INCOME
&
WATER QUALITY
LOS ANGELES COUNTY

"There are at least 1 million Californians living without access to clean, safe drinking water and many more across the country"
Persephene St. Charles
Woodard & Curran

Jordan Zhu
GIS Fall 2023

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Background: Los Angeles County has a total population of over 9.8 million people. The median age is around 38.2 and the average median household income is $82,516. However, 13.9% of the population are considered "low-income" or lay below the poverty line. Low income communities and communities below the poverty line also may have less accessibility to clean and safe usable water. This study spatially analyzes and looks at income, ethnicity, water use, and quality of water in cities across Los Angeles County.

This study conducts spatial analysis through maps for use in understanding the relationship between socioeconomic factors and water quality risk. All maps are in the projected coordinate system of NAD 1983 StatePlane California V FIPS 0405. The majority of the datasets are from the years 2014-2022.

RESEARCH QUESTIONS:

I) How do socioeconomic and demographic factors influence water demand in Los Angeles County?

a) What is the median household income by Census Block Group?

b) Where are the cities that use the most water by Census Block Group?

II) Where are the largest spatial distributions of high risk in quality of water?

III) How do clusters of disadvantaged communities across Los Angeles affect total water risk?

Agricultural and Open Land Use of Los Angeles County

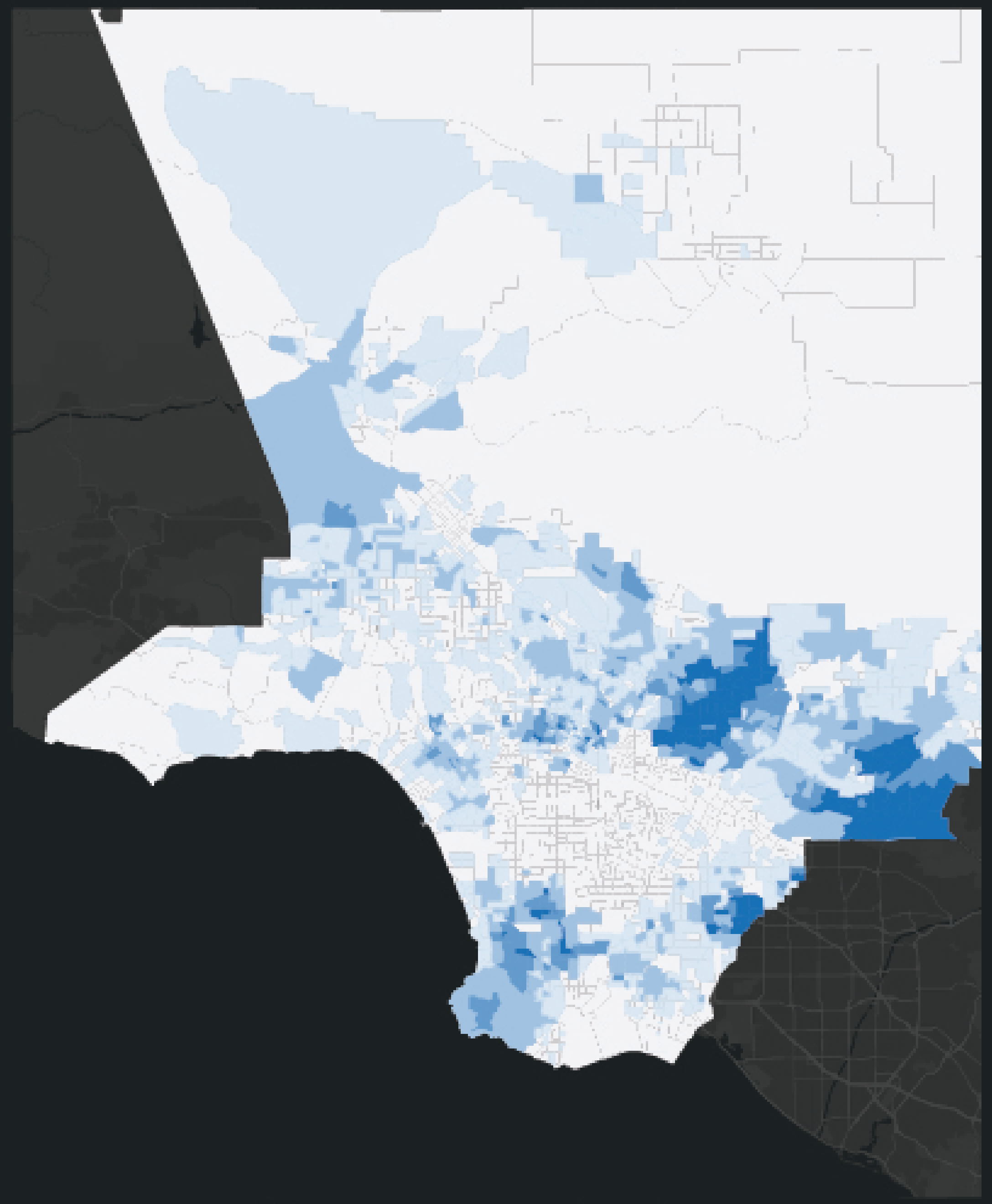
At first, looking at zoning and land use would have been more helpful, but due to limitations in rendering and loading the datafile, an open land use and agricultural map was the only land-use that worked. A lot of open space and agricultural use can mostly be seen in the Northern and Western parts of the county. Understanding open land use and agricultural use can be beneficial in analyzing water demand and possible water risk by how urban or not urban an area is based on agricultural use.

This map was created using data from the City of Los Angeles Department of City Planning and the Los Angeles County that already had separated each use by open space and agricultural use; color and an intersect tool was used to understand city boundaries within the total land usage.

