

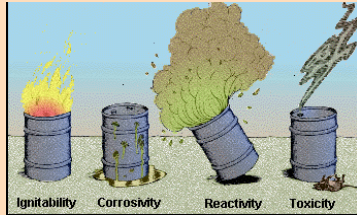
# The Ecology of Risk in a Sunbelt City: A Multi-Hazard Analysis

Amy Nelson, Bob Bolin, Ed Hackett, David Pijawka, Ed Sadalla, Diane Sicotte, Eric Matranga

### Abstract

This paper examines the spatial distributions of four point-source hazard sources in the Phoenix, Arizona metropolitan area. The key focus is on the locations of hazardous industrial and toxic waste sites in relation to the demographic composition of proximal neighborhoods. Our interest is to determine whether hazardous sites, including industrial facilities in the Environmental Protection Agency's Toxic Release Inventory, other Large Quantity Generators of hazardous wastes, Treatment, Storage, and Disposal Facilities for hazardous substances, and Superfund sites are inequitably located in areas with lower income and minority residents. We examine patterns of environmental injustice in the context Phoenix, AZ, a sprawling southwestern Sunbelt city with a substantial postfordist industrial sector. Using 1996 EPA data for four types of technological hazards and 1995 Special Census data for Maricopa County (Phoenix), Arizona, we utilize GIS mapping to plot the spatial distributions of hazardous sites and analyze the demographic characteristics of census tracts with and without hazard points. A second methodology is used to produce a relative risk index for census tracts based on the number hazard zones – one mile radii circles around each facility – that overlay each tract. Both methodologies disclose clear patterns of social inequities in the distribution of technological hazards analyzed by the demographic composition of at-risk census tracts. The findings point to a consistent pattern of environmental injustice across a range of technological hazards in the Phoenix metropolitan region.

### Definition of Environmental Hazard



Source: Environmental Protection Agency

### Research Questions

1. What is the spatial pattern of environmental hazards in relation to the demographic composition of neighborhoods in the Phoenix metropolitan area?
2. Do patterns of environmental inequity exist in Phoenix? (I.e. Are technological hazards disproportionately located in poor and minority neighborhoods?)
3. Are these patterns consistent across the four types of hazards?
4. Does a compounding of risk occur whereby poor and minority tracts house a disproportionate share of multiple types of hazards?

### Data

Types of Facilities Included:

1. Toxic Release Inventory (TRI)
2. Large Quantity Generator
3. CERCLA (Superfund)
4. Transfer, Storage, and Disposal (TSD)

### Industry Releasing Dioxins

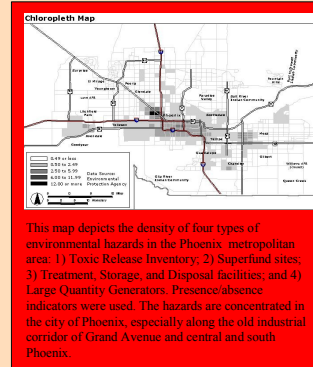


### Methods

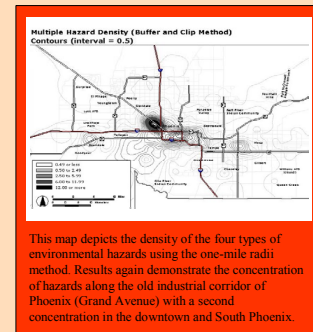
We developed a multi-hazard approach to assess the patterns of environmental inequity in the Phoenix metropolitan area (Maricopa County). Using geographic information systems (GIS), US EPA data, and 1995 Special Census data, we first produced a composite hazard map of selected point-source hazards. The demographic composition of urban census tracts with and without hazardous facilities is analyzed for the different types of hazardous facilities. Next we develop and test a new methodology that allows us to assess the cumulative risk burden to census tracts based on one mile radius circles around each hazard point. These multiple overlapping hazard zones are summed for each census tract and the score standardized by the total area of each tract. The resulting relative risk index provides a numerical score for each tract which is then analyzed with census tract demographic data.

Our primary interest is to determine if there is a **spatial concentration and compounding** of potential risks produced by the colligation of point-source hazards in areas with disadvantaged populations. We selected a range of hazard types to test whether a variety of facilities with diverse locational strategies and contamination histories nevertheless are found disproportionately in or near low income and minority (Latino/a and African American) neighborhoods.

