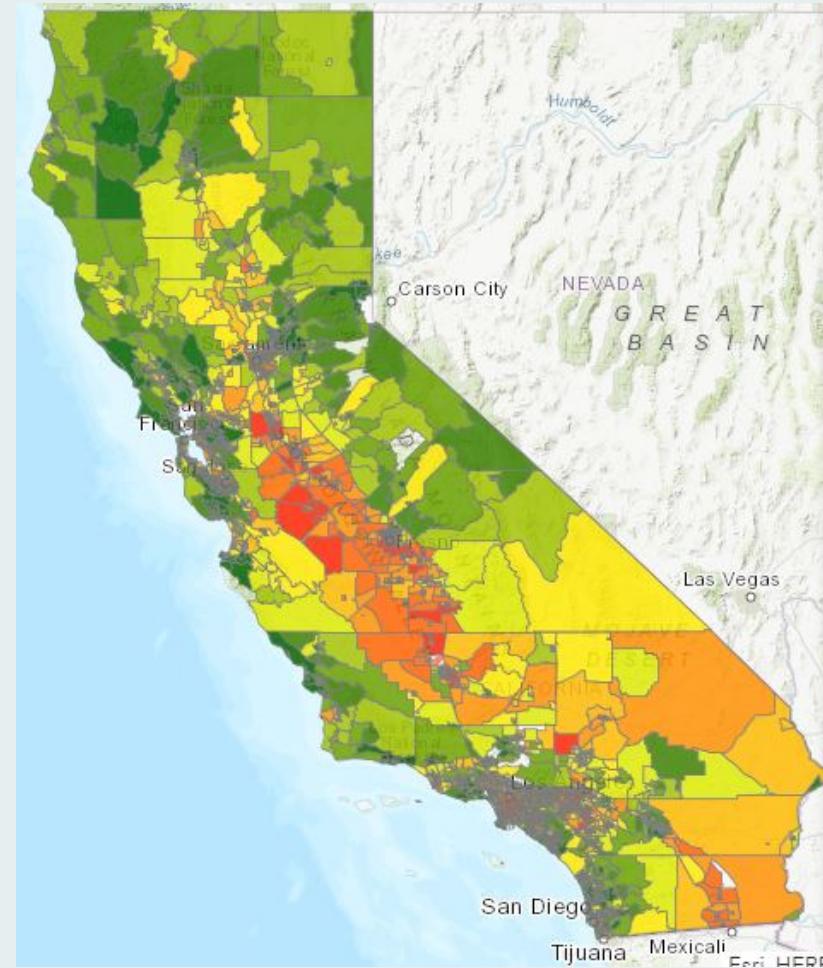


[Area Description Images](#)

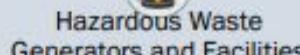
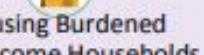


CalEnviroScreen 3.0

- broad indicator of present-day environmental / public health conditions state-wide
- mapping tool to identify California communities
 - most affected by different sources of pollution
 - most vulnerable to the effects of pollution
- includes environmental, health, and socioeconomic data
- produces a numerical score for each census tract in the state



CalEnviroScreen 3.0

Pollution Burden	Population Characteristics
Exposures	Sensitive Populations
 Ozone  PM2.5  Diesel PM  Pesticide Use  Traffic  Drinking Water Contaminants  Toxic Releases from Facilities	 Asthma  Cardiovascular Disease  Low Birth-Weight Infants
Environmental Effects	Socioeconomic Factors
 Solid Waste Sites and Facilities  Cleanup Sites  Groundwater Threats  Impaired Water Bodies  Hazardous Waste Generators and Facilities	 Poverty  Unemployment  Educational Attainment  Linguistic Isolation  Housing Burdened Low Income Households