Figure 1

Percentage of Largest Ethnicity Clusters in Los Angeles County

Figure 2



Percent Asian

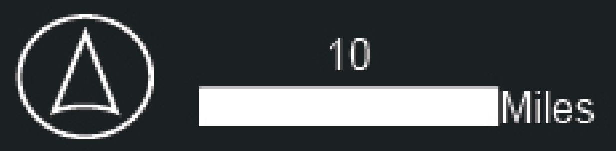
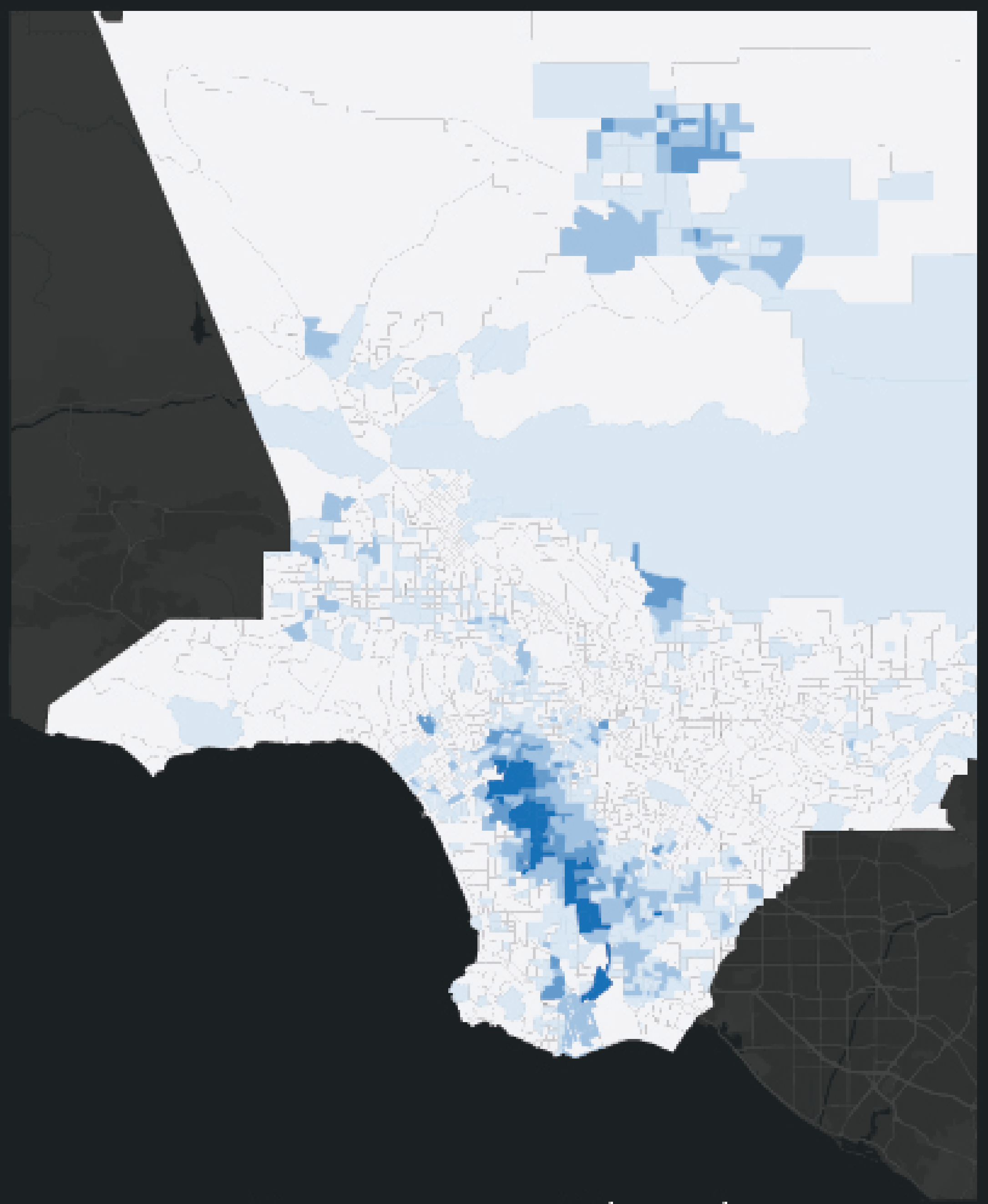


Figure 3



Percent Black

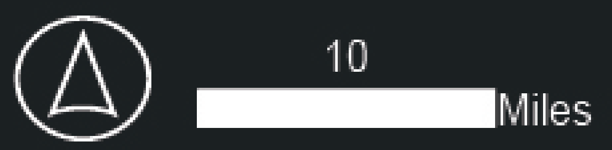
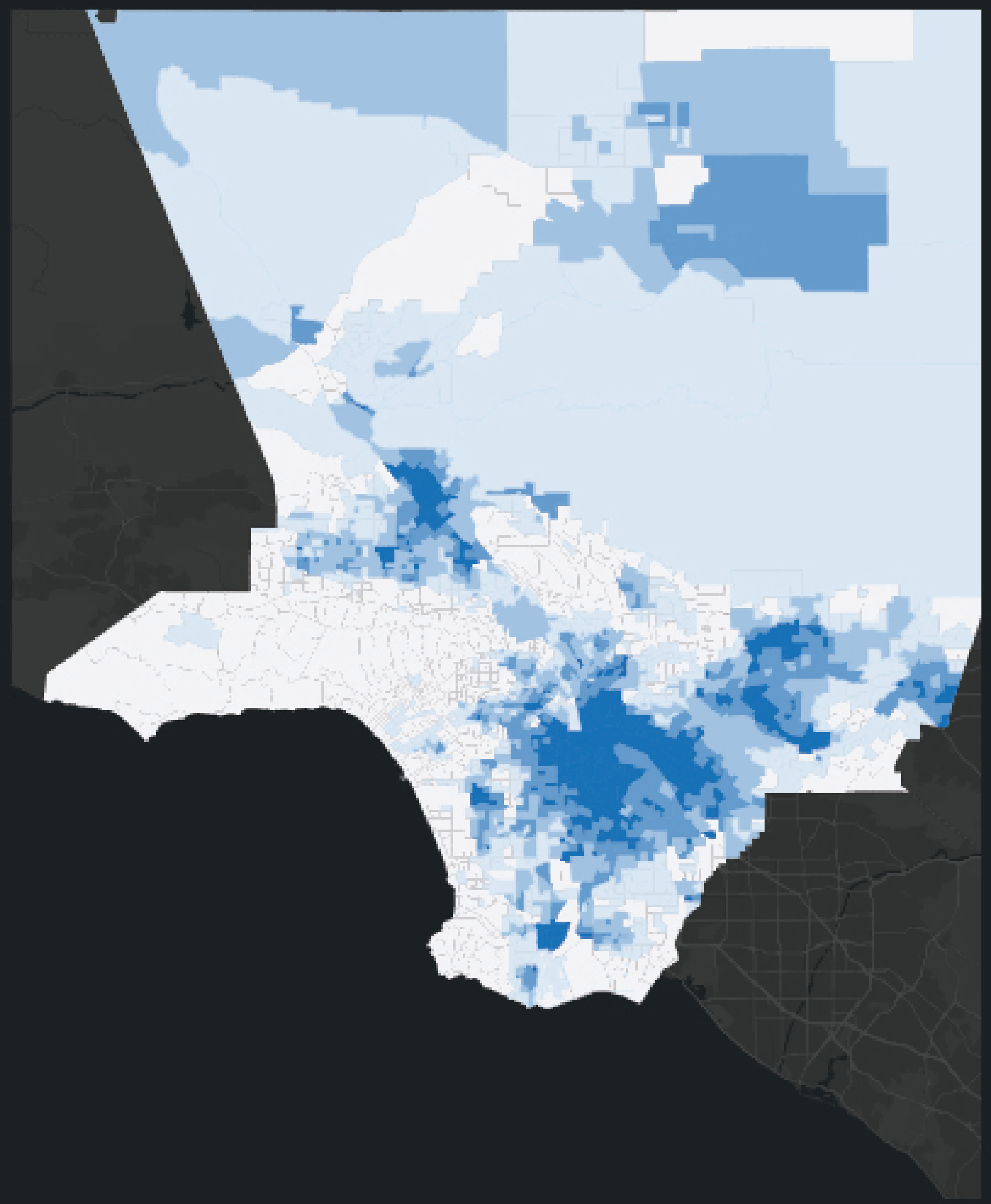
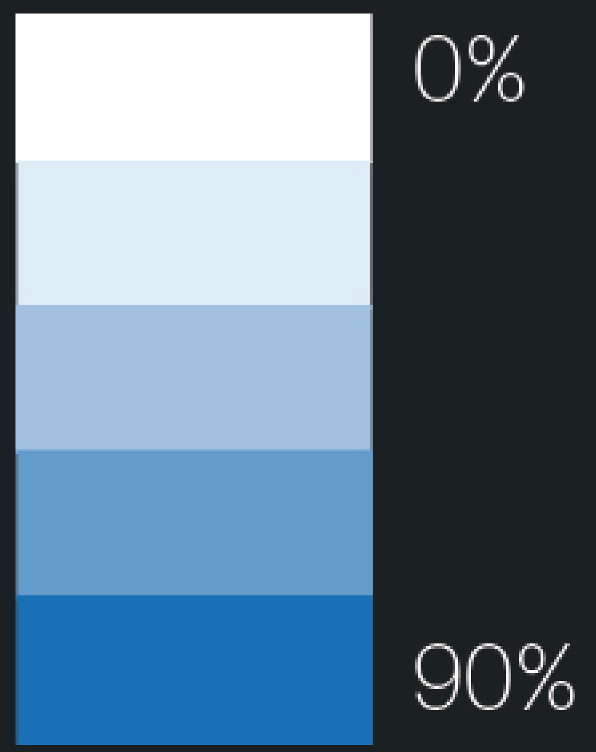


Figure 4



Percent Hispanic

Percentage of Ethnicity Cluster



RQ1: How do socioeconomic and Demographic factors influence water demand in Los Angeles County?

