Environmental Justice Screening Method:
Integrating Indicators of Cumulative Impact and Community Vulnerability into Regulatory Decision-making

Source: CBE

Source: David Woo

Manuel Pastor, USC
Rachel Morello-Frosch, UC Berkeley
Jim Sadd, Occidental College

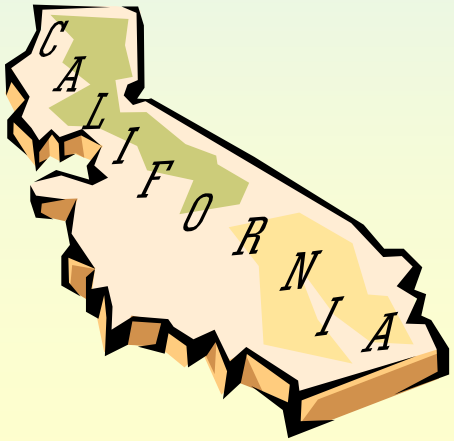
USC ... mental
& Regional Equity

Our Research Team

- Manuel Pastor, Ph.D. in Economics, responsible for project coordination, statistical analyses, including multivariate and spatial modeling, and popularization
- James Sadd, Ph.D. in Geology, responsible for developing and maintaining geographic information systems (GIS), including location of site and sophisticated geo-processing
- Rachel Morello-Frosch, Ph.D. in Environmental Health Science, responsible for multivariate statistical analysis, health end-points, and estimates of risk.

Our Research Team: Previous Work –

A wide range of issues and topics, all with a focus on environmental justice in California



- Location of TSDFs in Los Angeles County
- Distribution of TRI facilities in Southern California, with a second study considering all of California
- Longitudinal studies of siting of TSDF in Los Angeles County – assessing minority move-in hypothesis.
- Analysis of “riskscape” – estimate excess cancer risk and respiratory hazard from U.S. EPA Cumulative Exposure Project
- Analysis of “riskscape” and student demographics, with extension to consider association with asthma and student academic performance
- In virtually all analysis, evidence consistent with environmental disparities in California, reinforcing rationale for state mandates for the consideration of environmental justice

Current Project Summary

- Conduct multivariate modeling and testing to examine disparate impact of estimated risks associated with pollution exposures, particularly in Bay Area
- Conduct regression analysis of relationship between PM and ozone to birth outcomes, taking into account socioeconomic and other measures
- Compare available emissions inventory data with results of local study utilizing community-based participatory

- Develop a “screening tool” that would indicate locations and populations that may be of regulatory concern for disparate impact

- Consider alternative siting environmental justice assessment strategies for California Energy Commission

Screening Method Strategy:

- Develop indicators of cumulative impact and community vulnerability that:
  - Reflect research on air pollution, environmental justice, and health
  - Apply at various geographic levels
  - Are transparent, understandable and relevant to policy-makers and communities
  - Are reviewed early by community EJ groups, Project Advisory Committee and CARB
- Integrate indicators into environmental justice "screening method" applicable to multiple uses:
  - Regulatory decision-making and enforcement
  - Community outreach
  - Identifying areas for special regulatory attention

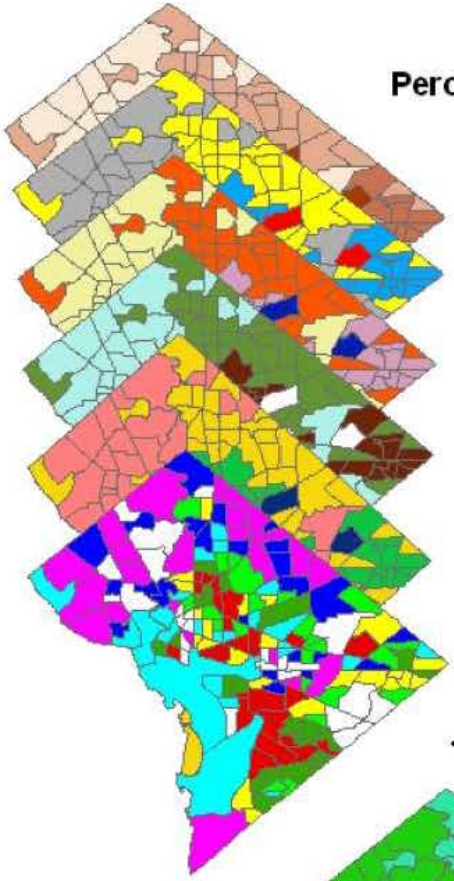
Categories of Concern and Analysis

- Hazard proximity and land use
  - Based on measures developed in EJ literature, ARB land use guidelines, and state data bases on environmental disamenities
- Health risk measures
  - Based on EJ literature, available state and national data bases, modeling from emissions inventories
- Social Vulnerability
  - Based on epidemiological literature on social determinants of health as well as EJ literature on determinant of siting and emissions

Not the Only Game in Town . . .

Environmental Justice Strategic Enforcement Assessment Tool (EJSEAT)

Social Demographic Indicators

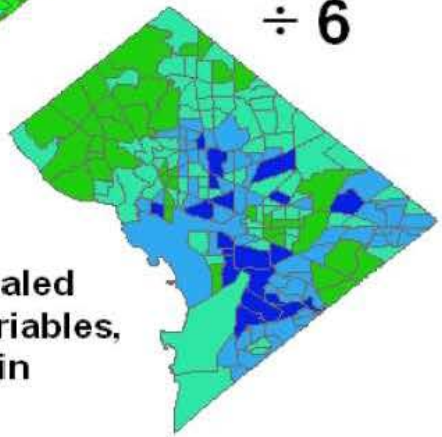


Scaled Percent of Population:

In Poverty
+
Counted as Minority
+
25 Years Old and Over without HS Diploma
+
Under 5 Years Old
+
Over 64 Years Old
+
In Linguistically Isolated Households

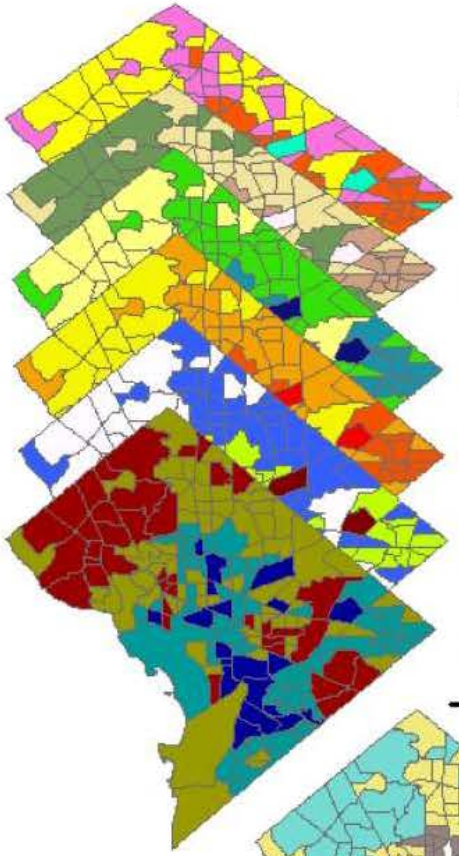
÷ 6

⇉



Average of Scaled Demographic Variables, Scaled Again

Environmental Indicators

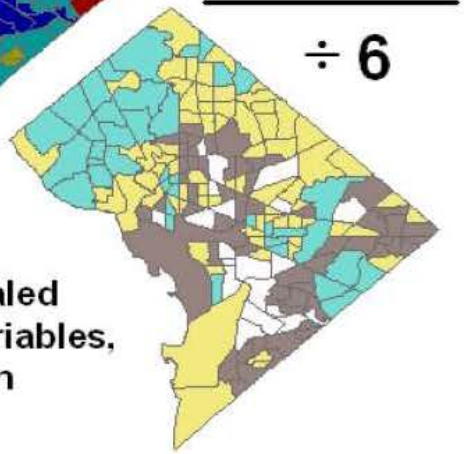


Scaled:

NATA Cancer
+
NATA Neurological and Respiratory
+
NATA NonCancer Diesel PM
+
RSEI
+
Population Weighted Ozone Monitoring
+
Population Weighted PM2.5 Monitoring

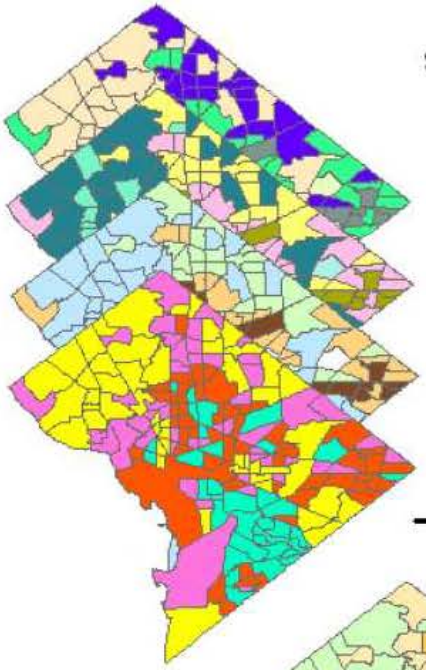
÷ 6

⇉



Average of Scaled Environmental Variables, Scaled Again

Compliance Indicators



Scaled:

Inspection Measure

+

Violations Measure

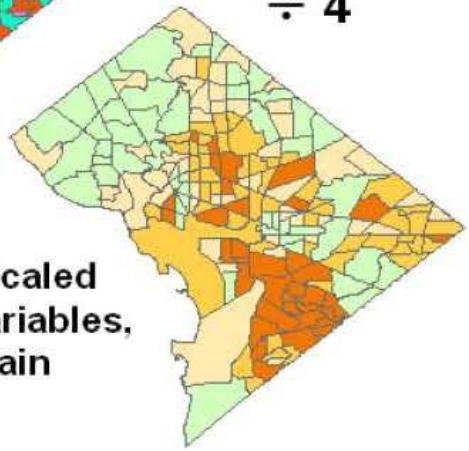
+

Formal Actions Measure

+

FRS Facility Density

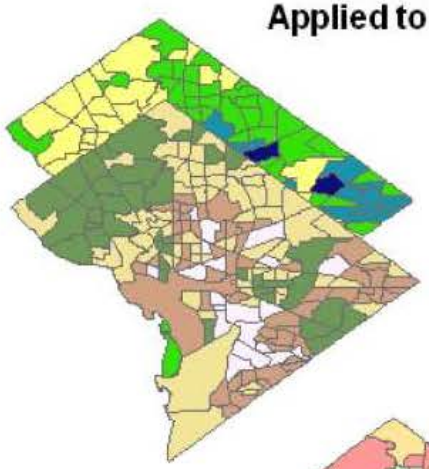
÷ 4



Average of Scaled Compliance Variables, Scaled Again

Health Indicators

Scaled County Data Applied to Each Census Tract:

