

Zoning and Land Use Assessment and Recommendations

Data Brief

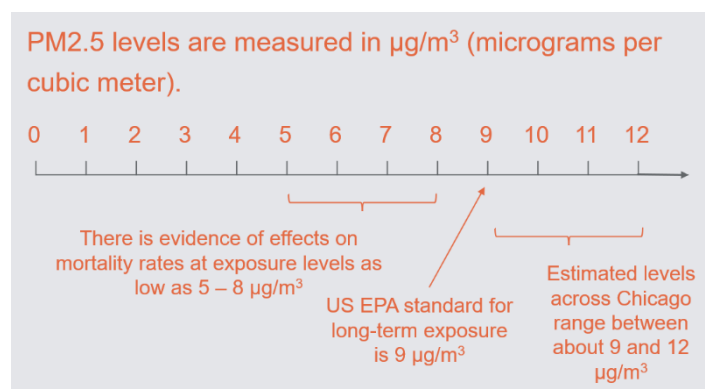
POLLUTION EXPOSURE

Pollution exposure is one of the seven outcomes prioritized for MPC's Zoning and Land Use Assessment. The outcome is defined as "*all neighborhoods feature low levels of pollution, taking into account cumulative impacts on overburdened communities.*" Pollution is the release of waste that contaminates air, land, or water. As part of the initial analysis, two measures of pollution exposure and one measure of pollution mitigation are evaluated:

- **Cumulative pollution exposure** combines several measures into a single pollution exposure index. This reflects the variety of ways people encounter pollution, from breathing it in from an industrial facility, to living near a waste site, to exposure from a busy roadway. The index includes air pollution (such as ozone, diesel, and particulate matter) as well as proximity to other waste (such as hazardous waste and superfund sites) and traffic. This data is from U.S. EPA through the EJScreen tool, collected between 2019 and 2023, depending on the pollution source.
- **Air pollution exposure (PM2.5)** uses satellite-based estimates of PM2.5 levels. PM2.5 is a specific type of particulate matter named for its small size (<2.5 micrometers). It can come from vehicles, industrial emissions, wildfire smoke, and other sources. It accounts for most health effects of air pollution in the U.S. This data comes from the University of Illinois's Healthy Regions and Policies Lab, collected between 2014 and 2018.
- **Tree coverage** is analyzed through a dataset compiled by the University of Vermont, released through the Chicago Region Trees Initiative. Trees can remove harmful substances from the air and lower temperatures (high temperatures can exacerbate pollution's harmful effects). This data is from 2017.

Why pollution exposure matters

Pollution exposure is a threat to human health and well-being. For air pollution in particular, when you breathe in PM2.5 particles, pollution can enter your body and cause health problems. More PM2.5 exposure causes increased rates of overall mortality, and there is evidence documenting impact on rates of COPD, heart disease, lung cancer, stroke, type II diabetes, neonatal mortality, and asthma (especially in children).¹ Estimates of PM2.5 exposure across the city used in this research show that there is no census tract in Chicago that meets the US EPA's public health standard (9 $\mu\text{g}/\text{m}^3$) for long-term PM2.5 exposure.



¹ [USA EPA Integrated Science Assessment \(ISA\) for Particulate Matter \(Final Report, December 2019\)](#)

What the research shows so far

Understand the outcome: Which places and people experience pollution exposure?

- **Latinx populations are exposed to more overall pollution and more air pollution.** Across the census tracts with the highest cumulative pollution levels, 37% of the population is Latinx, compared to about 30% of the total citywide population. Latinx populations are also exposed to more pollution in the air specifically: 50% of the population in the highest air pollution census tracts are Latinx. (“Highest” here means the top fifth of cumulative pollution or air pollution levels.)
 - **Pollution is concentrated where tree coverage is sparse.** The parts of the city with higher pollution levels—near downtown, along expressways, and along major industrial corridors—also tend to have low levels of tree coverage.
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Understand the zoning: Where is the land zoned for manufacturing?