The demographics of Los Angeles County tell an interesting story. As seen in Figure 5, the county is relatively dense in the central and southern sections of the area, which runs concurrent with the total domestic water demand. Figure 7 doesn't infer that there's no water demand in the less dense areas, just that more dense areas will likely have higher water demand clusters. It's also interesting to note that the more population dense areas tend to also have lower median household income as seen in Figure 6. The data is taken from the United States Census Bureau, as well as from Los Angeles County Open Data. The demographic data is by Census Block Group, and was paired through matching attributes on Microsoft Excel and lastly mapped in ArcGISPro. For figures 1-6, the same color palette is used and shows a choropleth graduated colors map of each respective demographic.

Figure 1,2,3 all show percentages of Asian ethnicity clusters, Black or African-American ethnicity clusters, and Hispanic or Latino ethnicity clusters in Los Angeles County. The darker blue indicates a much higher percentage, while the white and lighter blue show very minimal clusters. The largest percentage that was listed in the datasets were around 90%, so the highest percentage of any cluster will be around 90%. Figure 1 depicts highest percentages of Asian clusters in the county of Los Angeles. It can be seen that the highest clusters are around the Eastern portion of the county. Figure 2 shows the highest percentages of Black or African American clusters in the county, and shows the highest percentage of Black or African-American clusters to be around the Southern and Northern portion of the county. Figure 3 shows highest percentages of Hispanic or Latino ethnicity clusters, which can be seen in the central and Eastern portion of the county.