CalEnviroScreen Formula

Pollution Burden

Average of Exposures and Environmental Effects*



Population Characteristics

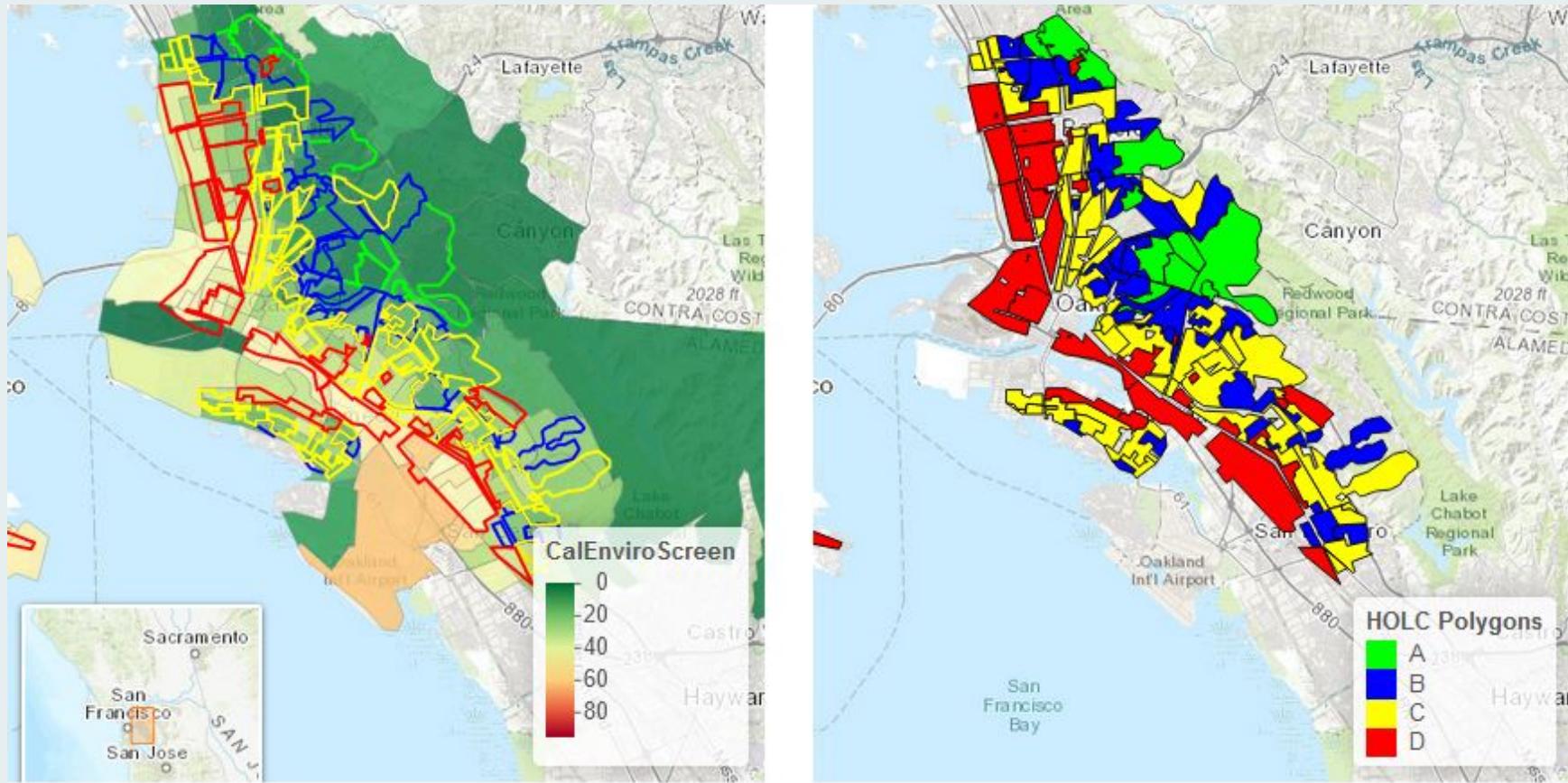
Average of Sensitive Populations and Socioeconomic Factors



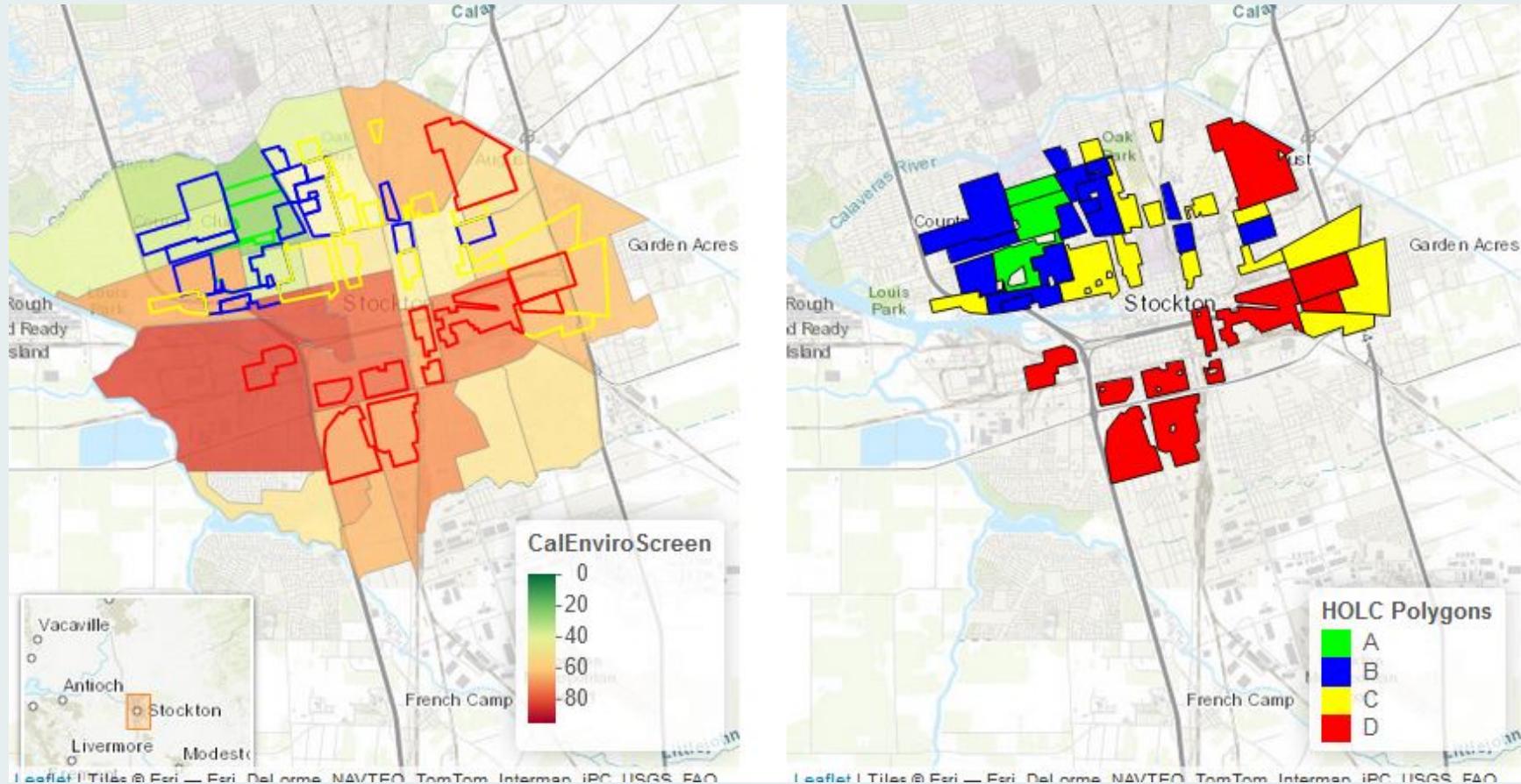
CalEnviroScreen Score

*The Environmental Effects component is weighted one-half when combined with the Exposures component.