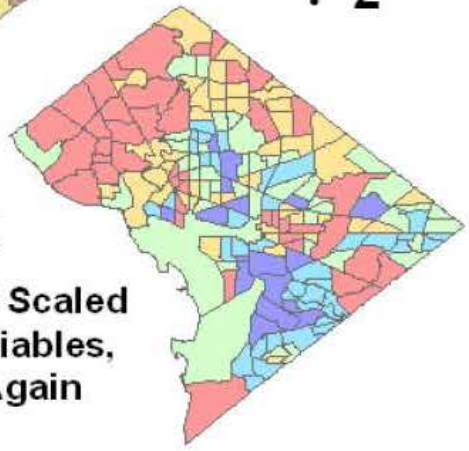


Percent Infant Mortality

+

Percent Low Birth Weight Births

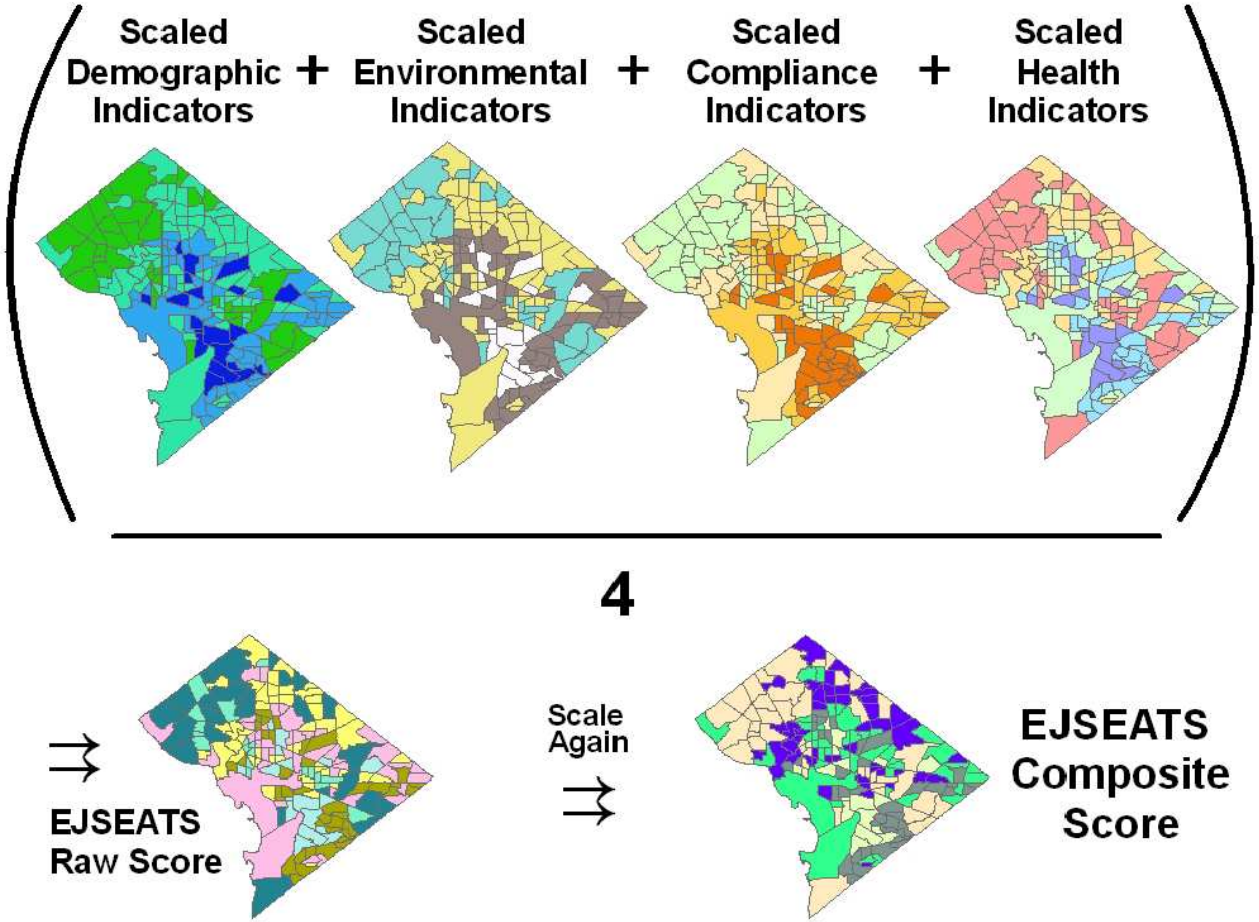
÷ 2



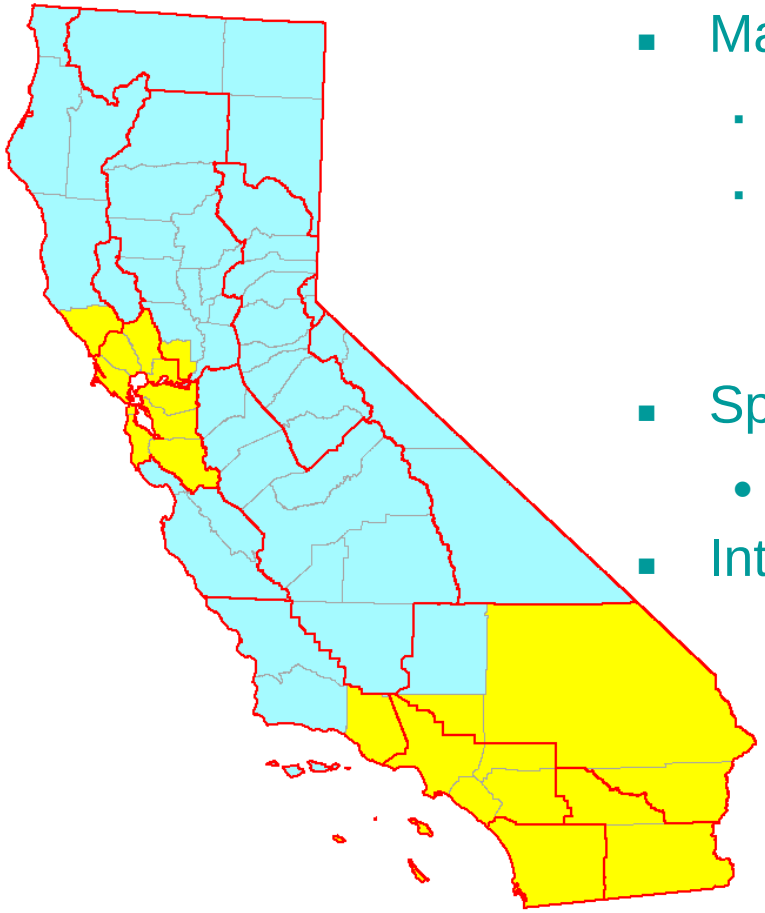
Average of Scaled Health Variables, Scaled Again

U.S. EPA "EJSEAT"
Environmental Justice Strategic Enforcement Assessment Tool

EJSEAT Scoring Methodology

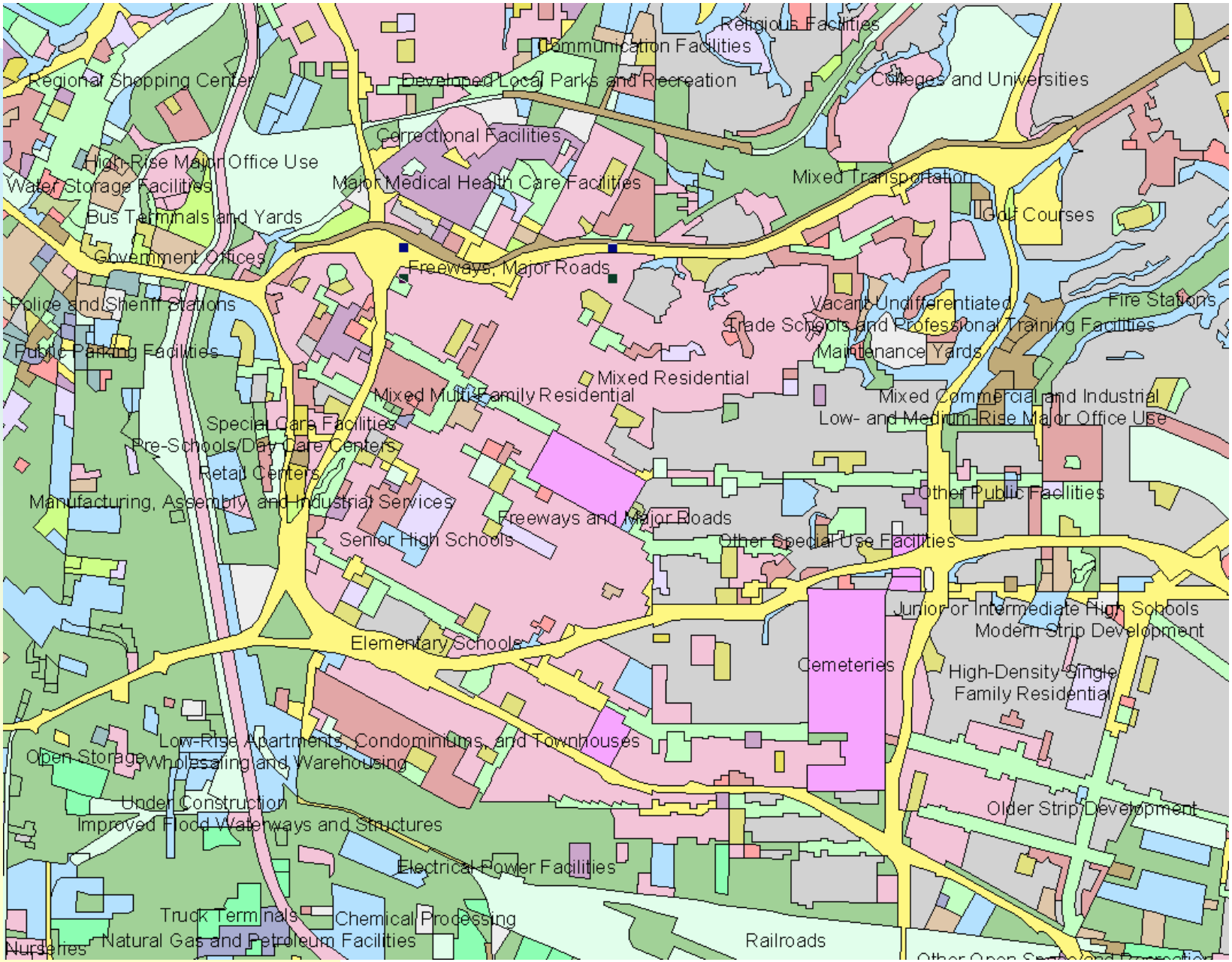


Our Methodology

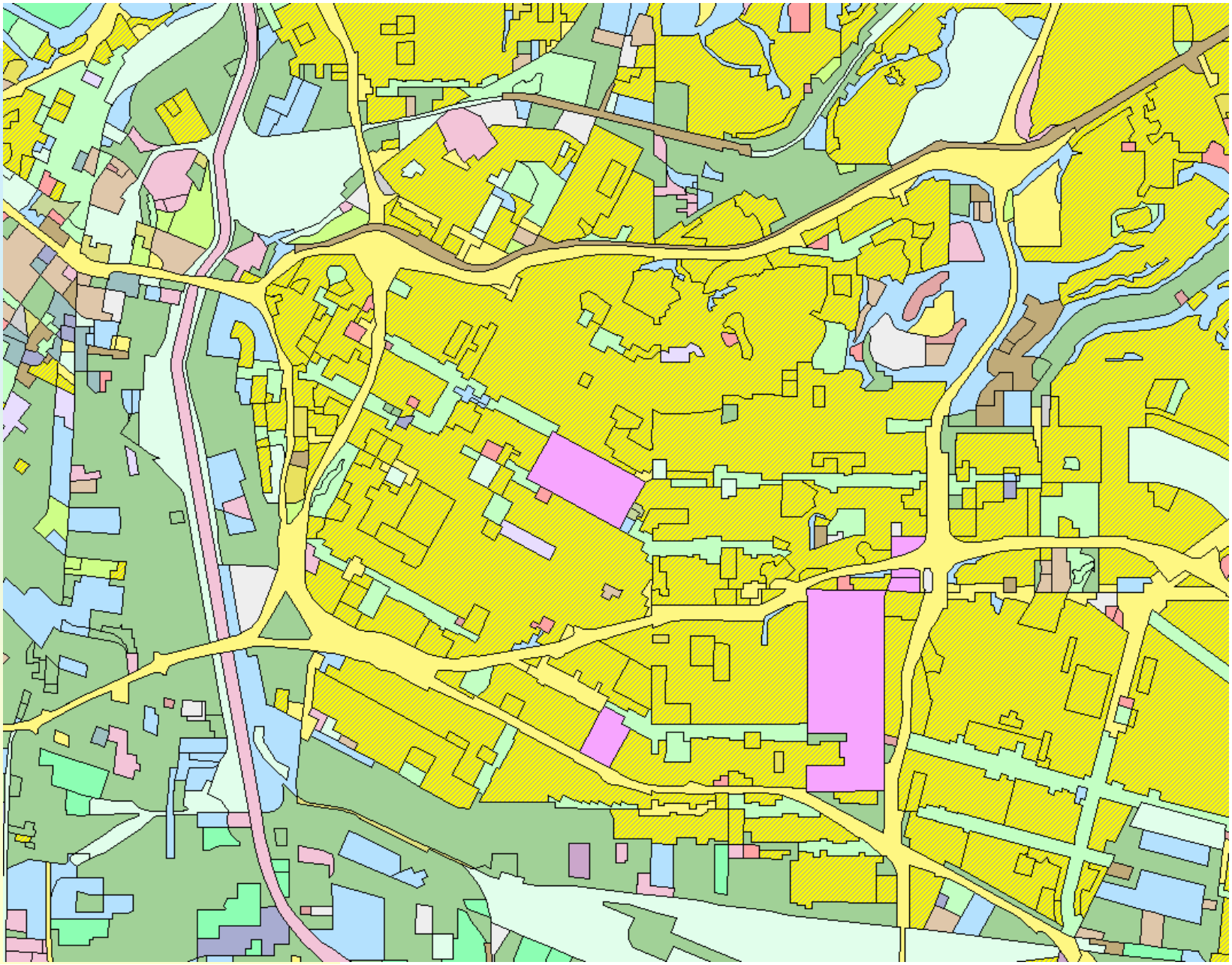


- Two regions; 6 air basins
  - 7 southern California counties
  - 9 Bay Area counties
- Map where people are exposed
  - Residential land use
  - Sensitive land use categories (ARB land use guidelines, 2005)
- Spatial Unit for Analysis
  - Most data sets calculated at tract level
- Intersect land use polygons with census tracts
  - Land Use data (SCAG, SANDAG, ABAG)
  - Residential
  - Schools
  - Health Care Facilities