Population Density in L.A. County

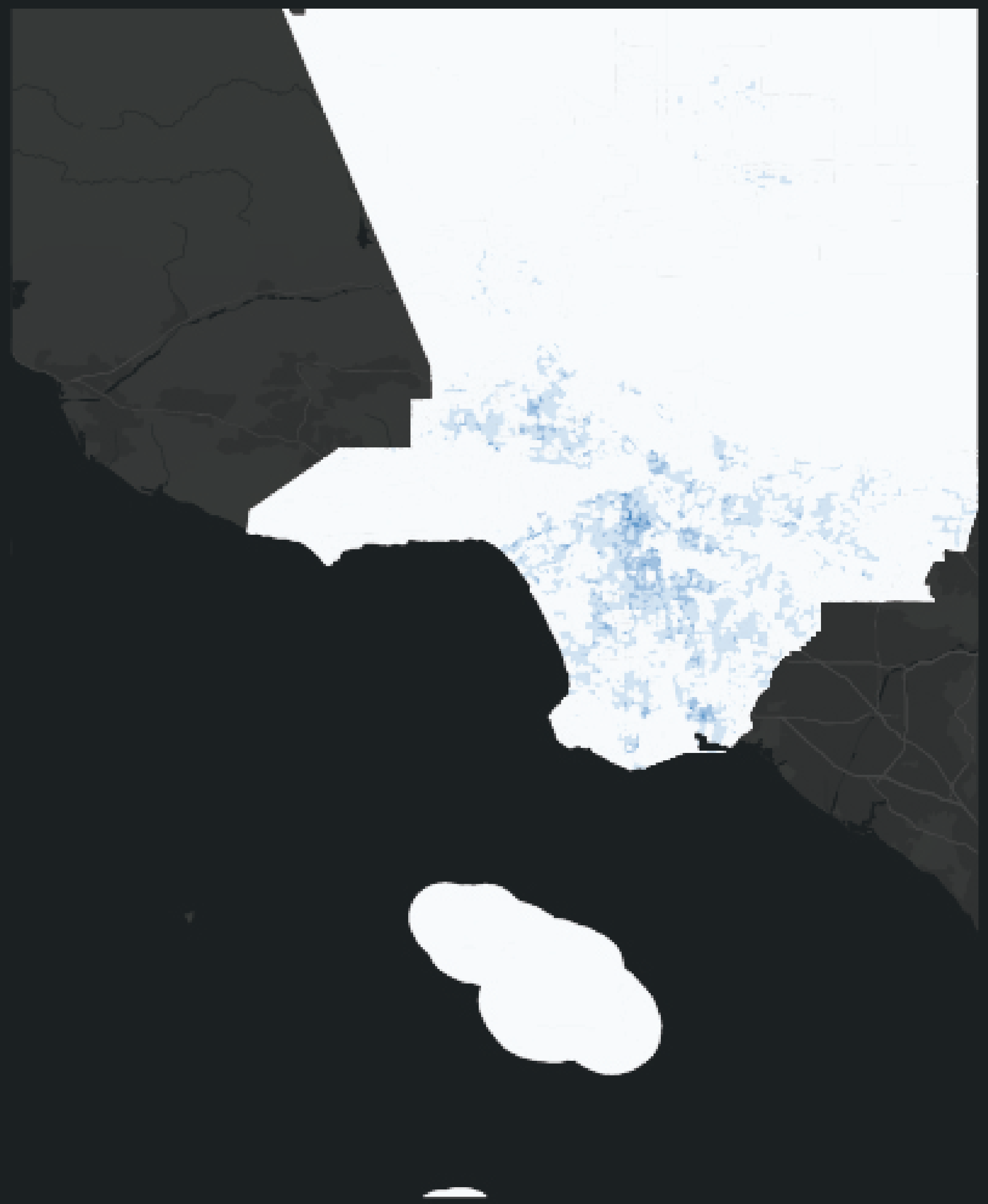


Figure 5

10 Miles

Population Density

Low

High

Median Household Income in L.A. County

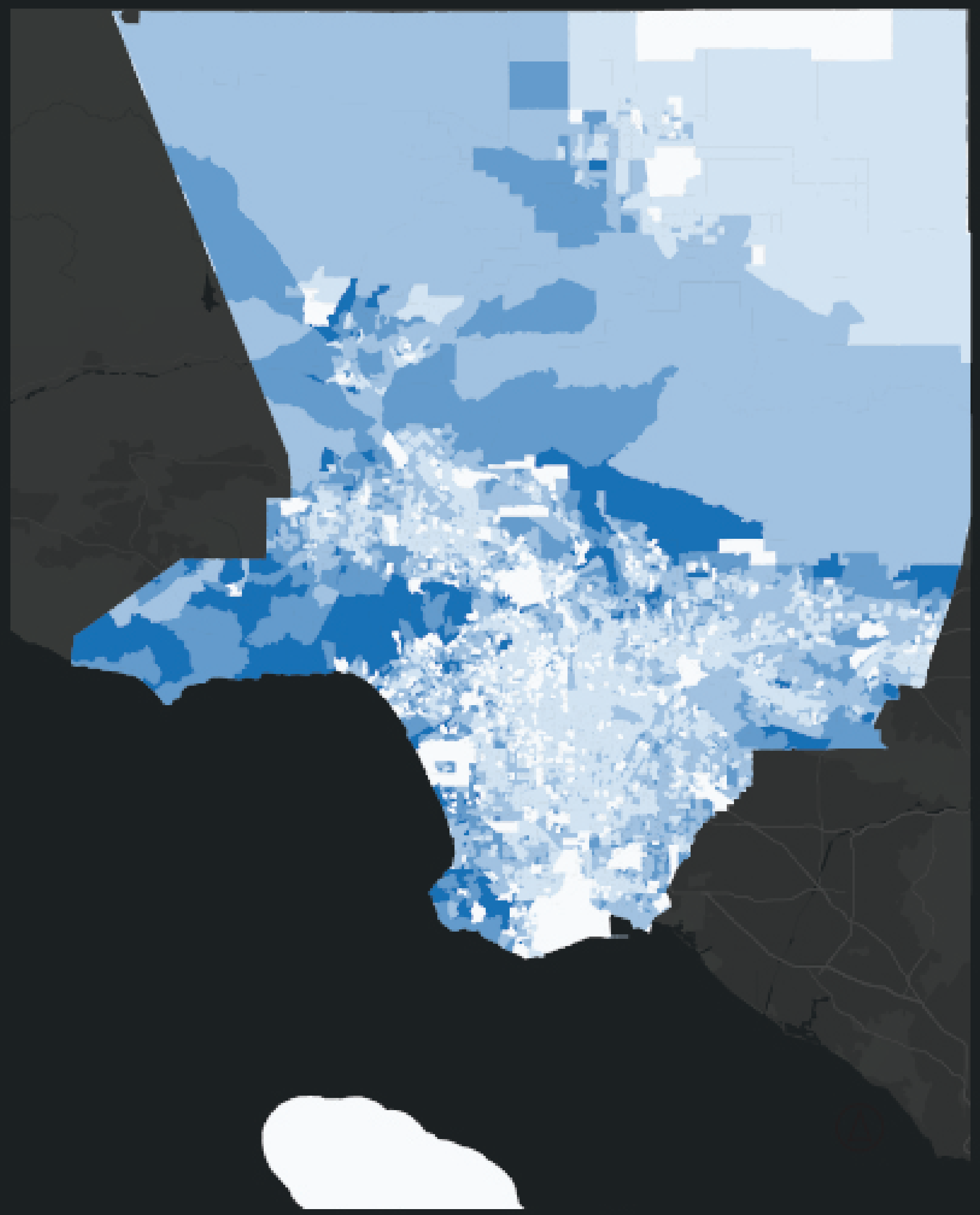


Figure 6

10 Miles

Median Household Income

$0 - $29,259
$29,260 - $69,298
$69,299 - $109,760
$109,761 - $169,671
$169,672 - $250,001