Combining Redline Maps & CalEnviroScreen Data

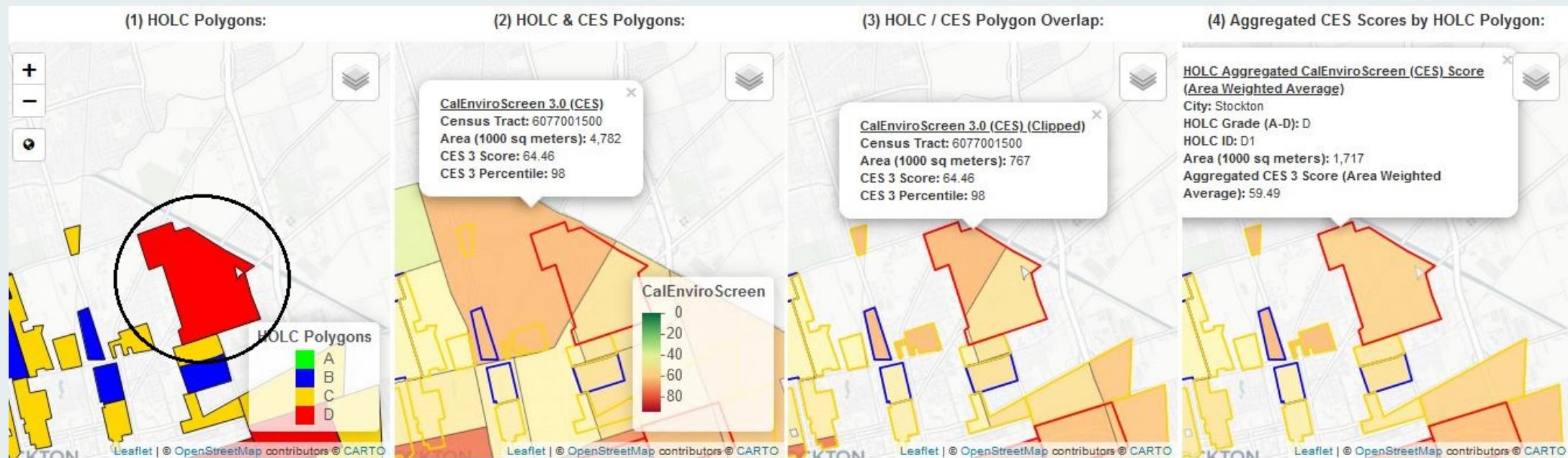


Combining Redline Maps & CalEnviroScreen Data



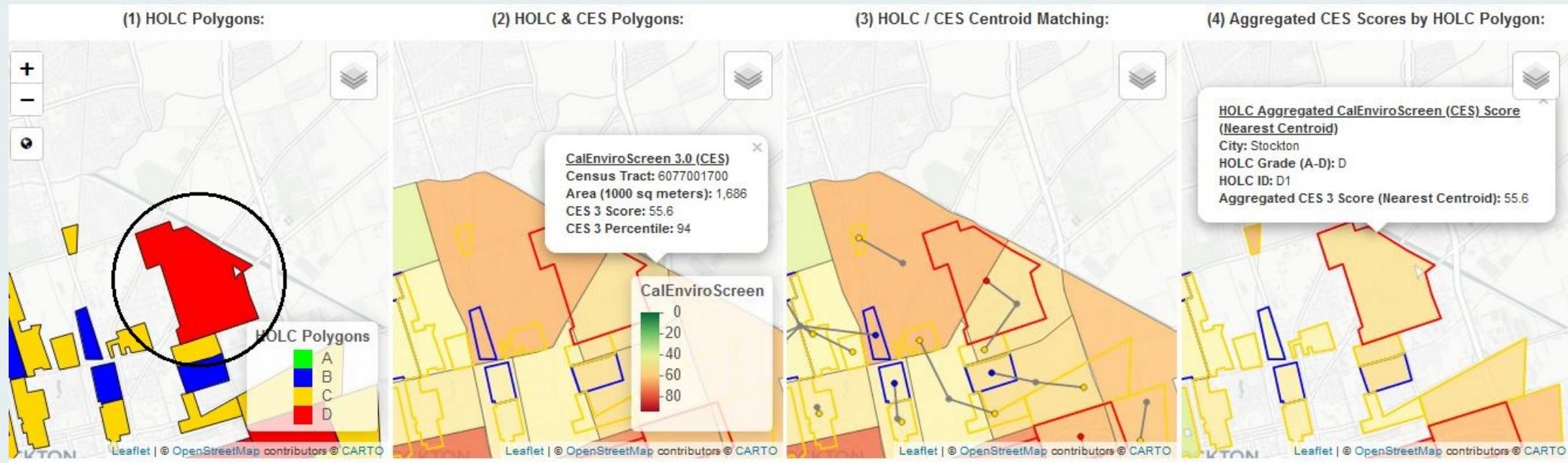
Translating CalEnviroScreen Scores to Redline Maps

For quantitative comparisons, translate CalEnviroScreen scores from census tracts to neighborhoods in Redline maps



Translating CalEnviroScreen Scores to Redline Maps

Multiple methods for translating CalEnviroScreen scores from census tracts to neighborhoods in Redline maps