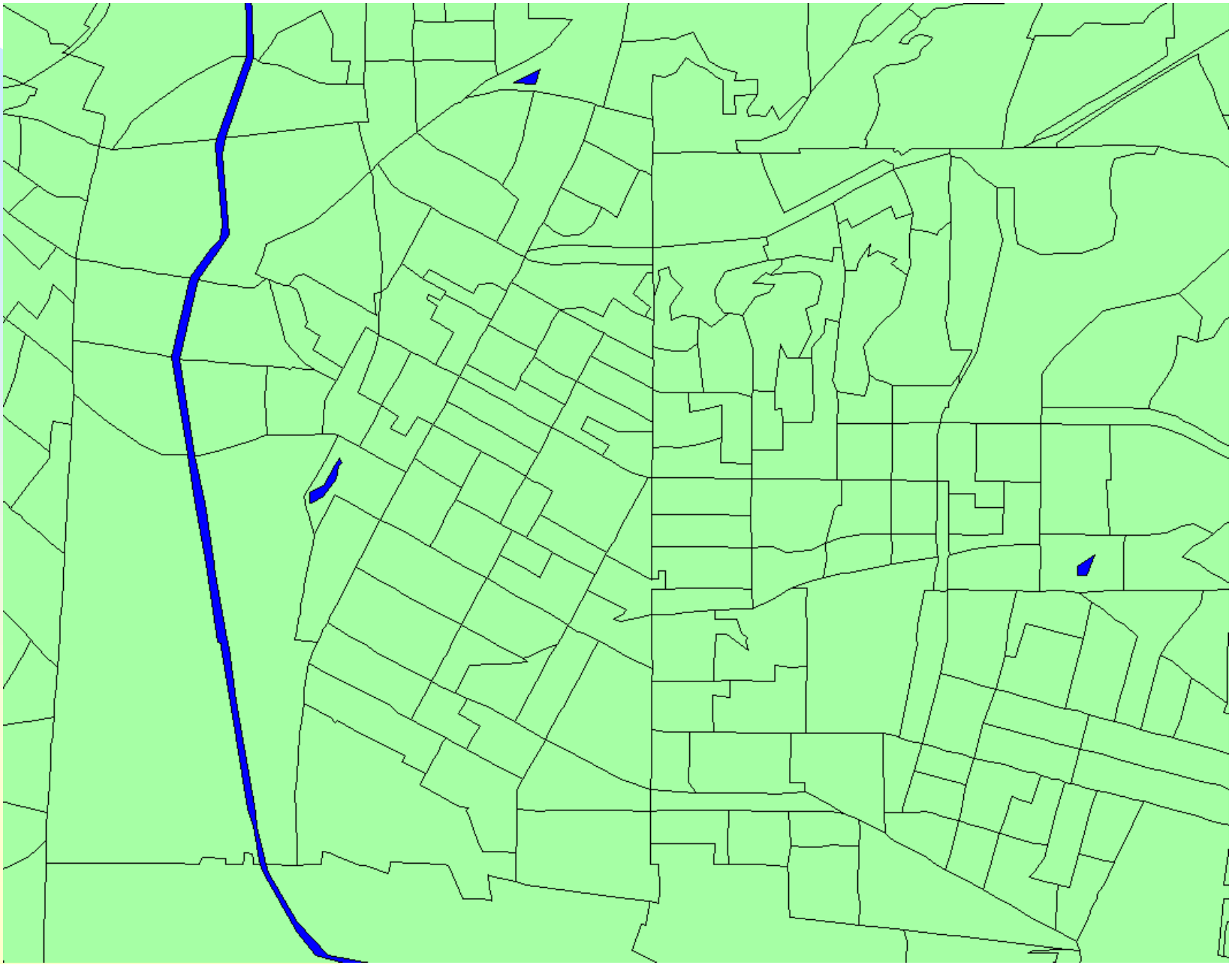
SCAG Land Use Polygons



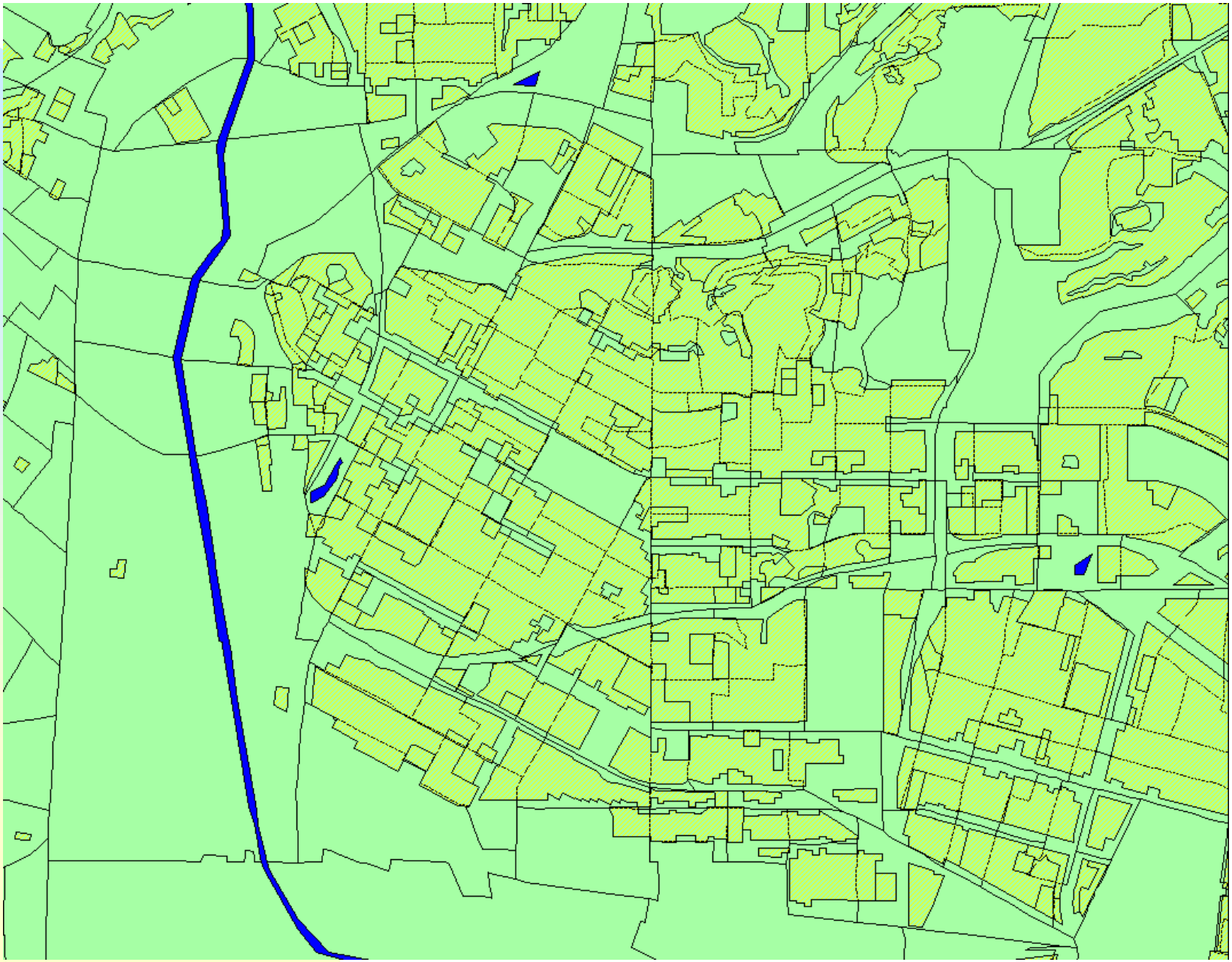
Select Sensitive Land Uses



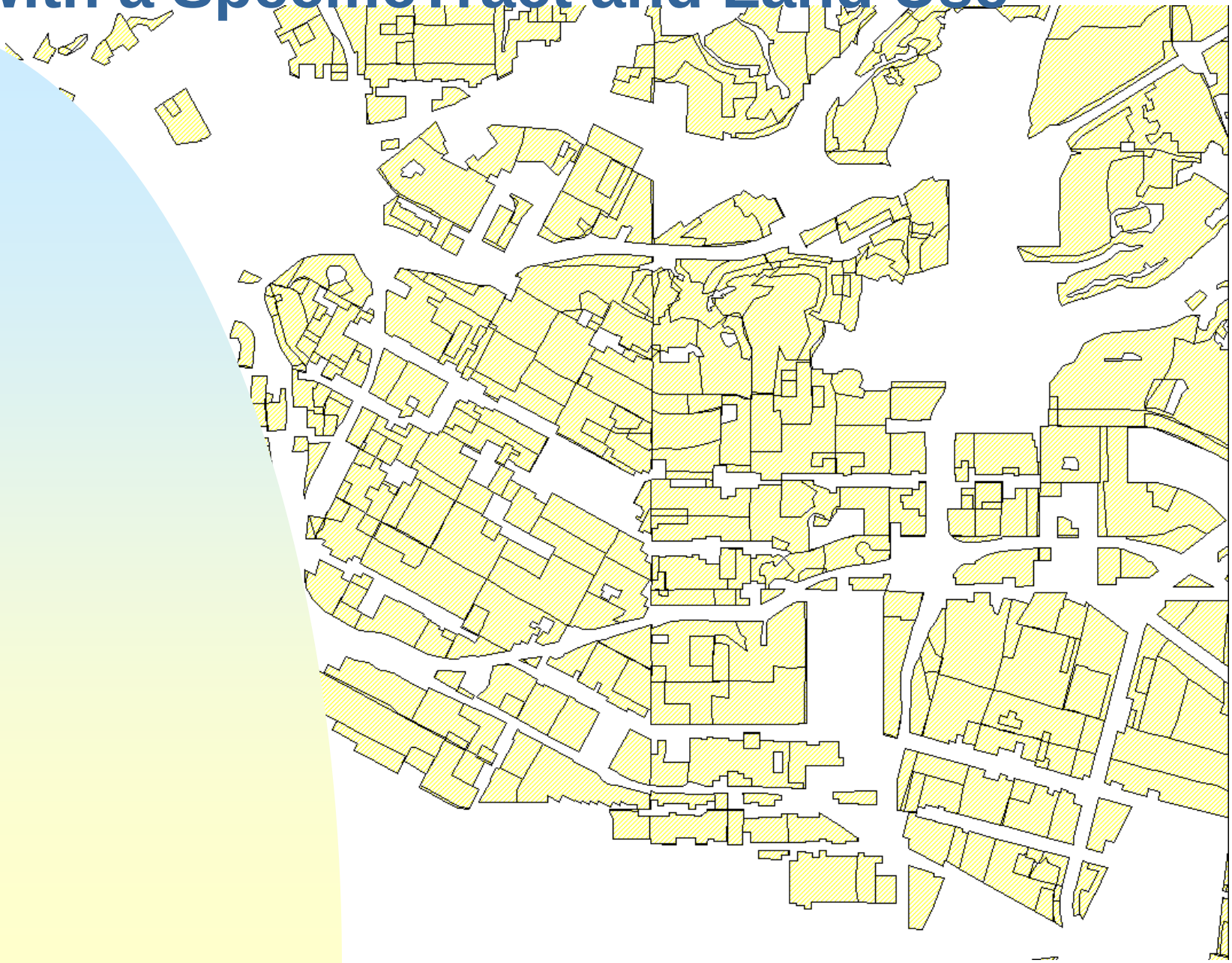
2000 Census Block Groups



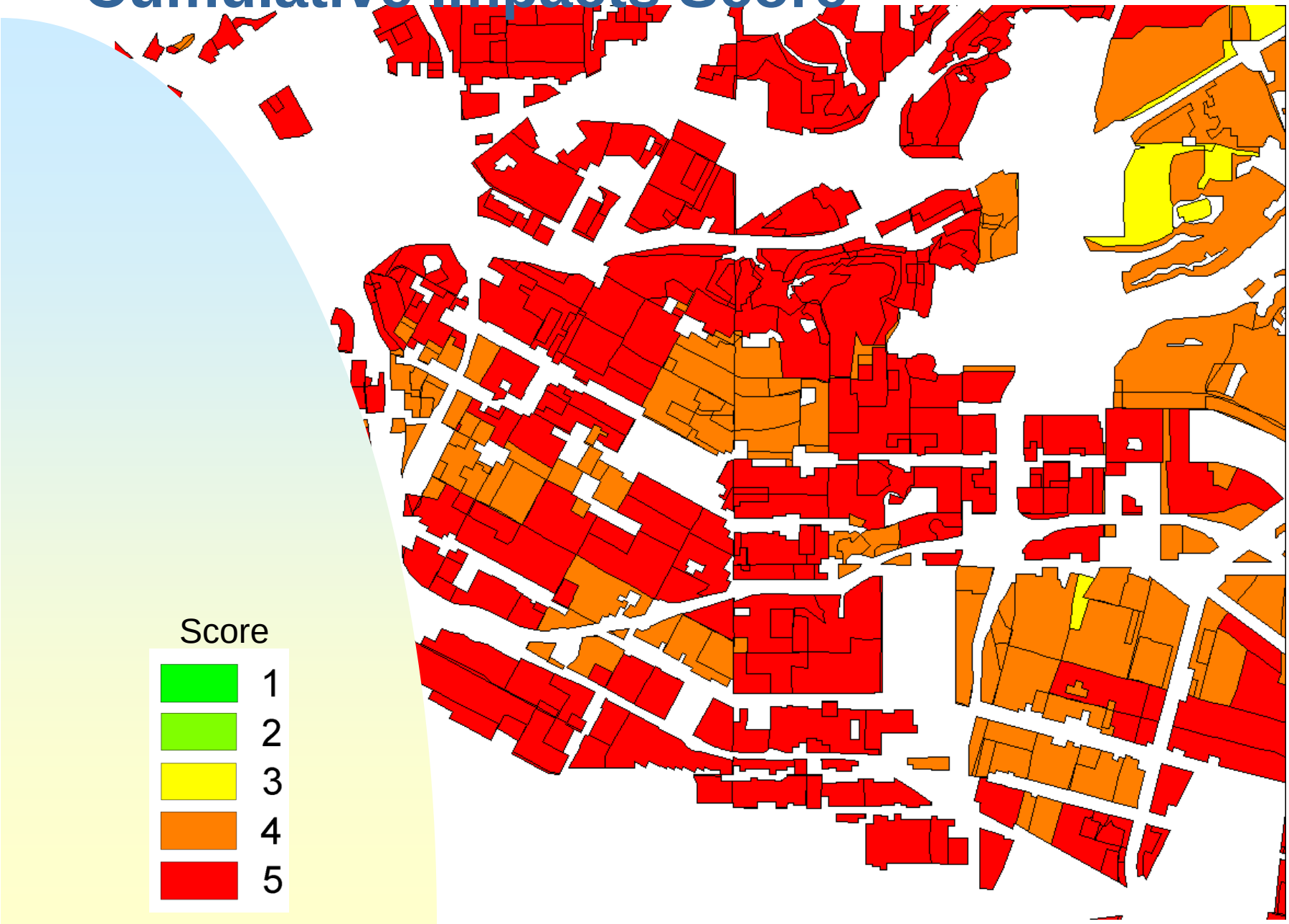
Intersect Land Use Polygons with Block Groups



Result: Sliver Polygons, each associated with a SpecificTract and Land Use