Water Demand in L.A County

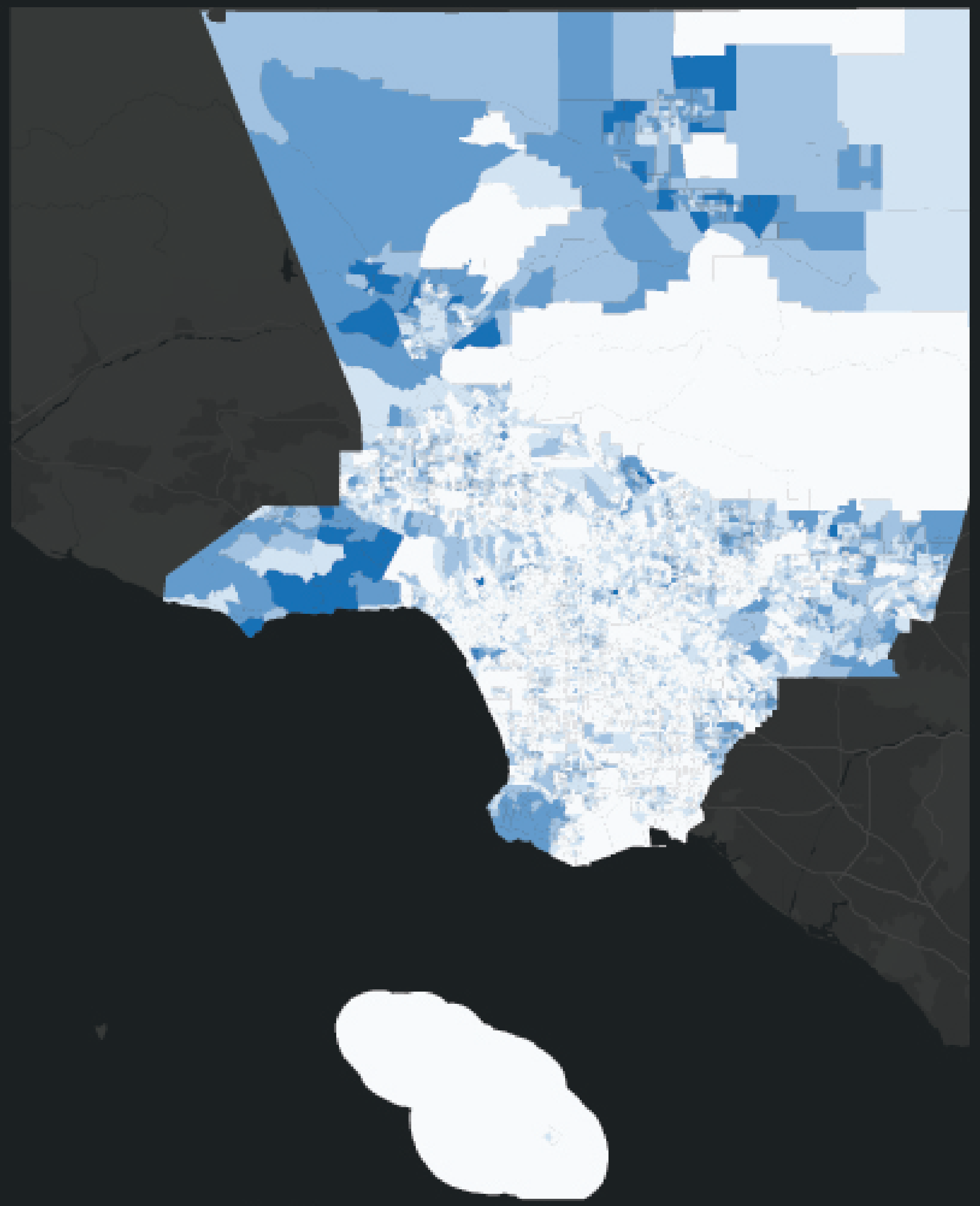


Figure 7

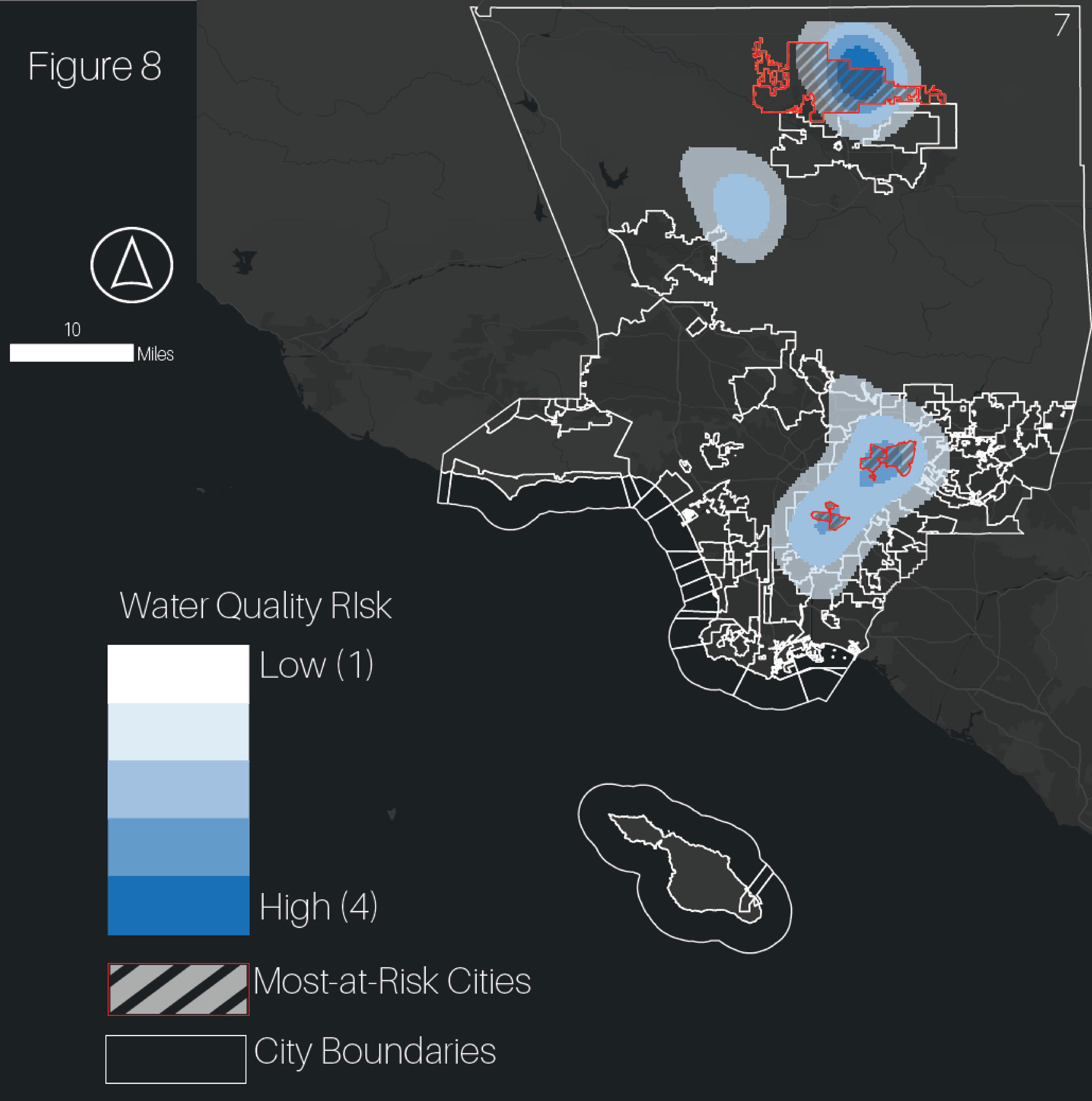
10 Miles

Water Demand by Gallon

0.00 - 99.02 / day
99.03 - 167.91 / day
167.92 - 282.53 / day
282.54 - 517.35 / day
517.36 - 1274.77 / day

RQ2: Water Quality Risk Kernel Density in Los Angeles County

Figure 8



After looking at domestic water demand, getting the gauge of the type of risk that the water was needed. The data for Figure 8 is from the Environmental Atlas of California which pinpointed water delivery systems and their potential risk in delivering quality water. These points were then separated into a risk index that Waterboards labeled as "SAFER" status. This status graded water systems as "Not-at-Risk, Potentially at Risk, At Risk, and Failing. These were graded based on bacteria found inside the water, such as E Coli., and how long it took for the system to correct those issues. Those points were then changed into a separate risk index of 1,2,3,4, where a Kernel Density analysis was conducted, which led to the analysis of which areas had the most potentially at risk or at risk water delivery systems. The cities that carried the most risk are highlighted in red.

Clean-up Programs & Water Quality Risk in Los Angeles County

Figure 9

4 Miles

Figure 9 uses XY Table to Point and Kernel Density to showcase where clean-up programs are relevant to total water quality risk in the county of Los Angeles. The clean-up programs range from underground storage tank leaks, spillages, and ruptures. The LUST or Leaking Underground Storage Tank is for petroleum leaks. These petroleum leaks could potentially cause chemicals to leak into surface and groundwater, which affects the usable water for the residents of the county. The red dot shows clean-up sites in general, and the yellow dot shows leaking undeground water tank clean-up sites. The water quality risk systems is more densely concentrated in areas where the water quality risk is. Unfortunately, no time table was able to be tracked, which could have potentially allowed the analysis to show a more conclusive understanding of the correlation between clean-up sites and total water quality risk.