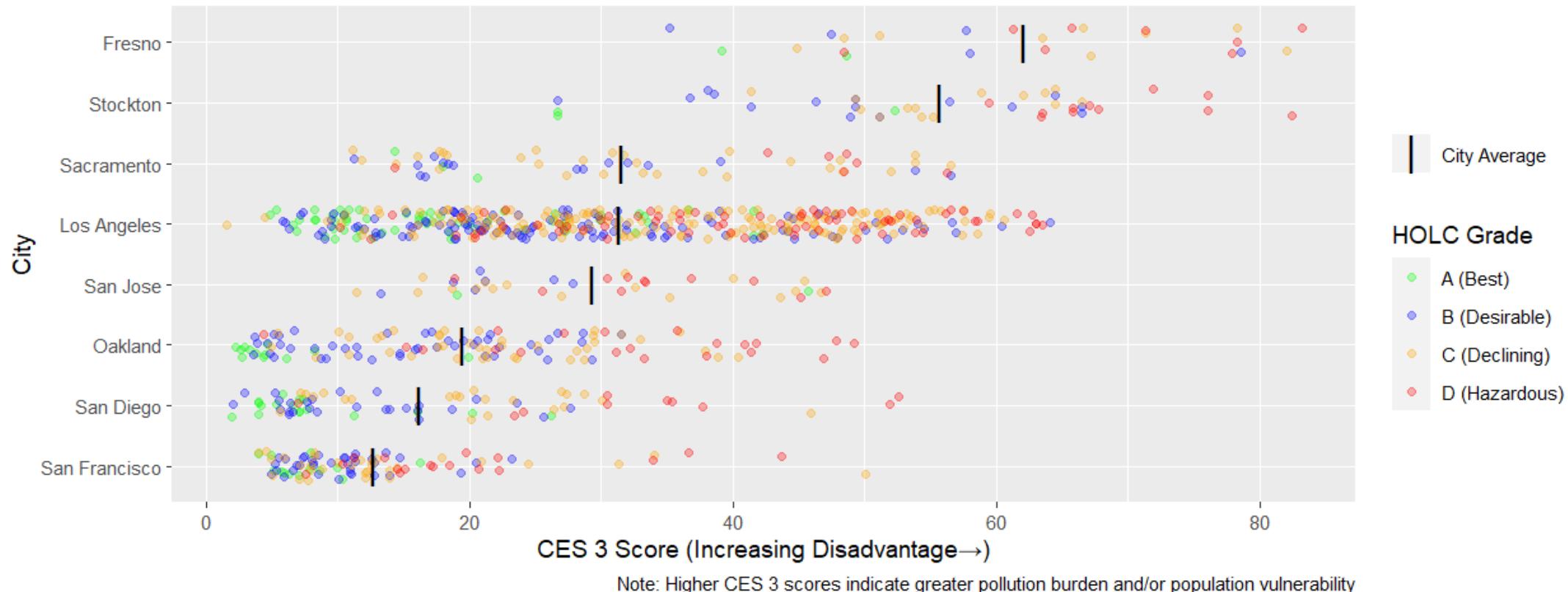
Translating CalEnviroScreen Scores to Redline Maps



Results – CalEnviroScreen Scores by City & Grade

CES 3 Score for Neighborhoods in California Cities Assessed by the HOLC in the 1930s

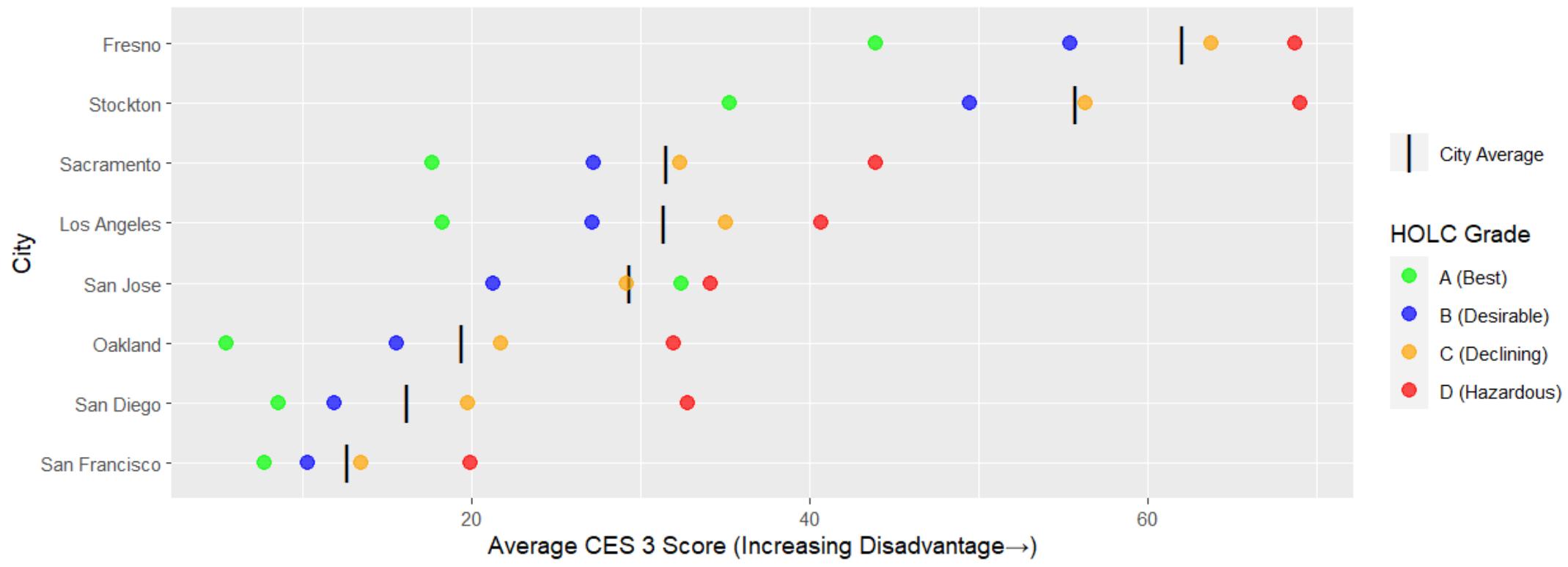
Each colored point represents a neighborhood in the HOLC maps, and black lines represent the average CES 3 Score of all neighborhoods assessed by the HOLC in the given city