### Treatment, Storage, and Disposal Facility



### Superfund Site



### General Site and Census Tract Characteristics

- 603 hazardous sites are located in 156 Census tracts
- 348 Census tracts are touched (bordered with one mile) by one or more sites
- Most of the 603 sites are CERCLIS and TRI facilities
- Of the 446 tracts only 118 are untouched by a hazard zone.

**Table 1**  
Mean Sociodemographic Characteristics for Census Tracts With and Without Hazardous Facilities (Presence/Absence Method)

| Variable           | Type of Hazard |           |           |            |
|--------------------|----------------|-----------|-----------|------------|
|                    | CERCLA         | LOG       | TRI       | Any Hazard |
| Hispanic (percent) |                |           |           |            |
| With               | 30.5           | 29.0      | 36.7      | 30.2       |
| Without            | 18.3           | 20.3      | 19.3      | 17.1       |
| t (sig.)           | 5.3 (.00)      | 3.1 (.00) | 5.1 (.00) | 6.1 (.00)  |
| Black (percent)    |                |           |           |            |
| With               | 4.9            | 5.3       | 5.9       | 4.7        |
| Without            | 3.3            | 3.5       | 3.4       | 3.2        |
| t (sig.)           | 2.2 (.03)      | 2.4 (.02) | 2.3 (.02) | 2.5 (.01)  |
| Native (percent)   |                |           |           |            |
| With               | 2.9            | 1.8       | 3.4       | 2.7        |
| Without            | 1.1            | 1.5       | 1.3       | 1.0        |
| t (sig.)           | 2.0 (.05)      | 8 (.45)   | 1.4 (.16) | 2.4 (.02)  |
| Income (\$)        |                |           |           |            |
| With               | 29,019         | 30,851    | 28,323    | 30,247     |
| Without            | 39,063         | 37,305    | 37,618    | 39,523     |
| t (sig.)           | 6.0 (.000)     | 2.7 (.01) | 2.7 (.01) | 5.3 (.00)  |

### Findings

1. Census tracts with at least one hazardous facility of any type are significantly poorer and home to more racial and ethnic minorities than are neighborhoods with no hazardous facility.
2. CERCLA sites are disproportionately located in poor and minority neighborhoods.
3. Tracts with at least one LOG or TRI have significantly higher Hispanic, black, and poor residents.

**Table 2**  
Mean Sociodemographic Characteristics for Census Tracts With Zero and Non-zero Hazard Density Indices (Hazard Index Method)

| Variable           | Type of Hazard |           |           |           |
|--------------------|----------------|-----------|-----------|-----------|
|                    | CERCLA         | LOG       | TRI       | CHDI*     |
| Hispanic (percent) |                |           |           |           |
| Non-zero           | 25.5           | 26.2      | 30.9      | 24.4      |
| Zero               | 14.0           | 16.9      | 14.9      | 13.0      |
| t (sig.)           | 6.3 (.00)      | 4.9 (.00) | 9.6 (.00) | 6.1 (.00) |
| Black (percent)    |                |           |           |           |
| Non-zero           | 4.1            | 4.7       | 5.6       | 4.2       |
| Zero               | 2.9            | 2.7       | 2.4       | 2.4       |
| t (sig.)           | 2.1 (.03)      | 3.7 (.00) | 5.4 (.00) | 3.8 (.00) |
| Native (percent)   |                |           |           |           |
| Non-zero           | 2.0            | 2.1       | 2.6       | 1.9       |
| Zero               | 0.7            | 1.0       | 0.8       | 0.7       |
| t (sig.)           | 3.4 (.01)      | 2.3 (.02) | 3.1 (.00) | 3.5 (.00) |
| Income (\$)        |                |           |           |           |
| Non-zero           | 32,649         | 32,347    | 30,544    | 33,628    |
| Zero               | 43,444         | 40,440    | 40,473    | 44,524    |
| t (sig.)           | 6.4 (.00)      | 4.9 (.00) | 6.0 (.00) | 5.2 (.00) |

\* Cumulative Hazard Density Index

### Findings

1. Analysis using the CHDI demonstrates even more significant relationships with sociodemographic variables than presence/absence analysis.
2. Census tracts with a CHDI above zero are home to significantly larger poor and minority populations than are tracts with a zero CHDI.
3. This relationship persists when CERCLA, LOG, and TRI sites are considered separately.