City Boundaries

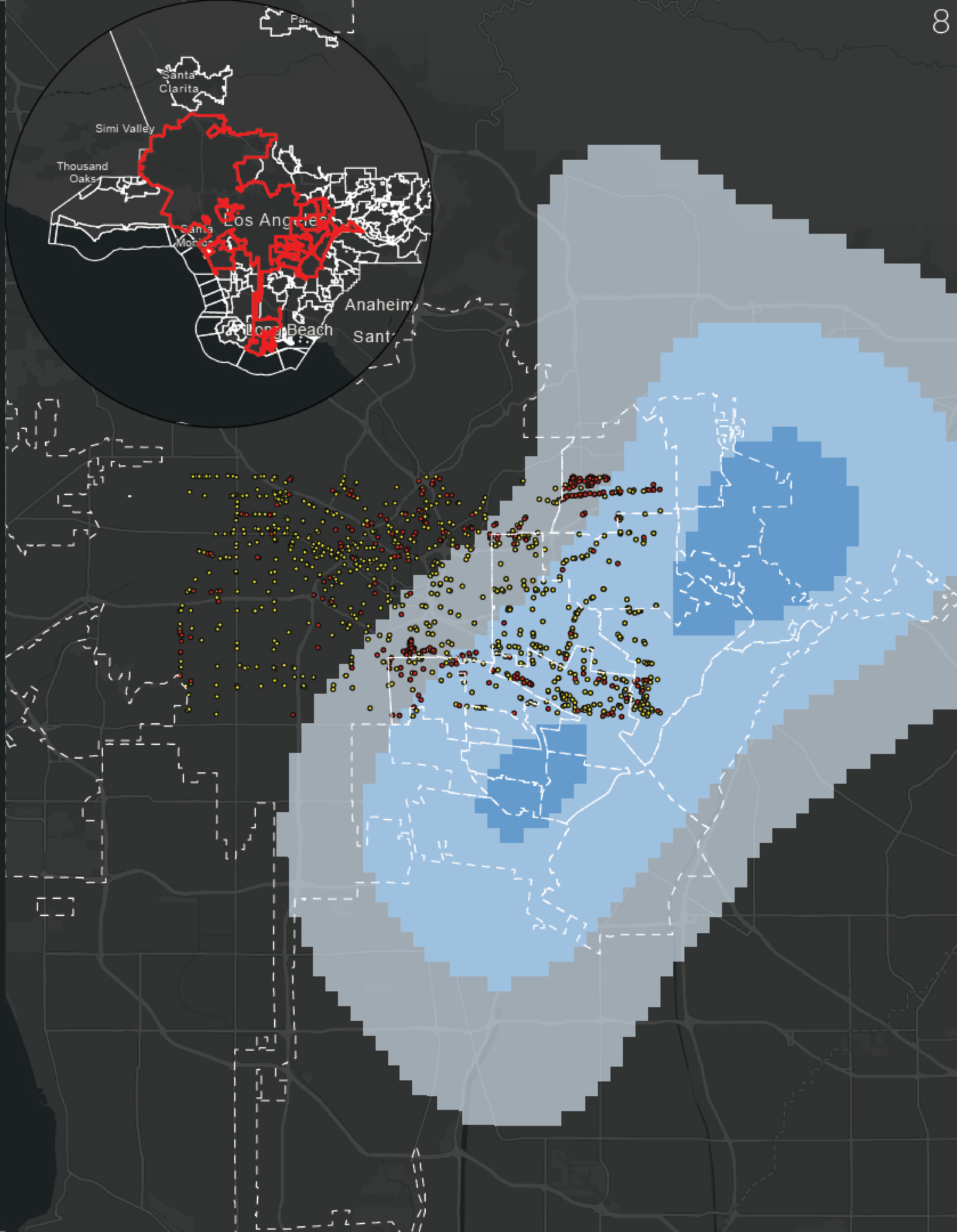
Clean-up Sites

LUST Sites

Water Quality Risk

Low (1)

High (4)



Water Risk & Specific Cities in Los Angeles County

Figure 10

10
Miles

Figure 10 uses XY Table to Points and then a kernel density analysis to show total water risk again. The purpose of this map is to outline the most-at-risk cities based on total density of water quality risk systems. These cities were found to be Rosemead and El Monte in the Eastern portion of the city, and then Bell and Bell Gardens in the Southeastern portion of the county. Lastly, Lancaster, which is in the far northern portion of the county. While there are definetely at-risk cities that border these specific cities chosen, due to the density of these at-risk water systems, it makes more sense to go for cities that had higher systems by city boundary.

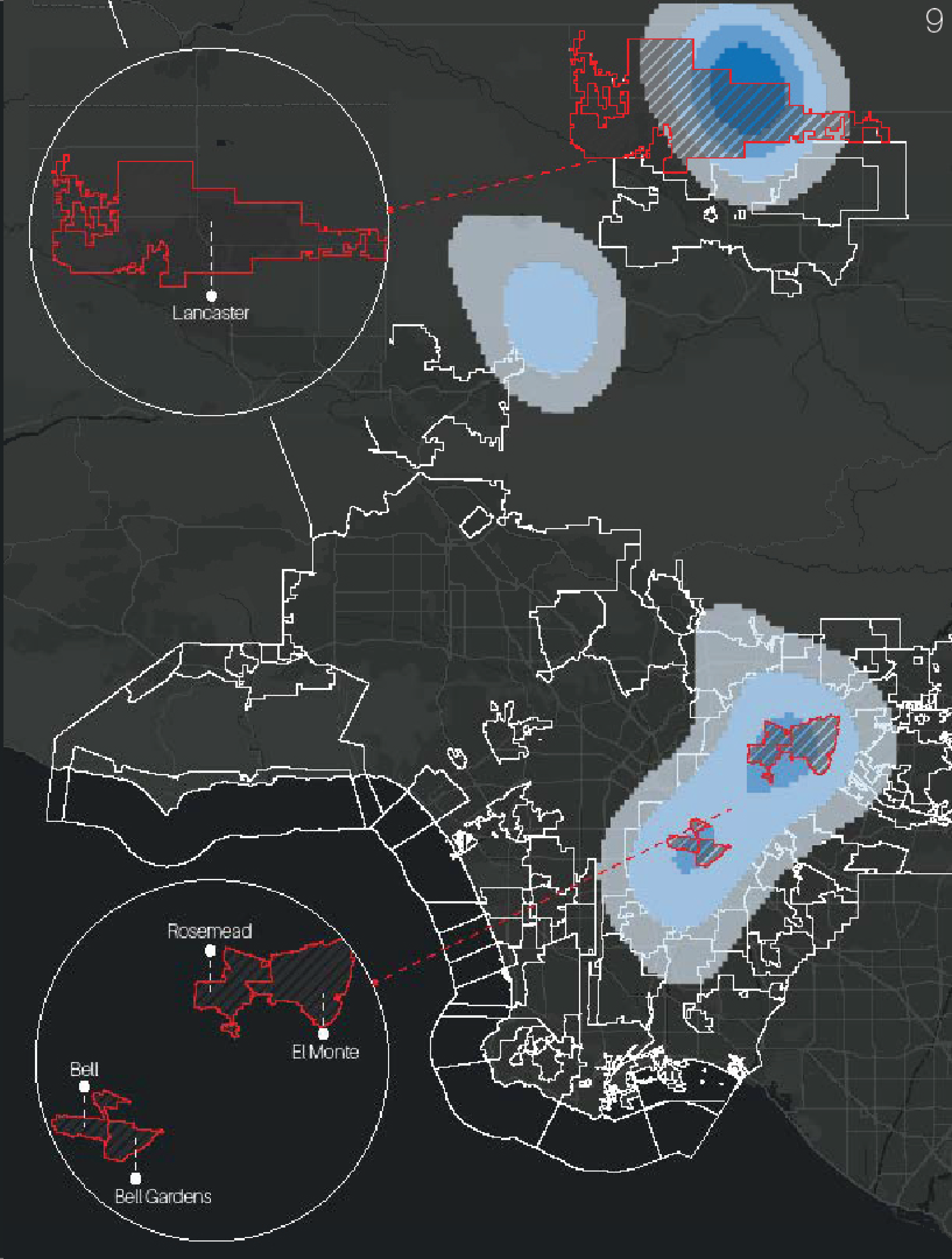
City Boundaries

Most-at-Risk Cities

Water Quality Risk

Low (1)

High (4)