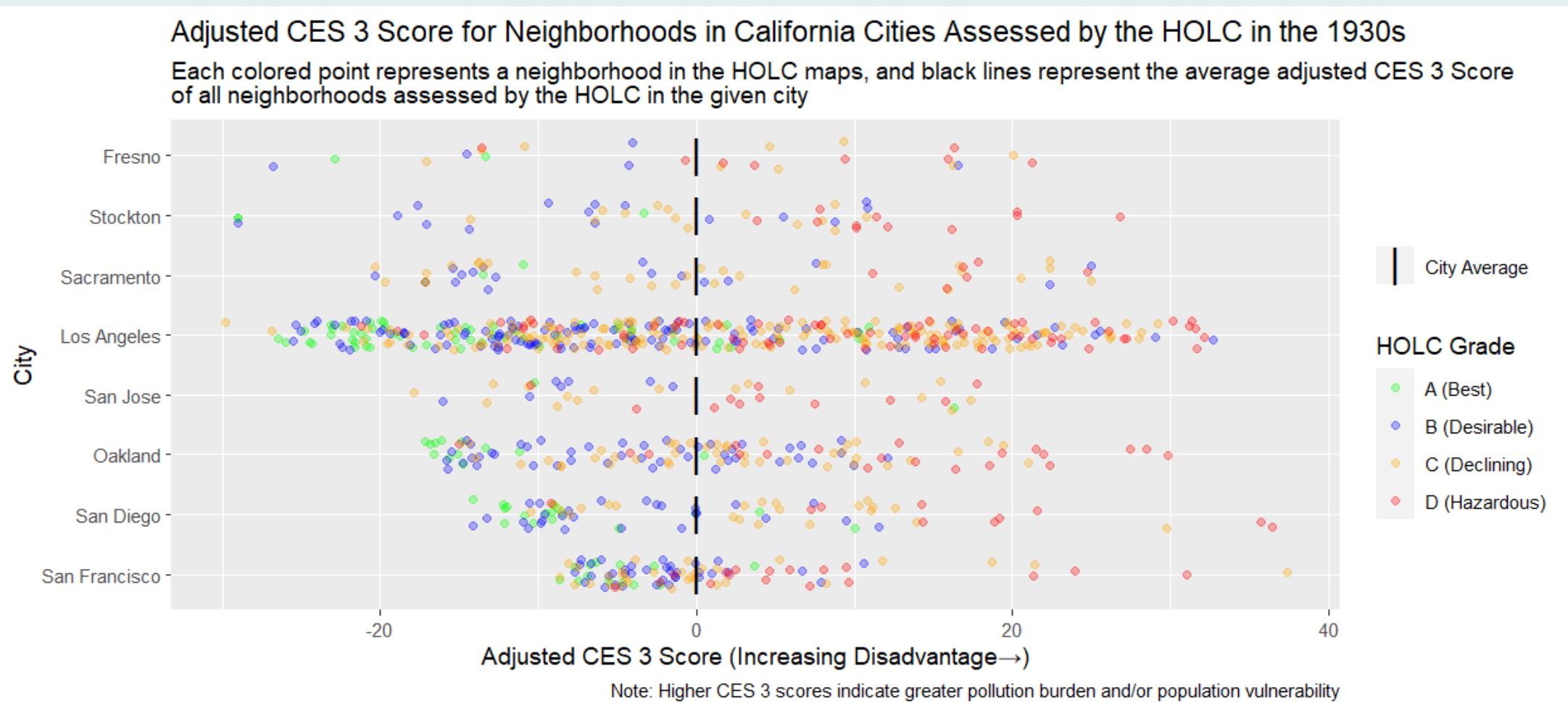
Results – CalEnviroScreen Scores by City & Grade

Average CES 3 Score by City and HOLC Grade for Neighborhoods in California Cities Assessed by the HOLC in the 1930s

Black lines represent the average CES 3 Score of all neighborhoods assessed by the HOLC in the given city