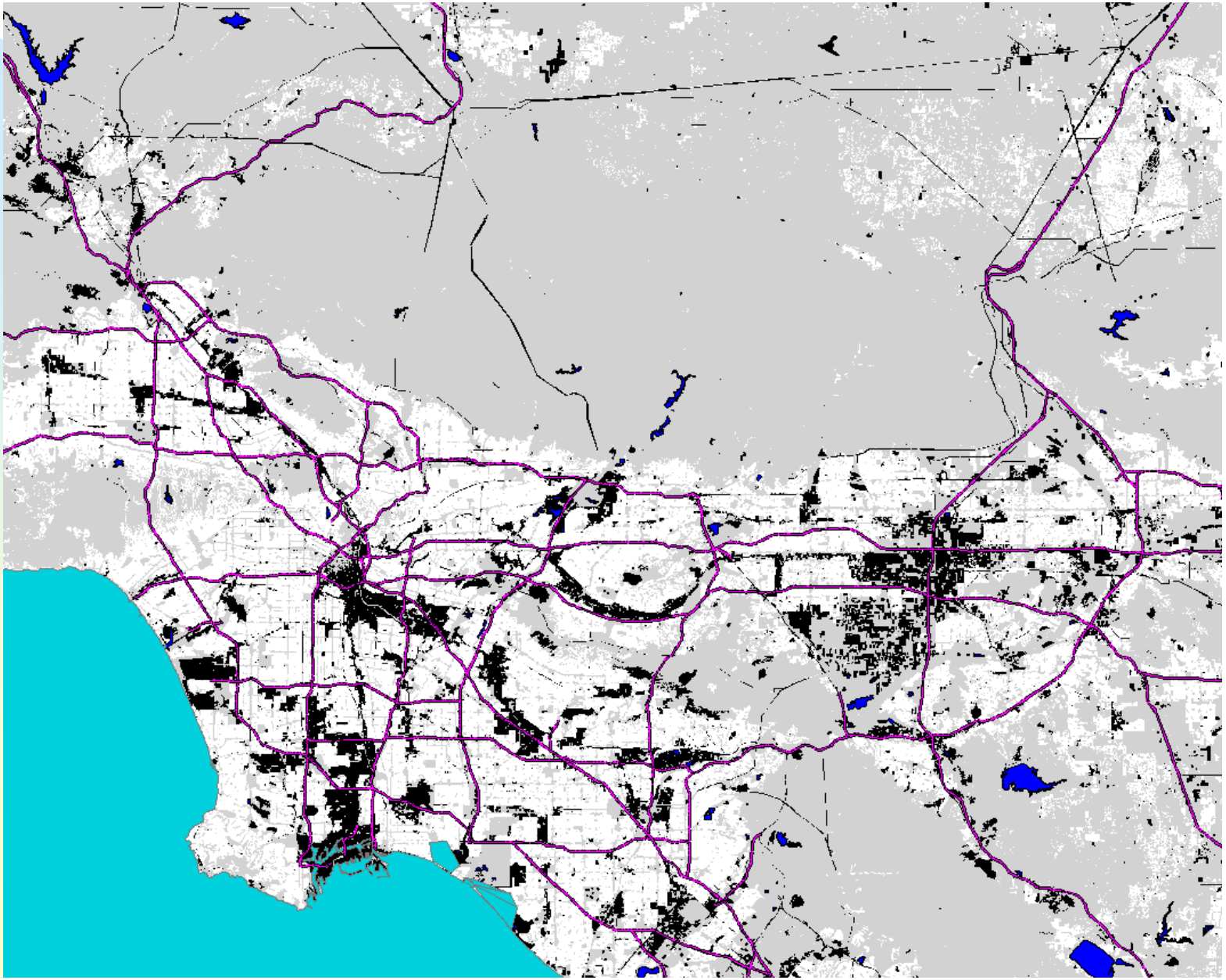


Each Polygon eventually receives a Cumulative Impacts Score

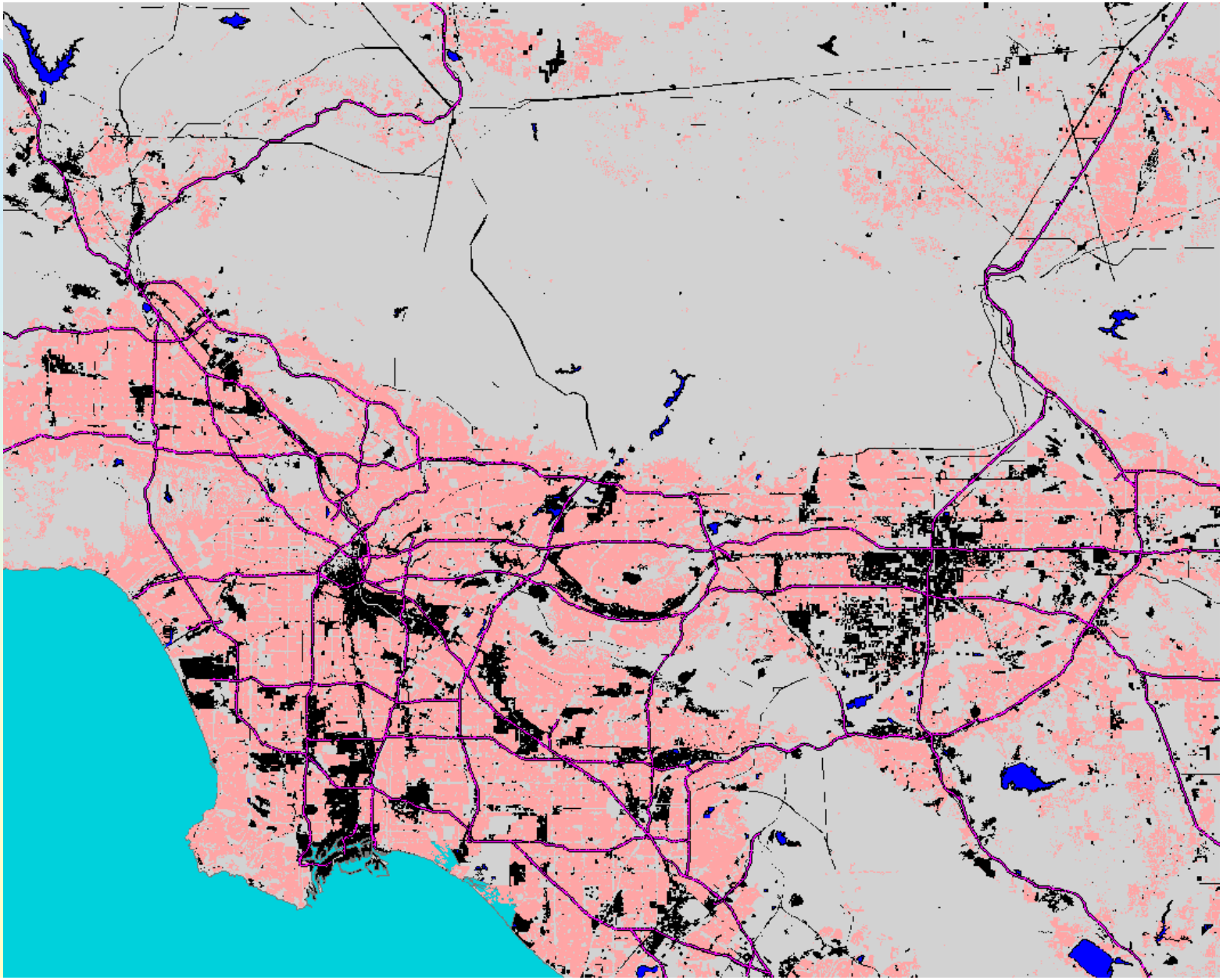


Land Uses Outside of Analysis

Black = Industrial, Transportation, etc.; Gray = Open Space, Vacant, etc.



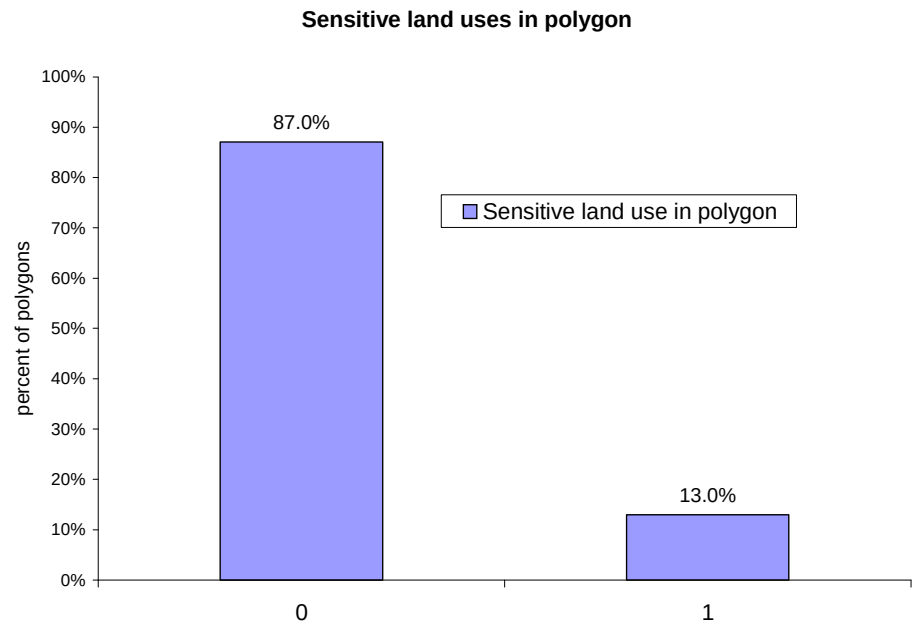
Land Uses in Analysis
(pink = residential, schools, or medical facilities)