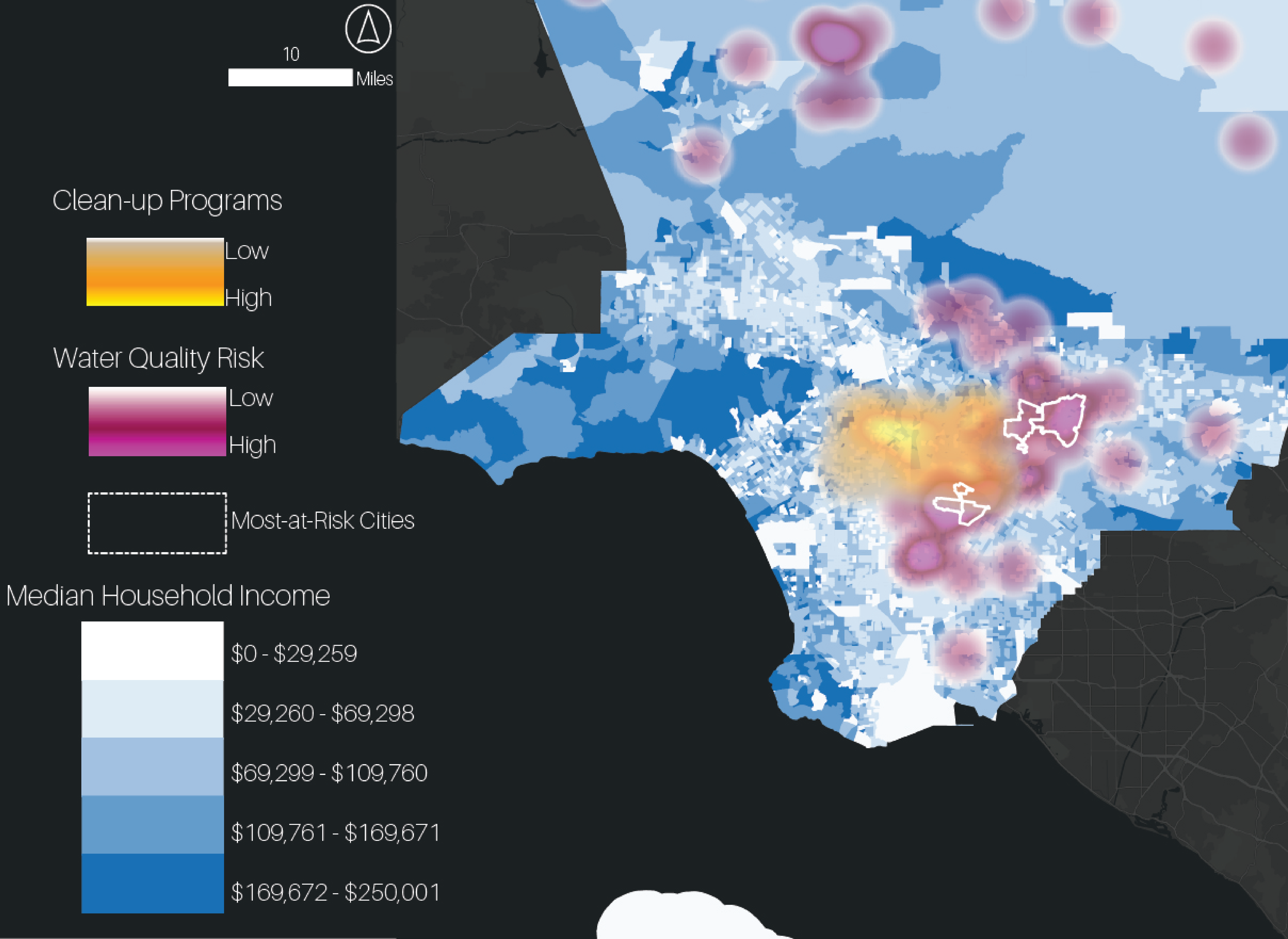


RQ3: Water Quality Risk & Cleanup Programs & Median Household Income in Los Angeles County

This map combines the water quality risk, clean-up programs, and median household income all in one final map to look at most-at-risk cities. XY Table to Points was used by mapping the points with latitude and longitude measurements. A kernel density analysis was then used of both clean-up programs and water quality risk.

As seen in Figure 11, the most-at-risk cities are labeled with dashed white lines, and the most-at-risk cities are overlapped by both water quality risk and portions of the clean-up programs. These cities also have lower median household compared to the rest of Los Angeles County. While the density analysis tells a story of possible risk, one challenge that arose is that while water quality risk shows highest concentration of at-risk water systems, a lot of at-risk systems are in areas with low population density and agricultural/rural areas.

Figure 11



Case Studies: Pictures

Case Study 1:
El Monte, CA

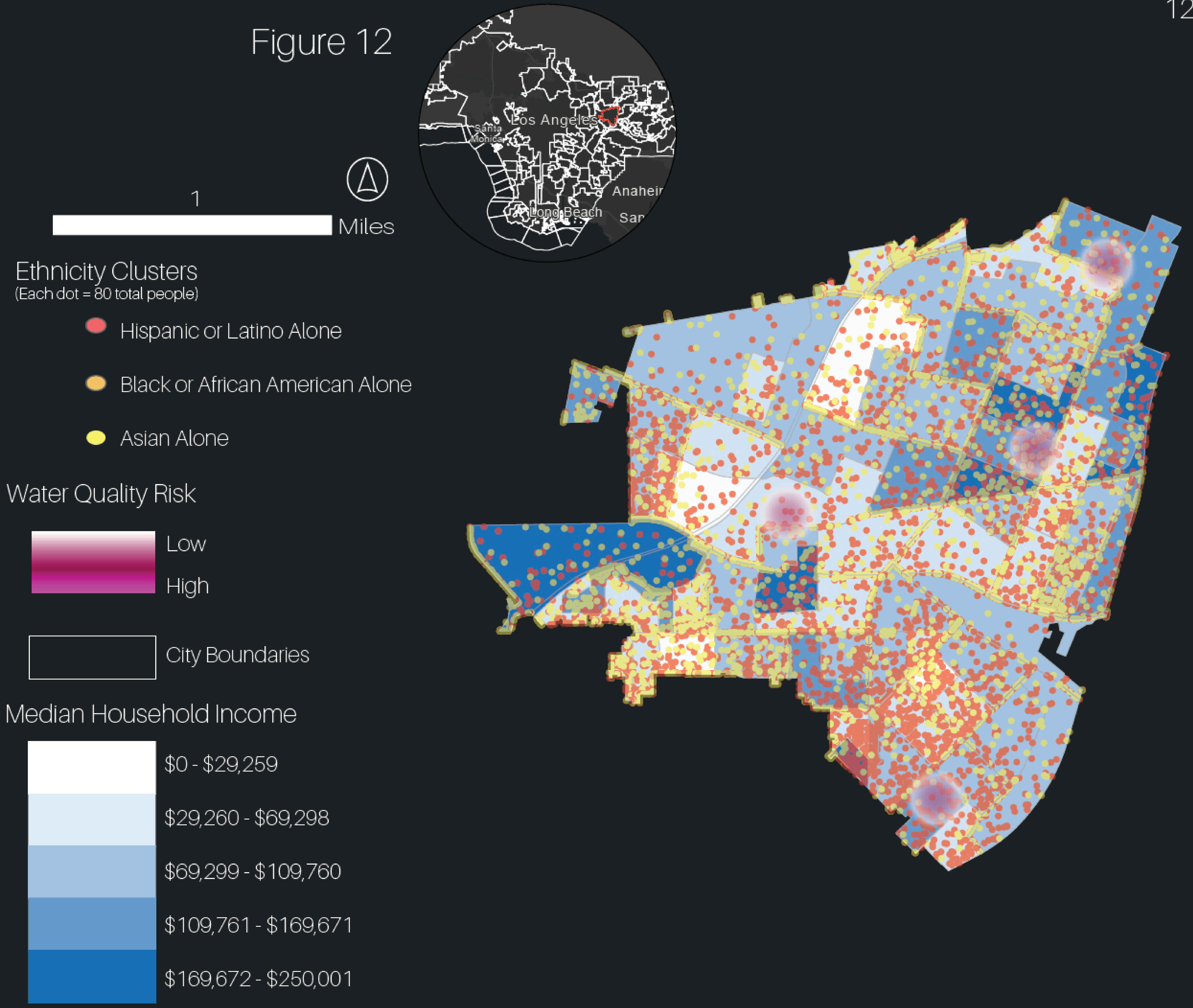
Case Study 2:
Bell, CA &
Bell Gardens, CA

Case Study 3:
Lancaster, CA

Case Study 1:
El Monte, CA

The first case study (Figure 12) looks at the city of El Monte, CA. While the original selection was Rosemead and El Monte, El Monte had more at-risk water systems within its own city boundary. Due to this, the city of El Monte was chosen as the primary focus of the first case study. This map was created through Summarize Within, Intersect, unique values, graduated colors, and kernel density to identify the amount of clusters of specific ethnicity groups in the city layered over median household income and water quality risk. The analysis showed higher clusters of Hispanic or Latino alone and Asian alone clusters. El Monte also had four specific at-risk water systems, which were located in different areas within the city boundary lines. This analysis shows that the most-at-risk water delivery systems, relative to the city's total income, were in areas that had a wide range of income values, and Asian or Hispanic or Latino alone groups.