Results – Adjusted CalEnviroScreen Scores

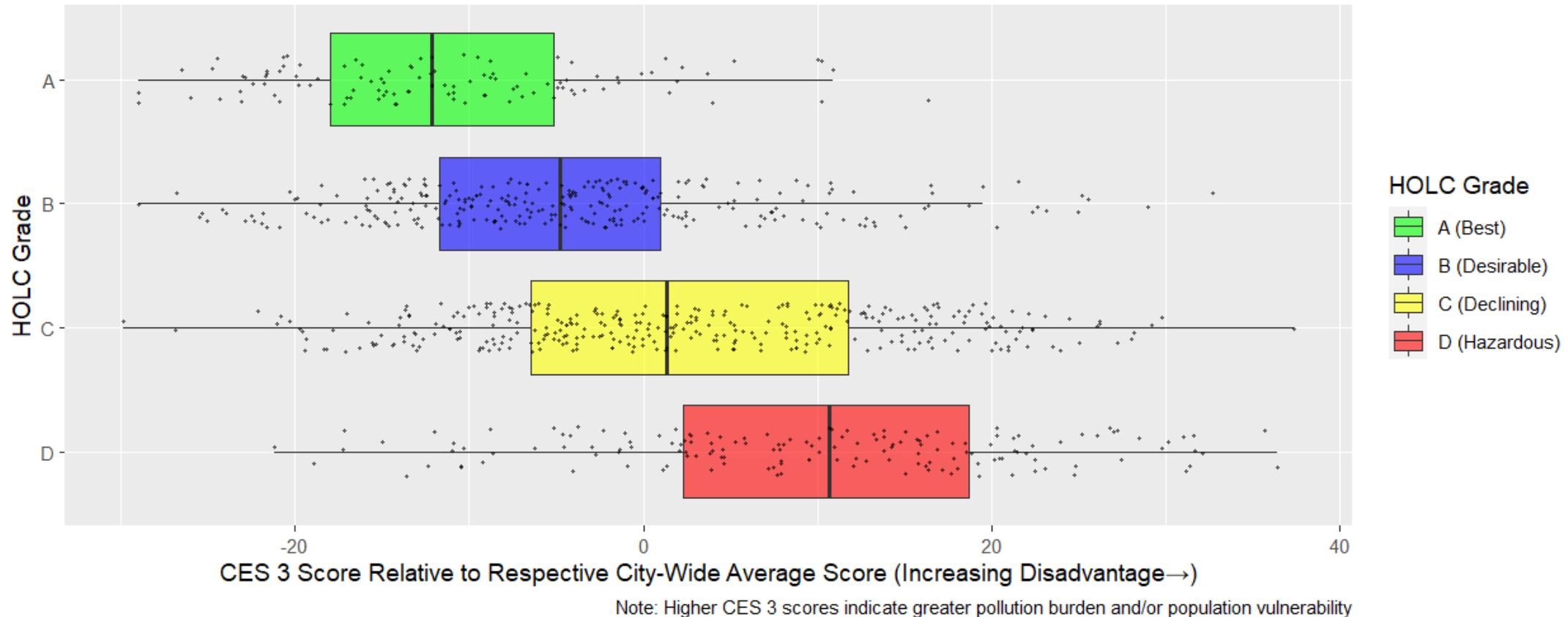


adjusted score = [neighborhood CalEnviroScreen score] - [citywide average CalEnviroScreen score]

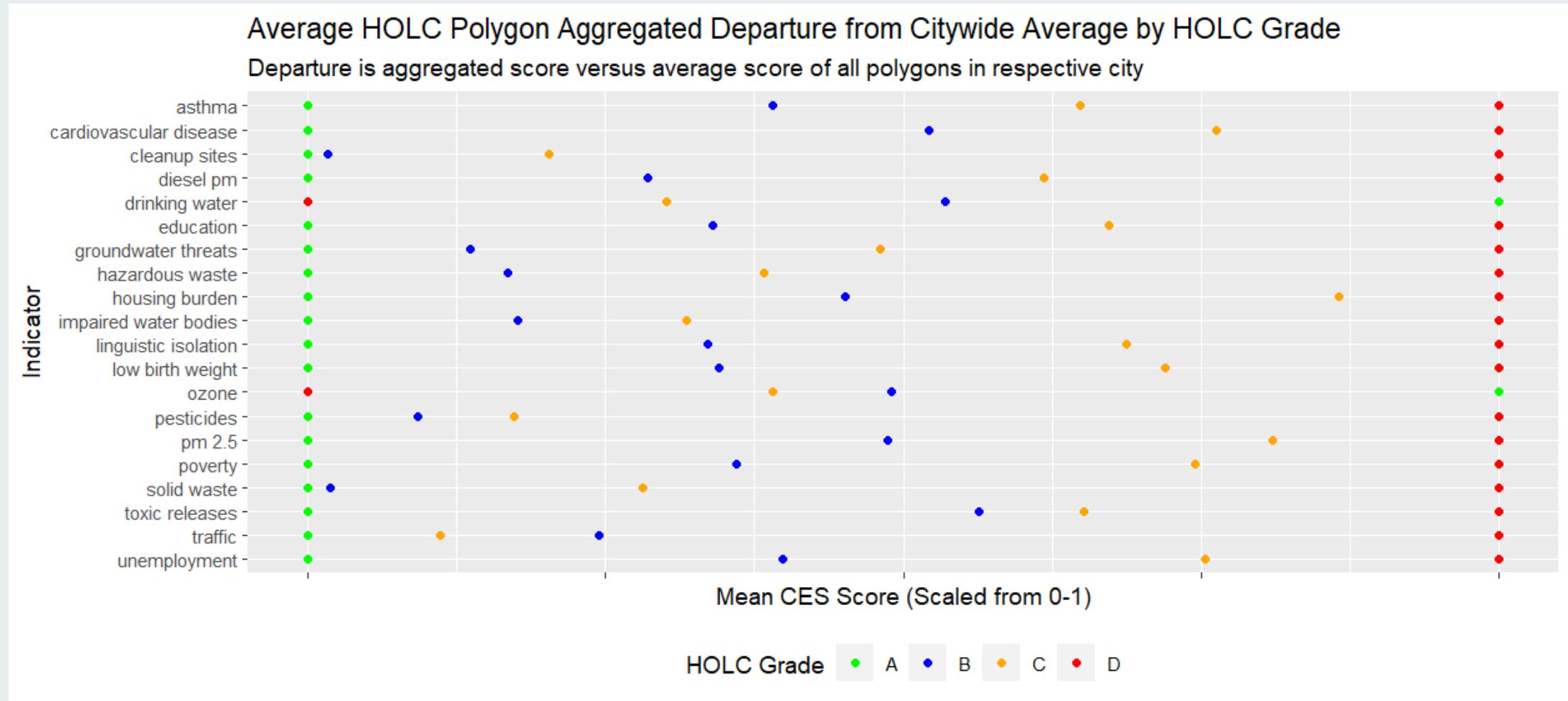
Results – Adjusted CalEnviroScreen Scores

CES 3 Score for Neighborhoods in California Cities Assessed by the HOLC in the 1930s