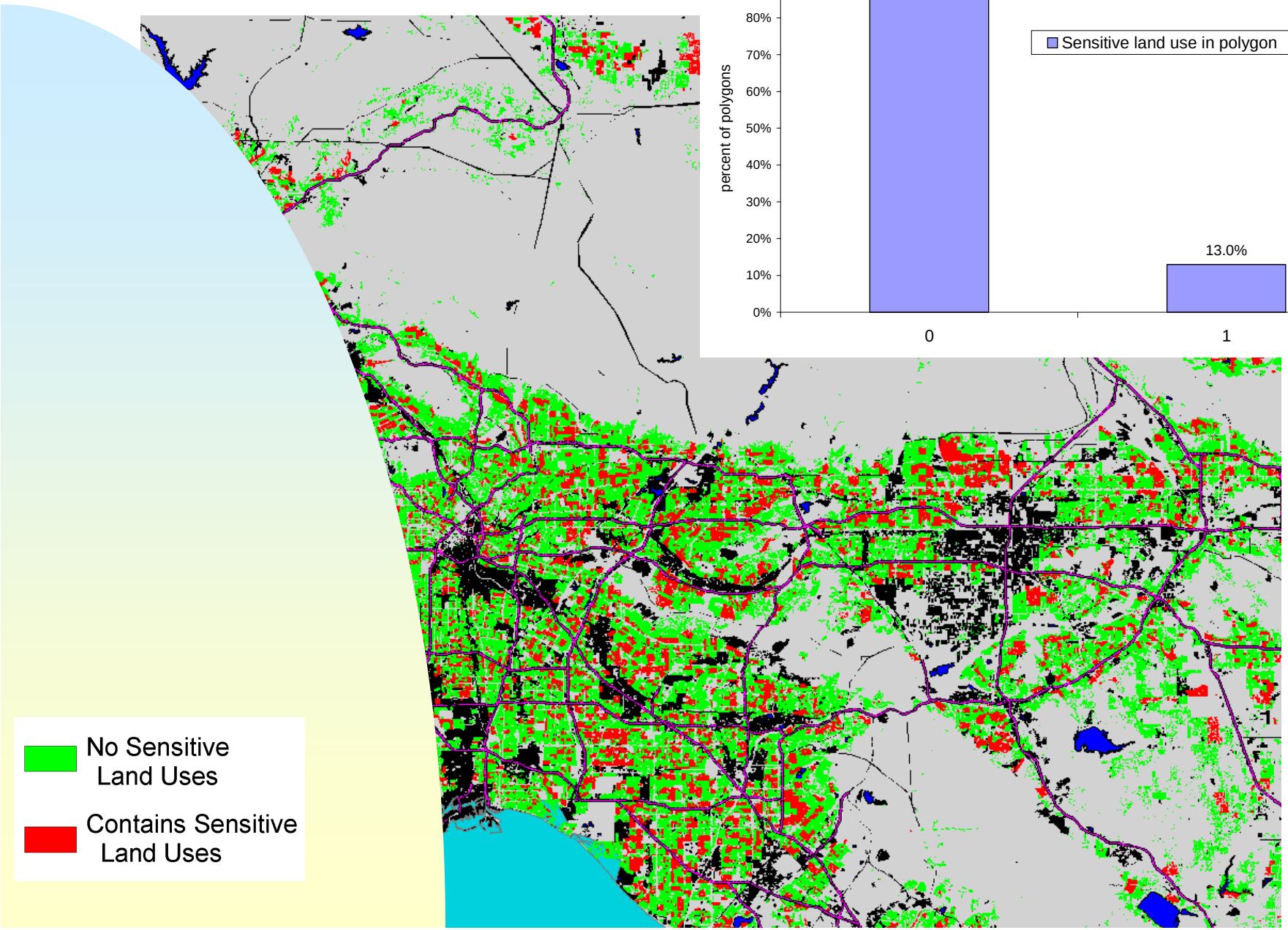


Sensitive Land Uses

- Sensitive land uses
  - Childcare facilities (geocoded from SIC)
  - Healthcare facilities (from ARB)
  - Schools (geocoded from CaDOE)
  - Land use designations provide additional check
- Polygons containing at least one sensitive land use are given a score of 1

Sensitive Land Uses



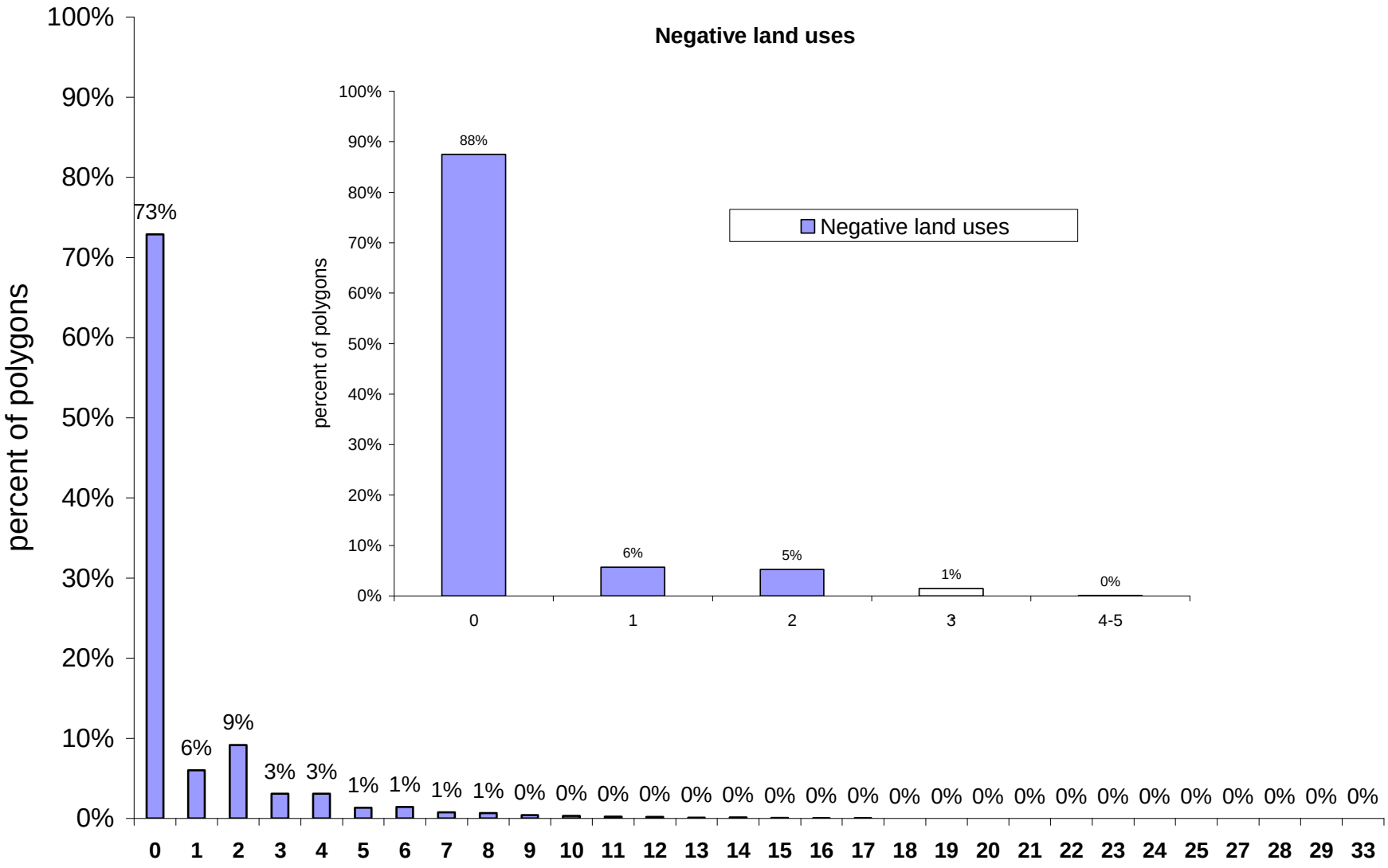


Hazard Proximity & Land Use Indicators (9)

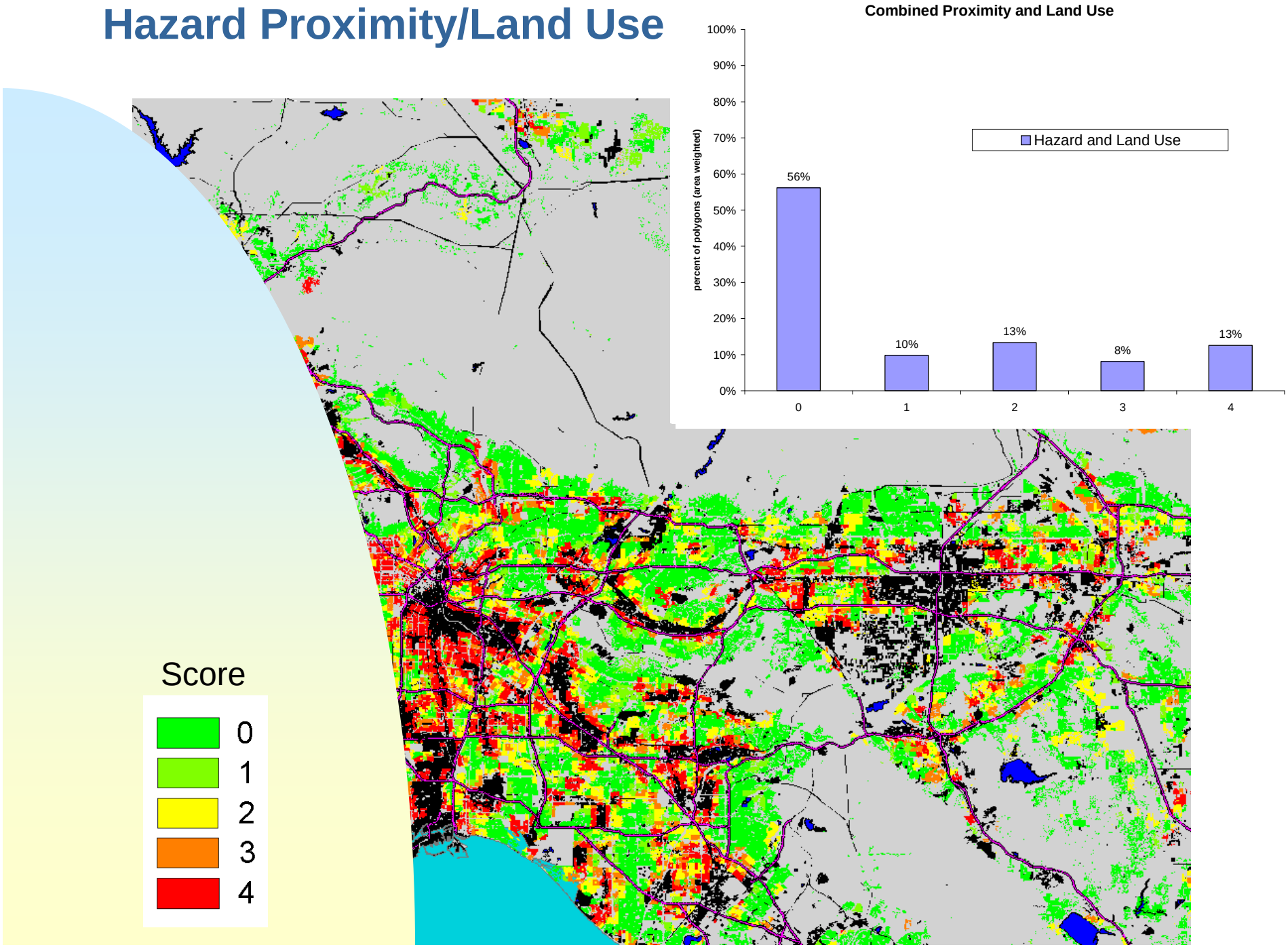
- CHAPIS (ARB)
- AB2588 “hot spots” (ARB)
- Chrome Platers (ARB)
- Hazardous Waste TSDs (DTSC)
  - Federal Response (includes Superfund)
  - State response
  - Voluntary cleanup
  - Military evaluation
  - School investigations and cleanup
- Rail
- Ports
- Airport
- Refinery
- Distribution facilities
- Traffic Density
  - to be added

- Sum of sites within buffered distance of polygon edge
- Score based on summing hazards and land uses, and normalizing to 0 (no hazards or land uses) to 4

Sources within block group or buffer


Negative land uses
percent of polygons
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Negative land uses
88%
6%
5%
1%
0%
0
1
2
3
4-5
73%
6%
9%
3%
3%
1%
1%
1%
1%
0%
0%
0