Figure 12



Case Study 2: Bell, CA & Bell Gardens, CA

The second case study (Figure 13) looks at both cities of Bell and Bell Gardens due to size of the city relative to other case studies. Bell and Bell Gardens combined only have one at-risk water system, and have majority ethnicity cluster of Hispanic or Latino alone groups. The income values also ranged greatly relative to the city, but on the larger scale of the county had lower income values.

This map was created through Summarize Within, Intersect, unique values, graduated colors, and kernel density to showcase clusters of ethnicity groups, median household income, layered under kernel density of water quality risk.

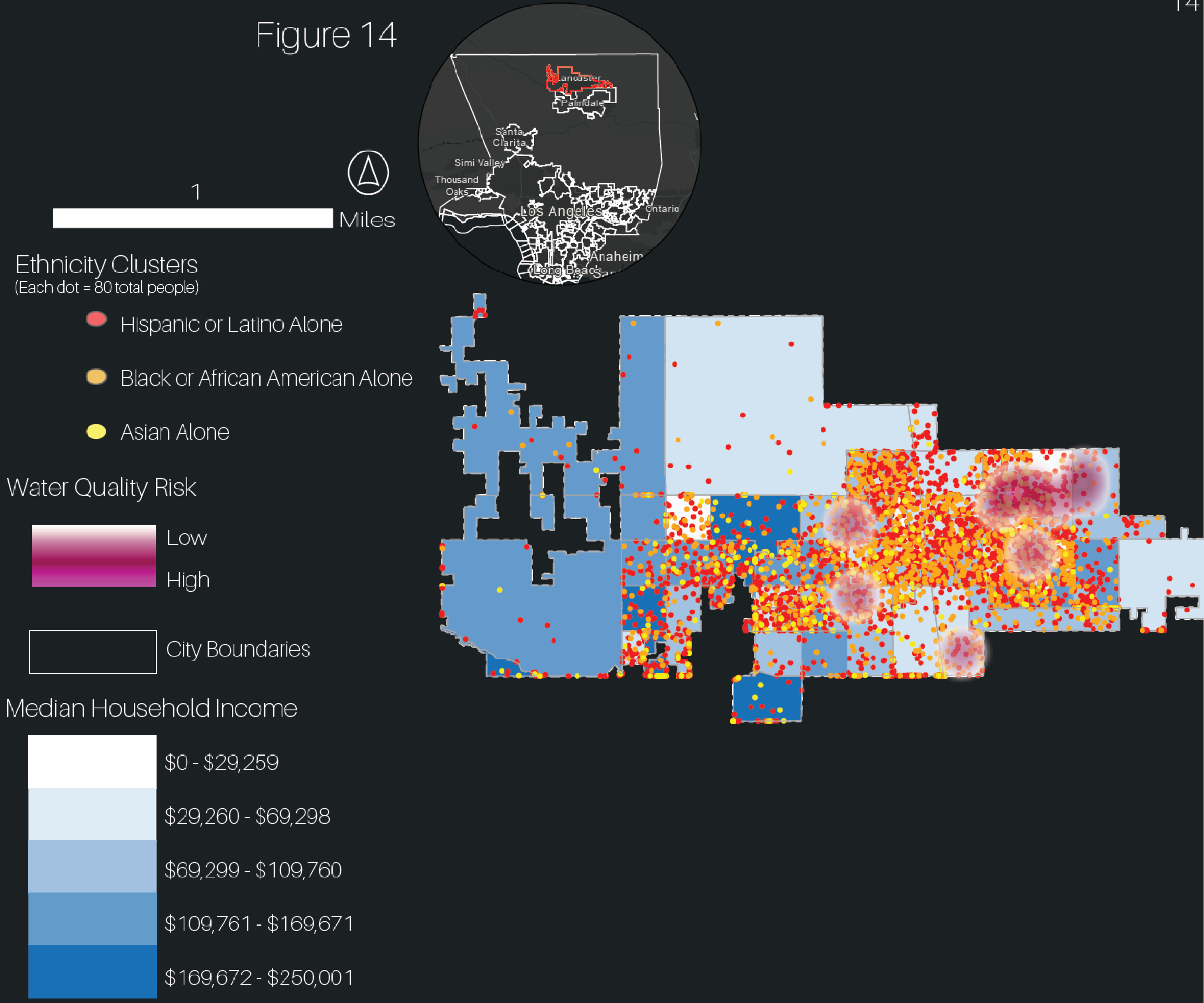
Figure 13

Case Study 3: Lancaster, CA

The third and final case study (Figure 14) looks at Lancaster, CA. Lancaster is an interesting city due to its distance from the urban area of Los Angeles County. This area had a significant amount of at-risk water quality. These at-risk systems were located primarily in the areas that had the highest concentrations of a diverse group of ethnicity clusters of all Hispanic or Latino, Black or African American, and Asian. The median household income was also relatively low in the areas that had the highest at-risk water quality.

This map was created through Summarize Within, Intersect, unique values, graduated colors, and kernel density in order to display an understanding and analysis of how ethnicitiy and median household income plays parts in water quality risk.

Figure 14



Conclusion

The spatial analysis looking at specific cities, such as El Monte, Bell, Bell Gardens, and Lancaster were picked simply due to its spatial distribution along the potential water risk area. Secondly, based on the land-use map, it can be determined that in more urban areas, such as El Monte, Bell, and Bell Gardens have slightly less water-risk as compared to Lancaster, which was in a more agricultural area. Low-income communities have dispro-portionate access to high quality of water in Los Angeles County. Ethnicity while may be coorelated with income, can not be considered conclusive for water quality risk. The lack of clean-up programs can indicate quality water systems, and the lack thereof can indicate low-quality water systems. Lastly, it's also possible to rule out ethnicity as a correlated factor with total water quality risk. However, it's likely that median household income, clean-up programs, and land-use are coorelated with total water quality risk.

Limitations

1) The datasets have a broad range of years, and also are relatively small in scale.
2) Zoning and specific land use wasn't used, which can play a big part in painting the picture of the relationship between land use factors and water de-mand and risk.
3) The case studies, while showcased a lot, were limited to only three studies. In the future, more case studies can potentially be beneficial.

Recommendations

Based on the spatial analysis conducted, it's recommended that policies are created to address potentially at risk/ at-risk/ and failing water delivery systems across Los Angeles County.

1) Clean-up programs that can address poor water delivery system man-agement can help with increase total water quality.

2) Monitoring water quality risk at all levels in every city across the county can be extremely helpful in identifying water quality risks on the local lev-el.

3) Ensuring that areas, regardless of income, require scheduled water-risk checks monthly to catch potentially at-risk or failing water systems before it happens.

4) Due to the high risk of poor water quality in higher agricultural areas (less urban), extending monitoring accessiblity and clean-up programs to areas that have higher concentrations of agriculture will be essential for the community in the area.

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