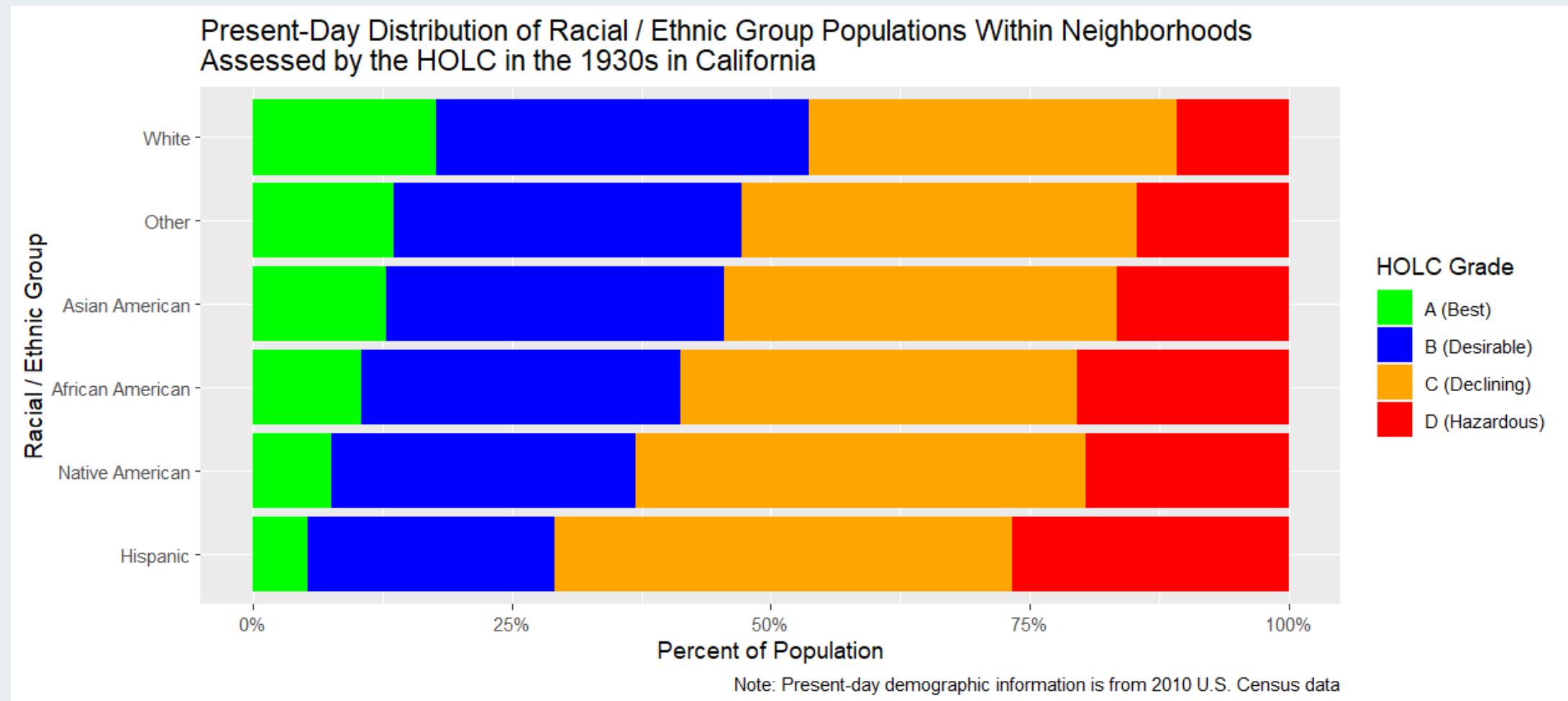
Each point represents a neighborhood in the HOLC maps



Results – 20 Indicators



Results – Present-Day Demographics



Presentation Formats

Presentation Formats

Storymap (ESRI / ArcGIS) — Pollution and Prejudice: Redlining and Environmental Injustice in California

- Detailed history / context
- Interactive Maps
- High level overview of analysis / results

 bit.ly/pollutionandprejudice

Shiny App (R / RStudio)

- Interactive tool to explore analysis / results in detail
- Tool to view CalEPA regulatory data in context of redlined areas (may add other tools / features to explore other data?)

 cawaterdatadive.shinyapps.io/Redline-Mapping/

Storymap Demo

 bit.ly/pollutionandprejudice

Shiny Application Demo

 cawaterdatadive.shinyapps.io/Redline-Mapping/

Datasets Used in Shiny App

- Redline Maps ([Mapping Inequality - University of Richmond / Virginia Tech](#))
- CalEnviroScreen 3.0 ([Office of Environmental Health Hazard Assessment Website & CalEPA Geoserver](#))
- CalEPA Regulated Sites ([CalEPA Geoserver & CalEPA Regulated Site Portal](#))
- CalEPA Site Program Types, Inspections, Violations, and Enforcement Actions ([CalEPA Regulated Site Portal](#))
- 2014/2016 Clean Water Act Section 303(d) Listed Waterbodies ([State Water Resources Control Board Website](#))
- California Drinking Water Provider Service Areas ([Water Resources Control Board Map Services & State Geoportal](#))
- California Water Board Regional Office Boundaries ([California State Water Resources Control Board Map Services & State Geoportal](#))

Tools & Methods

Tools & Methods

R (programming language) & RStudio used for:

- data access
- cleaning and reformatting data
- basic analysis and visualization
- geospatial data processing and analysis
- reporting
 - reports / presentations – Rmarkdown
 - interactive tools – Shiny & shinyapps.io

 r-project.org

Code and data on GitHub 

- transparency
- reuse
- collaboration

 github.com/daltare/Redline-Mapping

GitHub Site

 github.com/daltare/Redline-Mapping

Considerations / Limitations & Next Steps

Considerations / Limitations

Limited geographic coverage

- areas that existed in the 1930s
- only cities with population > 40,000

May be difficult to use to formulate specific policies on broad scale¹

“the racial makeup of the population in redlined areas has grown and evolved dramatically over the last eight decades, and the effects of the practice have spread beyond the confines of the original maps.