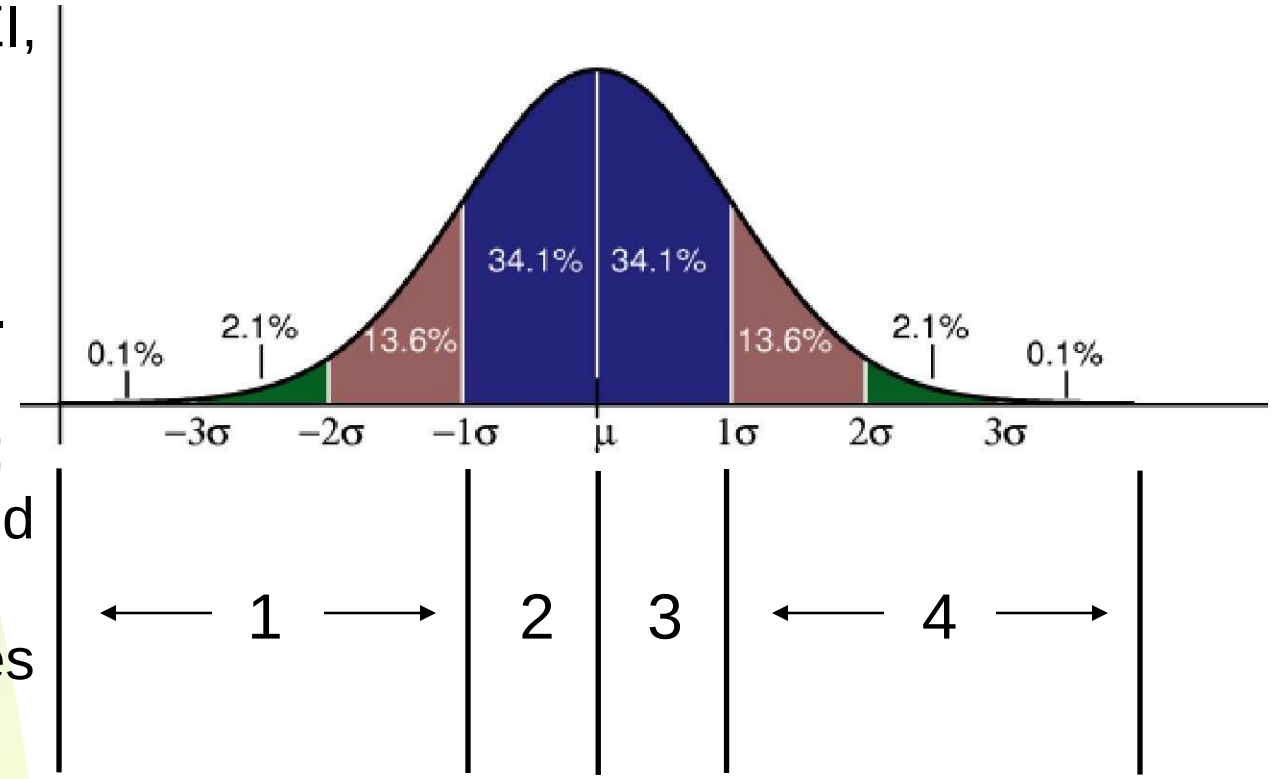
Hazard Proximity/Land Use



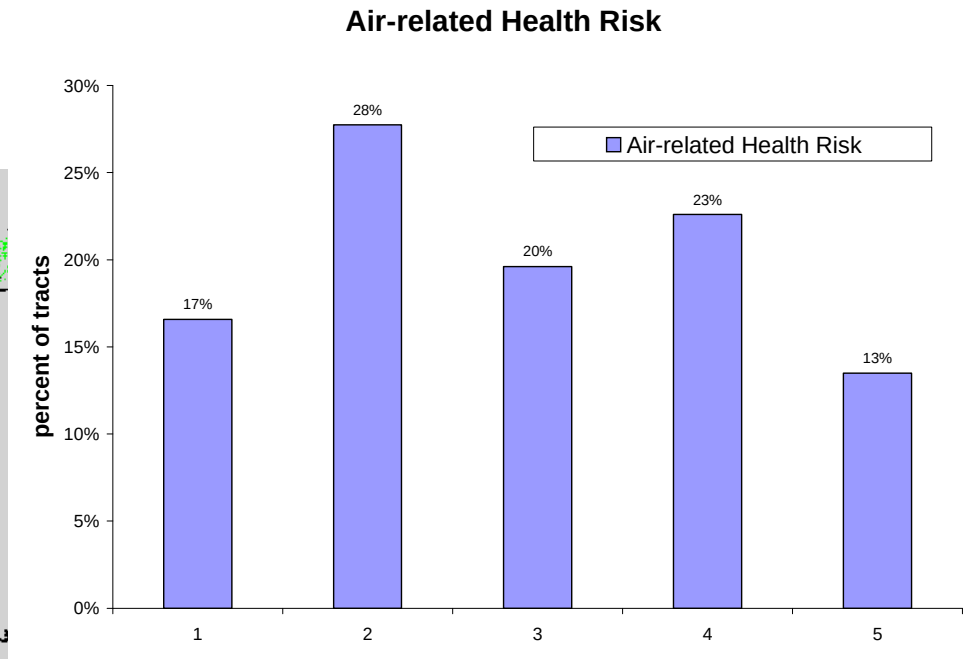
Health Risk Indicators (4)

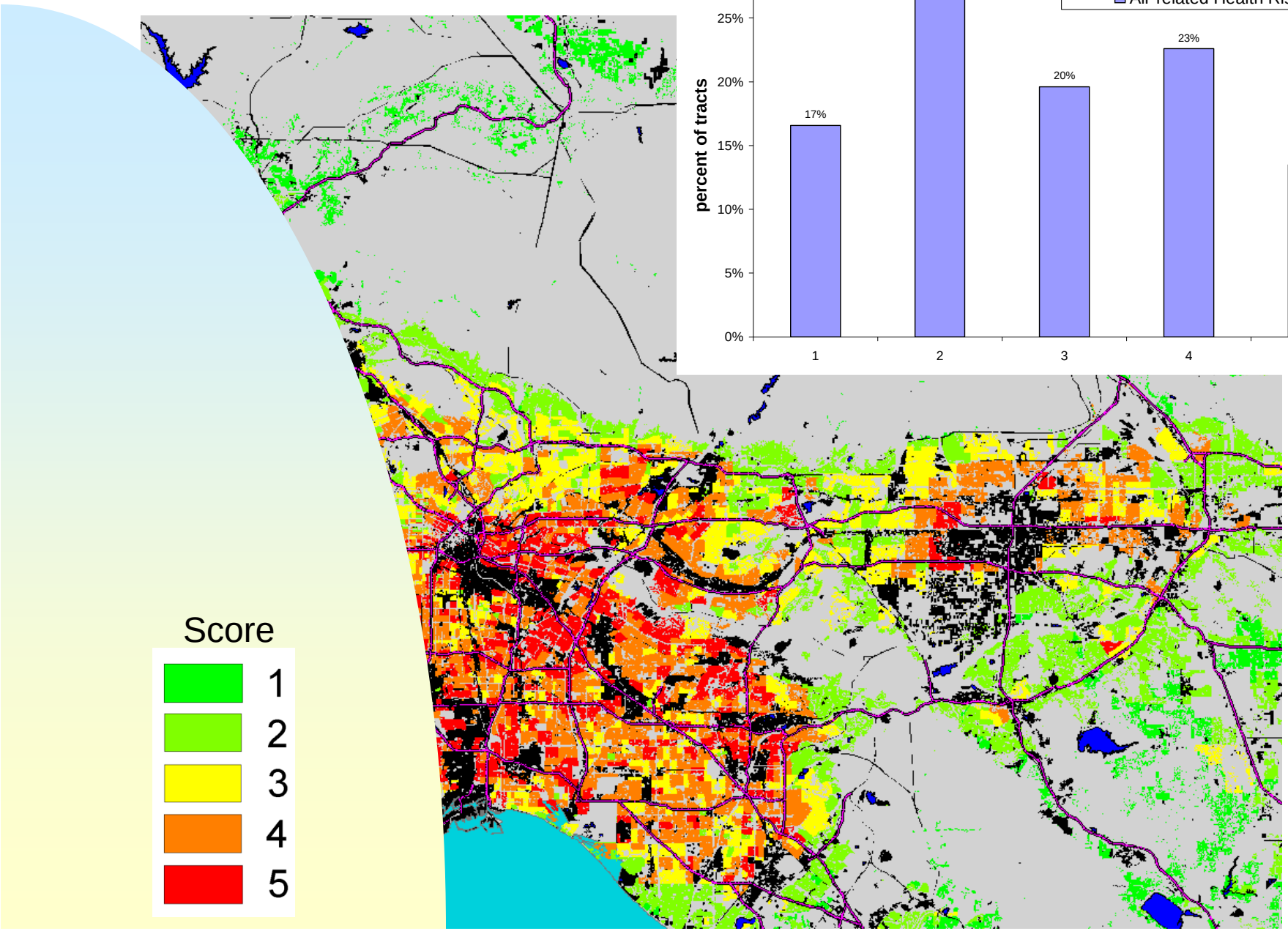
- RSEI (Risk Screening Environmental Indicators)
  - (2005) toxic conc. hazard scores
- NATA 1999 (National Air Toxics Assessment)
  - Respiratory hazard from all air pollutants
- ARB Estimated Inhalable Cancer Risk 2001
  - Calculated from modeled air toxics concentrations using emissions from CHAPIS
  - We used our corrected version of this data
- ARB estimated mortality from $PM_{2.5}$
- ARB estimated mortality from ozone exposure
  - To be added
- Health risk measures log transformed and means and standard deviations are calculated, range from 1 to 4 each

Scores are determined for each risk measure (RSEI, NATA, CATA, and PM 2.5), making use of mean and standard deviation. Each of these ranges from 1 to 4; they are then added together, and ranked into quintiles (with natural breaks) to derive a score ranging from 1 to 5.



Health Risk


Air-related Health Risk
Air-related Health Risk
percent of tracts
30%
25%
20%
15%
10%
5%
0%
17%
28%
20%
23%
13%
1
2
3
4
5


Score
1
2
3
4
5

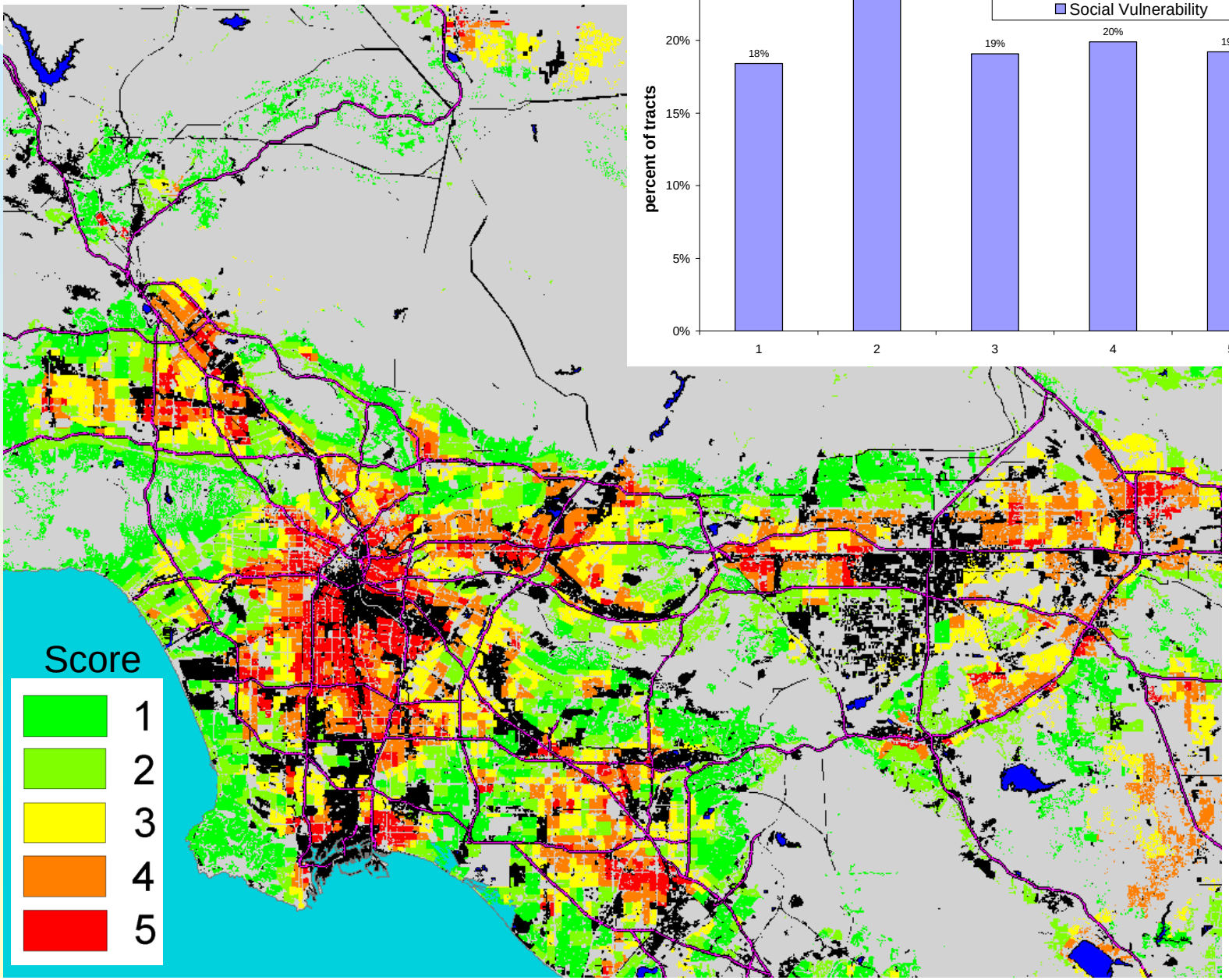
Social and Health Vulnerability (9)