- **Latinx and Black Chicagoans encounter more land zoned for manufacturing—and heavier types of manufacturing—in their neighborhoods.** Based on the top 30% most populous census tracts for each demographic², Latinx Chicagoans are most likely to see land zoned for manufacturing, with 29% of land in their neighborhoods zoned for manufacturing. Black Chicagoans are also more likely to see manufacturing, with 23% of land zoned for manufacturing. These shares are higher than the citywide share of land zoned for manufacturing (17%), as well as the share of land for Asian Chicagoans (9%) and white Chicagoans (6%) in their neighborhoods. The manufacturing in areas where most Black and Latinx Chicagoans live is also more likely to be zoned for heavy industry (M3 zoning) than the manufacturing encountered by white and Asian Chicagoans in their communities.
 - **Within areas zoned for manufacturing in their neighborhoods, Latinx and Black Chicagoans are more likely to encounter land uses categorized as transportation, utilities, and waste.** When considering the land uses for these areas zoned for manufacturing—what the land is being used for, rather than what it is zoned for—different demographics in the city are also seeing different distributions of activities. Based on the top 30% most populous census tracts for each demographic, Latinx and Black Chicagoans are much more likely than other groups to see land uses categorized as “Transportation & Communications” and “Utilities & Waste.”
 - **Whiter tracts are more likely to get rezoned to have less manufacturing.** Looking at changes in areas zoned manufacturing between 2003 – 2013 and between 2013 – 2023, the tracts that decreased in the share of manufacturing over those decades tended to have whiter populations.
 - **As manufacturing decreases, white population increases.** This pattern holds true across both decades of change. At the same time, as manufacturing decreases, Latinx population decreases.
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Understand the relationship: How does zoning affect pollution exposure?

- **Pollution and manufacturing zoning are correlated.** The census tracts that contain manufacturing have higher levels of cumulative pollution, on average.
- **The share of an area being zoned for manufacturing is a statistically significant predictor of higher levels of pollution exposure.** Other predictors of higher cumulative pollution include being closer to interstates, being farther from the lake, having a lower share of white population, and having fewer trees.

² These census tracts include between 75% and 85% of the citywide population for each demographic.

Questions you may have

- **How do other initiatives relate to this analysis?**

The Cumulative Impacts Assessment, led by the Chicago Departments of Public Health and the Environment along with community partners from the Environmental Equity Working Group, developed a Chicago Environmental Injustice Index showing communities that experience the greatest combined environmental, health, and social stressors. This work evaluating the cumulative impact of and vulnerability to pollution in Chicago's neighborhoods will inform decision-making and policy. In addition, the City's Voluntary Compliance Agreement with HUD requires it to advance strategies addressing Environmental Justice issues through department-level action plans. The Zoning Assessment acknowledges and supports this work by using some of the same data sources as the Cumulative Impacts Assessment. It also builds on this work by relating the evaluation of pollution exposure and its outcomes more directly to zoning.

- **What is a census tract, and why did you use it as your unit of analysis for the Zoning Assessment?**

A census tract is a geographic unit created by the U.S. Census. It typically contains between 1,200 and 8,000 people—there are about 800 census tracts in Chicago. It is the smallest unit at which most geographically granular data is available.

- **What data did you use to measure zoning, changes in zoning, and land uses?**

The focus of our analysis is on zoning that allows for manufacturing uses, because manufacturing uses are documented as sources of pollution. (The analysis confirms that manufacturing zoning is in fact correlated with pollution exposure.) "Land zoned for manufacturing" is defined as any type of M district or any Planned Manufacturing District, and "near manufacturing" as within a census tract that contains any amount of land zoned for manufacturing. Zoning maps were compiled and compared for three distinct points in time: 2003, 2013, and 2023. Since there was a major zoning code rewrite in 2004, this allows for better understanding of any changes that occurred as part of that rewrite. The team used 2020 data from CMAP's Land Use Inventory, which identifies more than 50 categories of land uses across the Chicago region.

- **What are the types of manufacturing districts?**

- M1 (Limited Manufacturing / Business Park District): Low-impact manufacturing, wholesaling, warehousing and distribution activities within enclosed buildings. Intended to promote high-quality new development and reuse of older industrial buildings.
- M2 (Light Industry District): Moderate-impact manufacturing, wholesaling, warehousing and distribution uses, including storage and work-related activities outside of enclosed buildings. Intended to accommodate more land-intensive industrial activities than the M1 district.
- M3 (Heavy Industry District): High-impact manufacturing and industrial uses, including extractive and waste-related uses.
- PMD (Planned Manufacturing District): Overlay areas that prohibit residential development and other specific uses. There are 15 total PMDs within larger areas designated as Industrial Corridors.

- **What are the limitations we should keep in mind about these findings?**

(1) The data we use to measure air pollution are model-based estimates, rather than measurements. The University of Illinois used estimates from EPA sensors in Cook County and 20 neighboring counties to ground truth the data. Since sensors are geographically limited, a satellite-based model was used to fill in the gaps. Using machine learning techniques that incorporated multiple air quality predictors (such as vegetation, land use, wind speed, temperature, precipitation, aerosol optical depth, point emissions, areal emissions, and more). These satellite-derived estimates allow for a more granular comparison of air pollution across different parts of the city.

(2) These findings show how pollution is correlated with manufacturing-zoned land, while also considering other features that differ across the City of Chicago and help explain the presence or absence of pollution (i.e. demographics or proximity to downtown). They do not, however, establish any causal relationships. Subsequent analyses will tell us whether zoning changes, over time, have caused any significant changes in pollution.