“proposals that base their remedies primarily on formerly redlined areas... exclude important Black neighborhoods and communities, and would skew impact toward a handful of large cities”

—America’s formerly redlined neighborhoods have changed, and so must solutions to rectify them.
Brookings Institution, 2019.

1 - America's formerly redlined neighborhoods have changed, and so must solutions to rectify them. Brookings Institution, 2019.

Considerations / Limitations

Difficult to determine degree of causation

- lots of other factors between the 1930s and today that impact current conditions
- many HOLC loans were made before the maps were drawn ¹
- distribution of HOLC loans doesn't necessarily follow the pattern you'd expect from the maps (HOLC ratings were not always deterministic) ¹

"Others have argued that the maps were confidential documents and an analysis of individual HOLC loans, most of which were made by 1936, before the "residential security maps" were completed, indicates that the agency provided mortgages to both white and minority borrowers"

—HOLC “Redlining” Maps: The Persistent Structure Of Segregation And Economic Inequality. National Community Reinvestment Coalition, 2018.¹

1 - HOLC “Redlining” Maps: The Persistent Structure Of Segregation And Economic Inequality. National Community Reinvestment Coalition, 2018.

Considerations / Limitations

Still important because...

- reflection of prevailing attitudes about race and credit risk (influences on FHA, VA, and other public and private lending programs)¹
- we understand the mechanisms that lead from reduced credit access to socioeconomic / environmental / public health impacts
- helps to understand context for our work

“While the ultimate use of the HOLC residential security maps is a subject of debate, it is clear that the HOLC maps compiled the common understanding of local-level lending decision makers of the risk in the neighborhoods of their cities.¹

“Since the HOLC maps document the contemporary expert judgement of neighborhood lending risk, they provide an archive of lending risk perception ... which can help us understand the extensive reconfiguration of the U.S. urban system”¹

1 - HOLC “Redlining” Maps: The Persistent Structure Of Segregation And Economic Inequality. National Community Reinvestment Coalition, 2018.

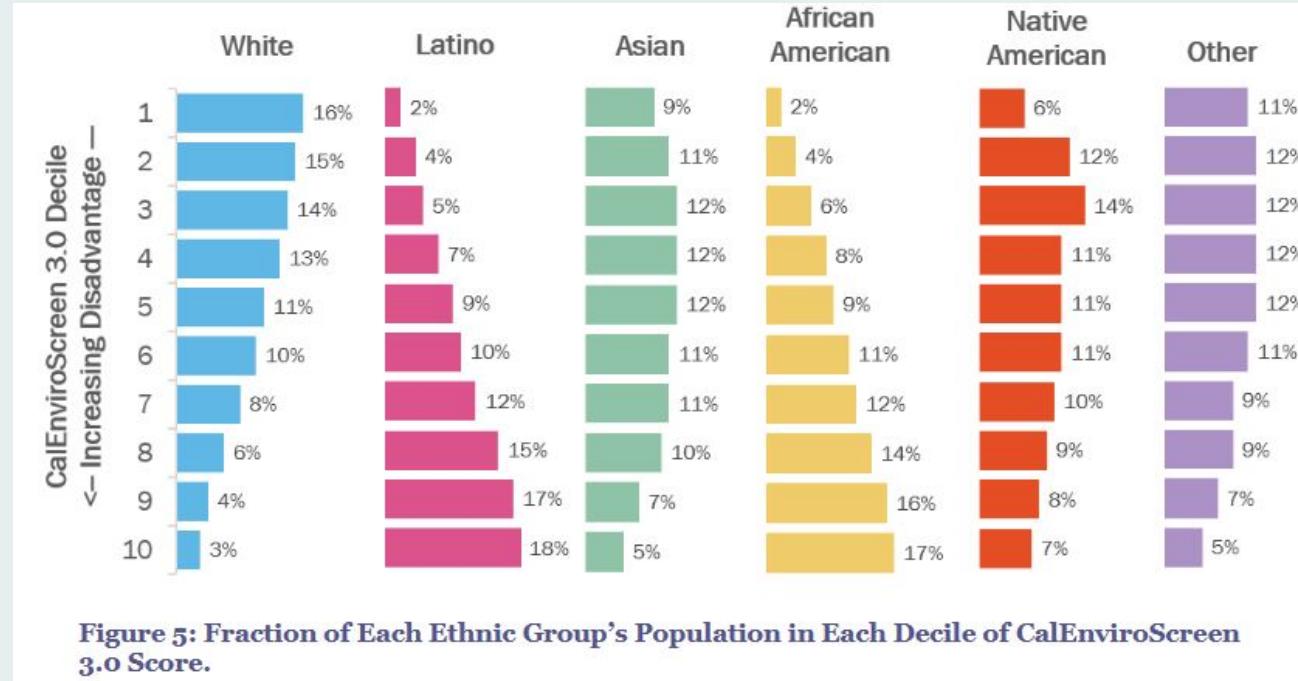
Potential Next Steps

- Improve on the existing analysis
- Include other indicators of current conditions vs. Redline maps
- Incorporate other historical policies / programs that provide more geographic coverage (e.g., zoning, deed restrictions, planning documents)
- In-depth study of a particular local area (including other indicators & historical policies)

Potential Next Steps

Inform and support our mission to ensure equitable access to clean air, water, and land for all Californians

- from CalEnviroScreen we know that, state-wide, people of color are vastly over-represented in the census tracts with the highest pollution burden / vulnerability



Analysis of Race/Ethnicity, Age, and CalEnviroScreen 3.0 Scores, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, June 2018

Thanks!

Slides / Contact

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Waterboards Data Center

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