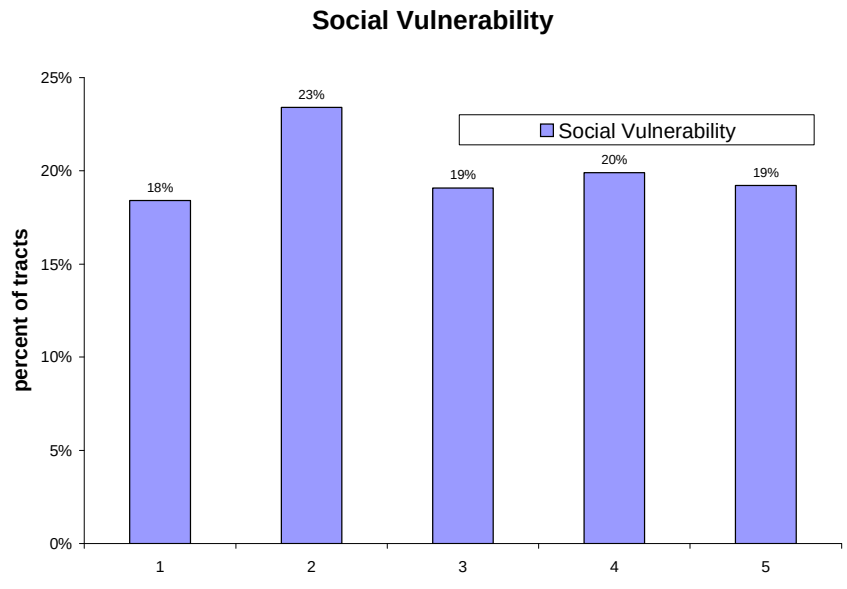
Metrics include (2000 Census):

- % residents of color (non-White)
- % residents below twice national poverty level
- Home ownership - % living in rented households
- Educational attainment – % population > age 24 with less than high school education
- Age of residents (% <5)
- Age of residents (% >60)
- Voter turnout - % votes cast among all registered voters in 2000 general election
- Linguistic isolation - % pop. > age 4 in households where no one > age 15 speaks English well
- Birth outcomes – % preterm or SGA infants 1996-2003

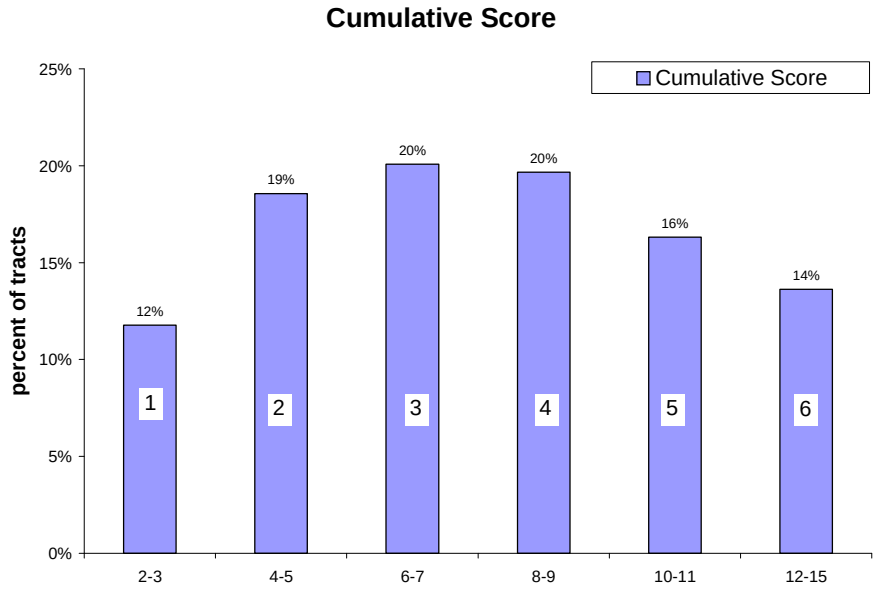
- As with risk measure, social vulnerability measures are ranked from 1 to 4 utilizing means and standard deviations.
- Total scores are added (with a strategy to account for missing observations) and normalized to a scale of 1-5.

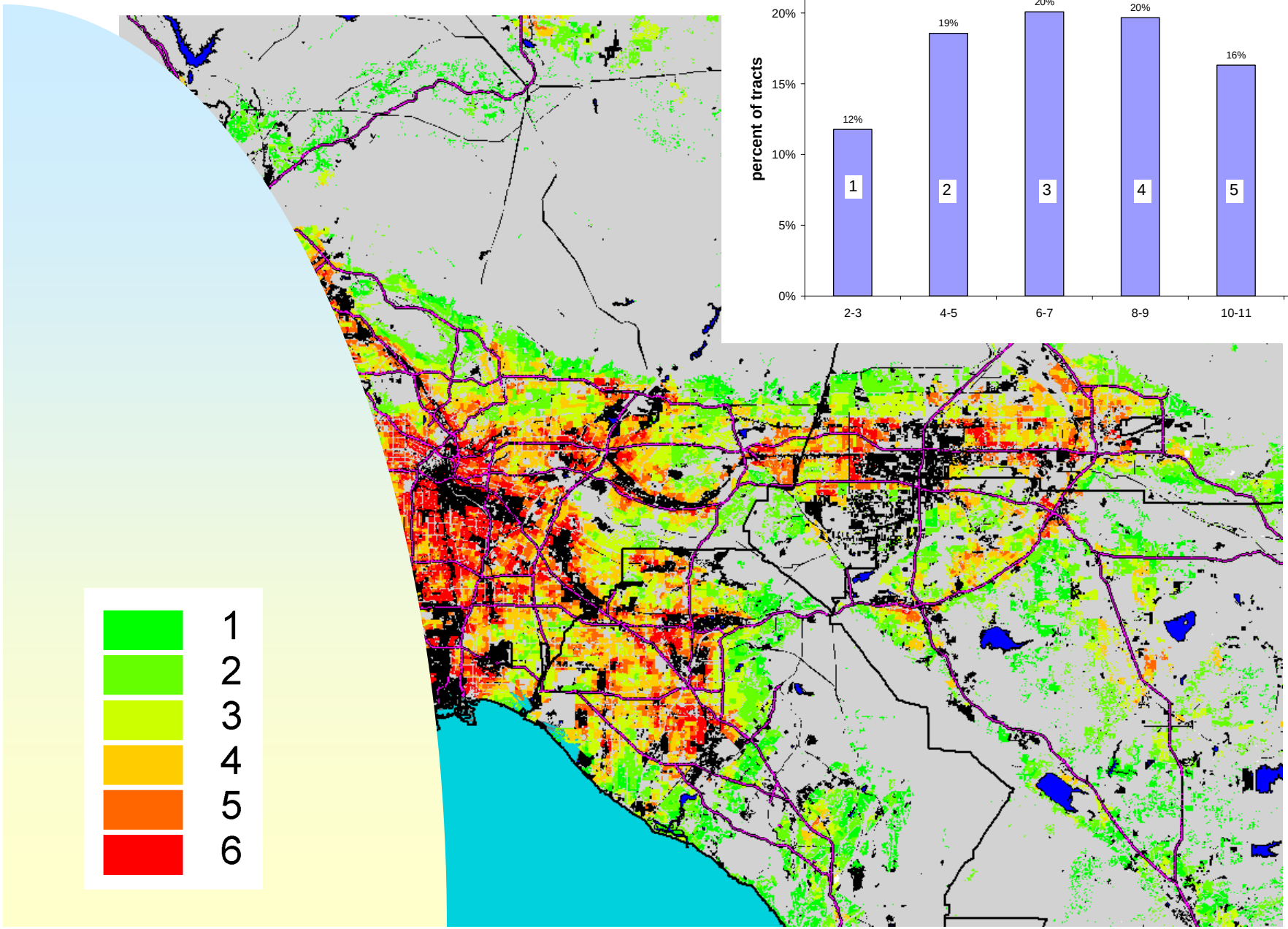
Social and Health Vulnerabil



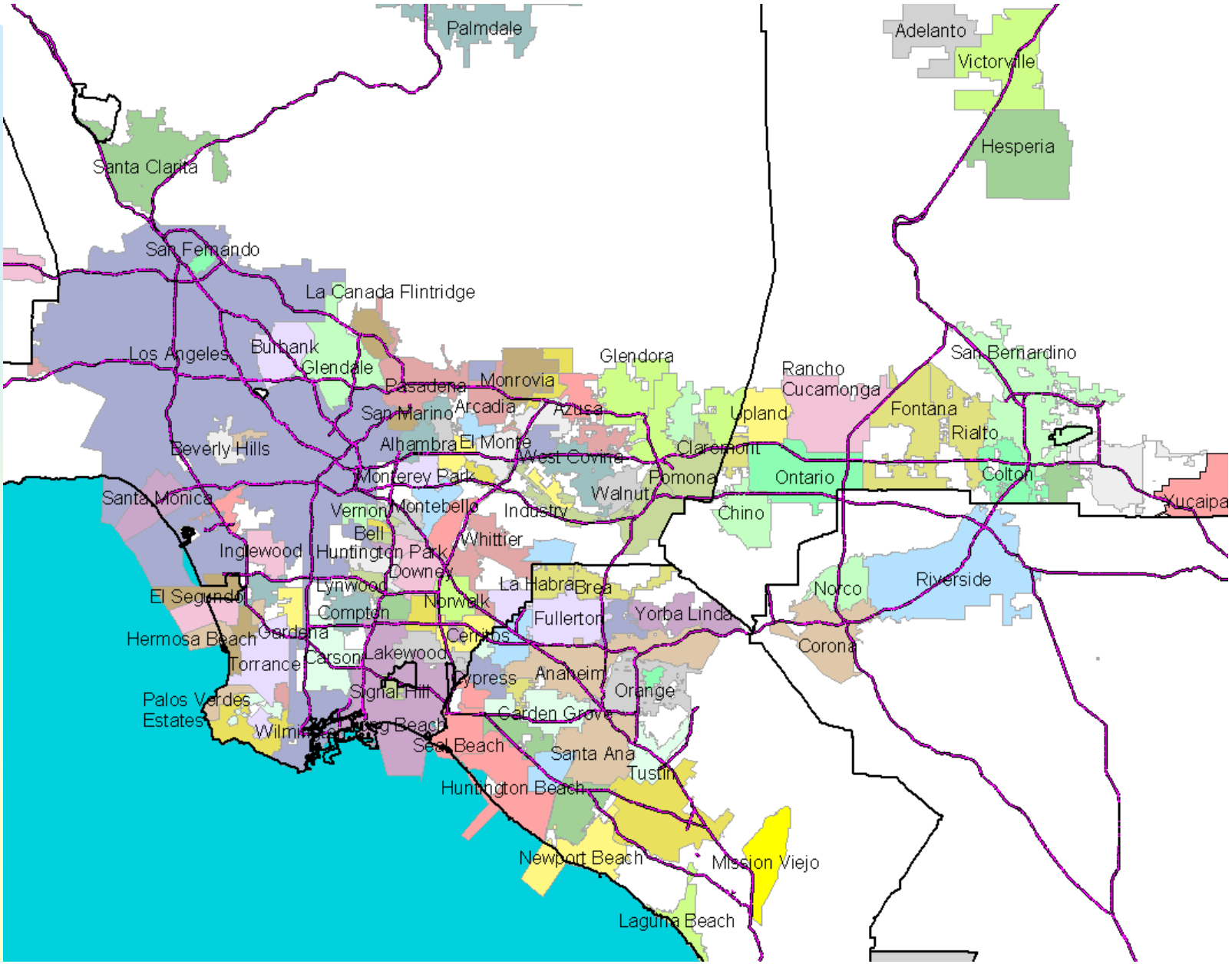


Cumulative Impact Score

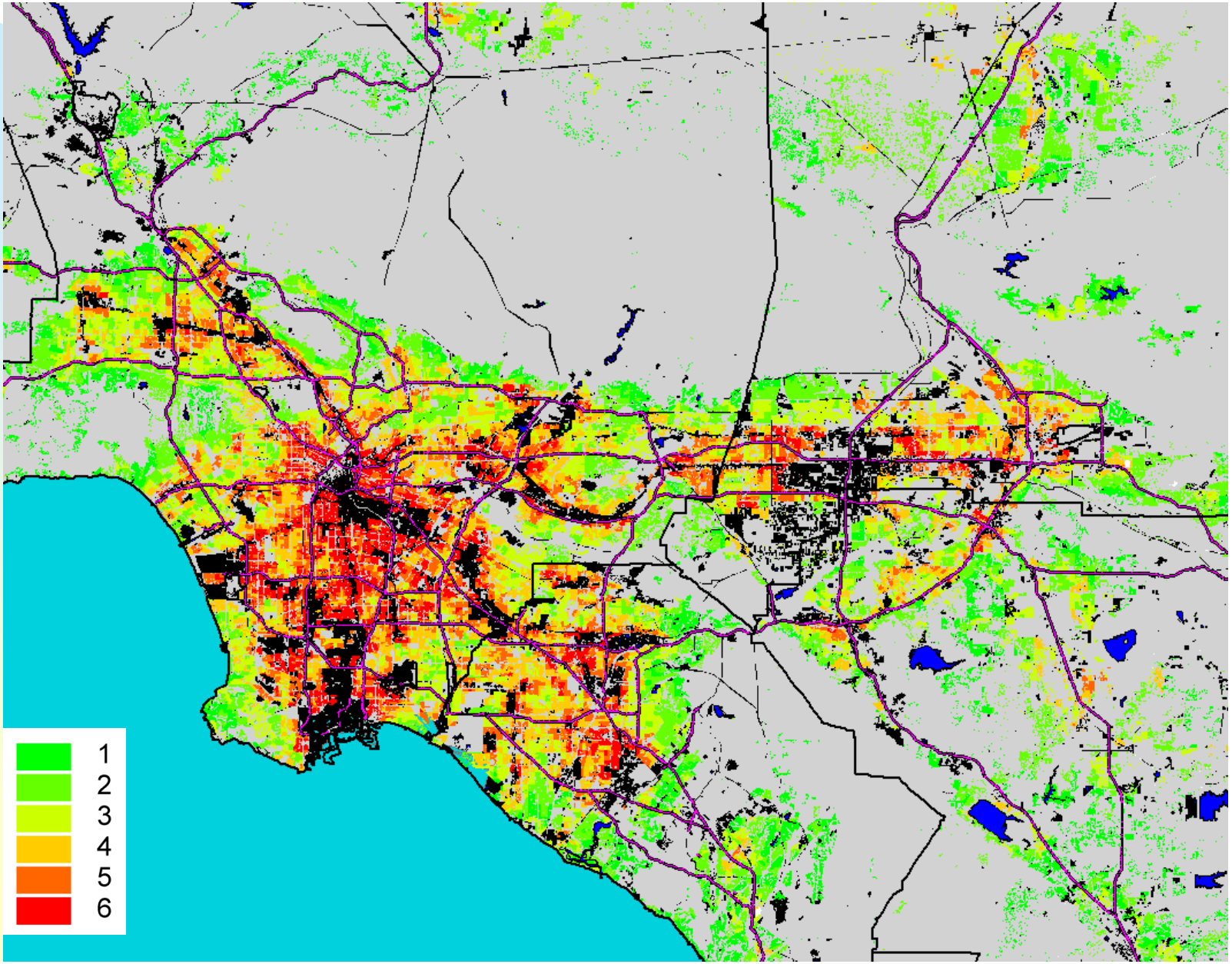




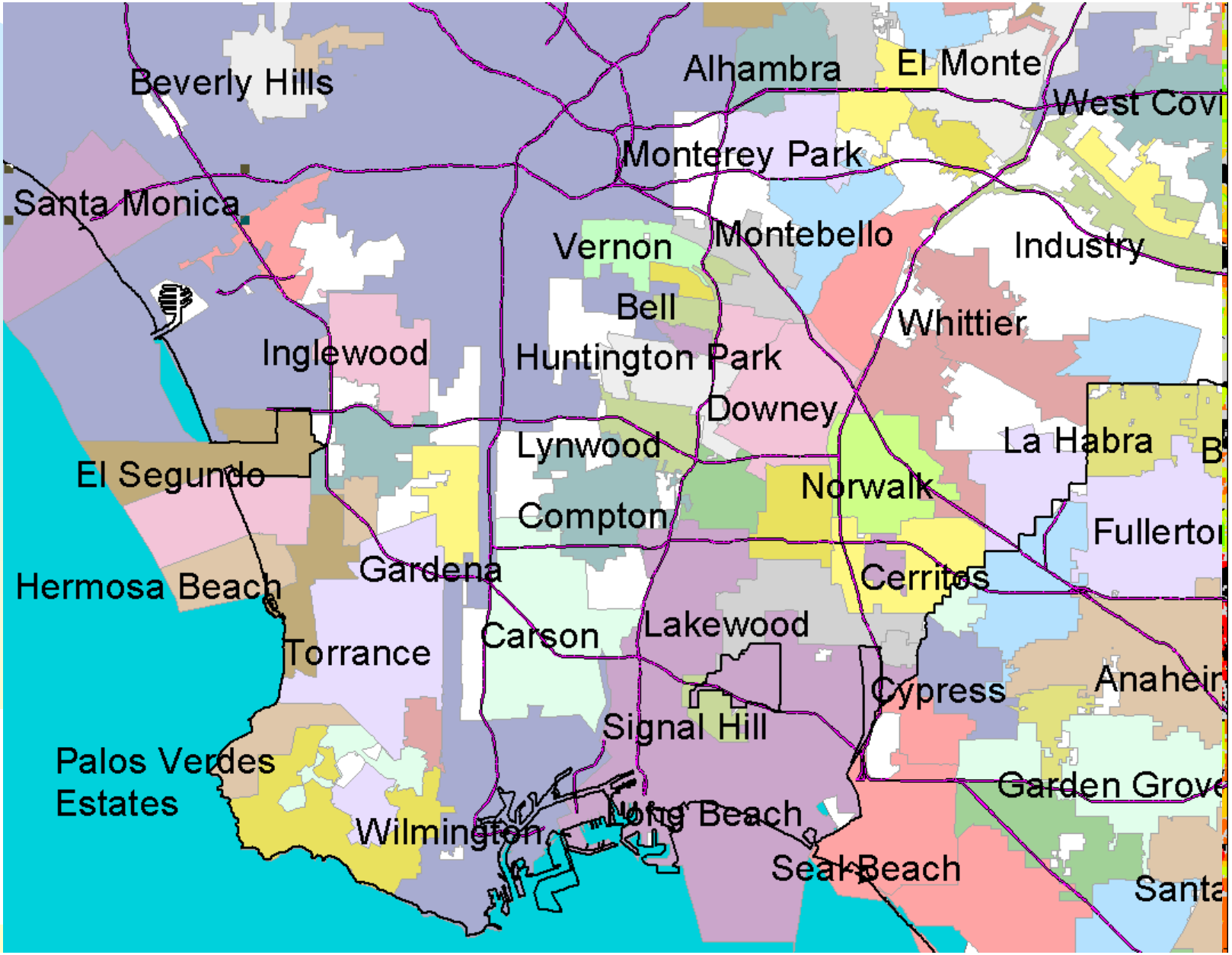
Southern California Cities



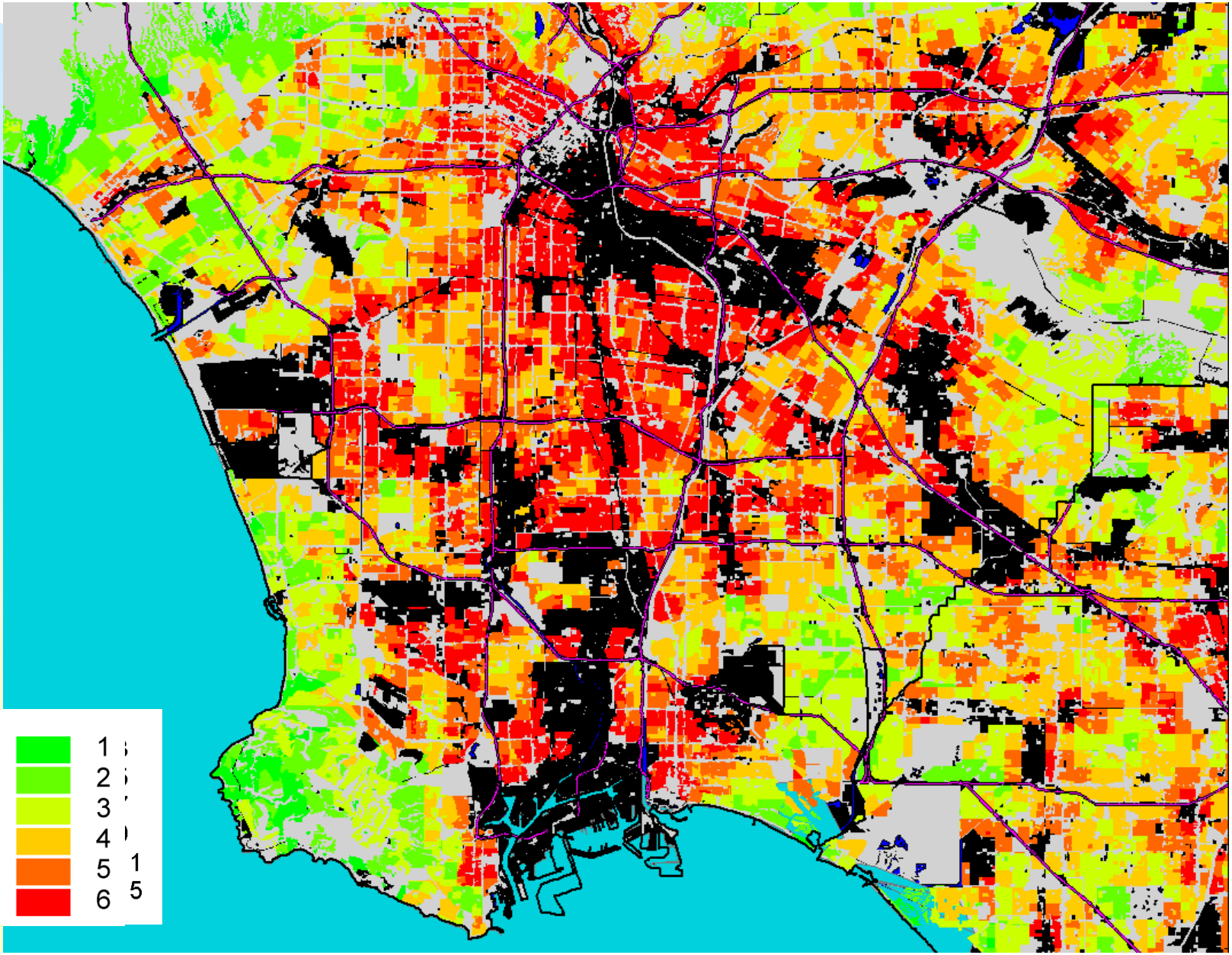
Adjusted Cumulative Score



Adjusted Cumulative Score



Adjusted Cumulative Score



Future work

Additional Indicators

- Land Use
  - Distance-weighted traffic counts
- Health Risk
  - Estimated mortality from ozone
- Social and Health Vulnerability
  - Residential real estate value as proxy for wealth/class

Buffer Distance

- Conducting sensitivity analysis by varying buffer distance
- 1 mile vs. ½ mile from polygon centroids
- 1000 feet and 2000 feet from polygon boundaries

Robustness Analysis

- Varying weighting and scoring schemes
- Dropping in and out single measures

Important Caveats

- Screening method is still in development -- beta version being shared but final version forthcoming
  - Developed with specific reference to air quality and not screening for concerns such as water or pesticides
    - Requires high-resolution land use data which is not available in all areas of the state
      - Developed with secondary databases not micro-studies – so this is screen not assessment

Potential Contributions

- Can be a way of developing shared understanding about what areas may be of high regulatory priority
  - Transparent approach that is publicly accessible and not too difficult to implement & update
    - Is open to modification by sophisticated users to change weights or data inputs