Project Overview

Southeast Chicago has a well-documented history of serving as home to businesses and industries that have generated air, soil, and water pollution, strong odors, and other adverse impacts that significantly compromise the quality of life of community residents. Through development of the Commercial Avenue Revitalization Plan (see Table 1, row 1 on page 23 for full source information)--a Great Cities Institute-led effort around the revitalization of South Chicago's Commercial Avenue--the need for community-informed coordination on environmental justice and public health issues emerged. Recognizing the opportune timing of the Department of Planning and Development (DPD) Industrial Corridor Modernization Process, the Calumet Connect Industrial Corridor Working Group was formed in early 2019.

This group quickly coalesced around the need for a data-informed exploration of industrial land use in Southeast Chicago, with the ultimate goal to influence the direction and priorities of DPD's approach to the future of the Calumet Industrial Corridor. The group determined early on that a mixed-methods approach would be most appropriate, as it was important to all stakeholders to not only understand quantitative data trends, but to also understand lived experiences and resident voice genuinely and robustly. The group designated the Metropolitan Planning Council (MPC) as the quantitative analysis lead for Phase I: exploration of land use and public health within the city of Chicago's Calumet Industrial Corridor and surrounding ½ mile (see map of study area boundary on page 36). While this work was underway, the qualitative analysis team (see member listing above) gathered data resulting in the production of the Community Needs Assessment, which can be found directly after the Phase I Appendix, on page 227. Due to time and resource constraints, the Metropolitan Planning Council outsourced Phase II of its quantitative analysis, which was focused on an exploration of Southeast Chicago's real estate/market incentive activity. This section can be found immediately after the Community Needs Assessment, on page 271. ***Please note that each of these three components--Phase I, Community Needs Assessment, Phase II--have their own distinct Table of Contents, which can be found, respectively, on pages 4, 229, and 271.***

In conducting these various analyses to set a baseline for understanding the scale and magnitude of industrial land use impacts, the working group and analysis teams intend to help shape 1) the direction of the advocacy and communications strategy the Working Group will develop with regards to future Calumet Industrial Corridor planning, and 2) DPD's future research, community engagement, and policy/process strategy for the Industrial Corridor Modernization Initiative.

Phase I

The following Table of Contents outlines the structure of the Phase I analysis, which consists of three sub-sections ('Industrial Occupation and Land Use', 'Permitting Violations', and 'Health Outcomes and Services'), a Conclusion, and an Appendix.

Each quantitative sub-section contains 1) a list of "guiding questions" that served as MPC's foundation for conducting analyses, 2) an outline of components that comprise the research findings, 3) a description of quantitative methods employed, 4) a table of data sources, 5) a summary of methodological and/or data limitations the research team encountered, 6) an explanation of research findings and finally, 7) a reflection on further research/areas of interest the working group feels would need to be conducted by other entities (like the Department of Planning and Development) in order to answer the previously described "guiding questions". These research "asks" have also been summarized in a separate document, available upon request.

In the Phase I Conclusion section, we present overall key findings, culminating from Working Group discussion and feedback. These high-level findings have served as the foundation for Calumet Connect/the industrial corridor working group's ongoing advocacy and communications strategy.

Table of Contents

List of Figures

List of Tables

Industrial Occupation and Land Use

Guiding Questions (Quantitative)

- What is the history of industrial occupation in the study area, and how has this history been reflected in the residential and worker population of the area?
- What characteristics define the study area's current residential population, and how has this population changed over time (by age, race/ethnicity, educational attainment, etc.?)
- What characteristics define the study area's current mix of industries and jobs, and how has this changed over time?
- What is the spatial distribution of past/current pollution-generating properties in the study area, and how does this correspond to the way the land in the study area is/has been used?
    - What is the spatial distribution of land use classes in the study area?
    - What land use classes occupy the highest shares of land acreage, and has this mix of classes changed over time?
- Of the portions of land that are in close proximity to past/current pollution-generating properties (i.e. within a ¼ mile), what is the total percentage of that land that is allocated for (and occupied by) residential activity?

Outline of Research Findings Components

- Figures and tables displaying study area boundary, industrial corridor boundary, and distribution of businesses/industry types within these areas
- Findings on industrial occupancy history
- Explanation of large-scale job and employment trends (job and sector change over time)
- Overview of resident demographic trends and occupancy changes
- Figures and findings on land use allocation (including shares of land by category)
- Narrative on proximity of Toxics Release Inventory (TRI) and Superfund sites to residential land

Methods

Study area boundary and current industrial occupancy

For the purpose of this report, our study area refers to the area of land within the City of Chicago's Calumet Industrial Corridor, as well as the surrounding half mile, which includes census tracts in Cook County, Illinois; see Figures 2 and 3 on pages 36 and 37, respectively, for

a visual of the study area boundary as well as the corridor boundary. The research team opted to map both of these overlaying the various Chicago community areas that fall within them. The next visual (Figure 4), displays the study area boundary along with the underlying streets and surrounding area topography.

In order to create these maps--which we viewed as a precursor to collecting information on the industrial occupation of the area--the research team began by downloading a shapefile of all 26 of the city of Chicago's industrial corridor boundaries from the City of Chicago Data Portal (see Table 1, row 4 for full source information), and uploaded the file to a clean ESRI ArcMap interface. It should be noted that we used ESRI ArcGIS version 10.7.1 (as held by MPC's organizational license) whenever spatial visualization/analysis tasks were required. From here, the research team downloaded a shapefile of the city's community areas (see Table 1, row 5 for source information). After reprojecting both of these shapefiles (converting to the 'NAD_1983_2011_StatePlane_Illinois_East_FIPS_1201_Ft_US' projected coordinate system), we downloaded ESRI's 'World Dark Gray Canvas Base' basemap, and exported Figure 6. From here, the research team deleted all corridor attributes from the industrial corridor shapefile except for the Calumet Industrial Corridor. Using the 'Clip' Analysis Tools function (located within the 'Analysis Tools' sub-toolbox), we clipped the community areas shapefile so that only community areas within the corridor would be displayed. After changing this shapefile symbology, we exported Figure 3.

After returning to use the original unclipped community areas shapefile, the research team then used ArcToolbox's 'Buffer' tool (located within the 'Analysis Tools' sub-toolbox) to create a half-mile buffer around the Calumet industrial corridor. The use of a half-mile designation as the surrounding buffer area was selected based on an industrial working group conversation geared around the appropriate area of observation for our analyses.

We again used the 'Clip' function to only display the community areas within the study area boundary itself, resulting in the production of Figure 2.

In Figures 8 to 13 on pages 42-52, we display the distribution of the various businesses (mostly industrial) currently occupying this land/the surrounding area. Given the dense clustering of these facilities in some portions of the study area, the research team opted to display the distribution of current businesses through a series of figures, rather than just one map. In order to create these maps, we turned to a list of current Southeast Chicago businesses compiled by the Chicago Center for Health and Environment (CACHET). The list, compiled by CACHET staff and provided to the research team, was compiled based upon 2018 data from Dun & Bradstreet, Inc, and contains information on 91 facilities located in the Southeast Chicago area (see Appendix Table 39 on page 212 for full record listing). It should be noted that while most of these facilities are located in Cook County, Illinois, a few are located just across the state border, in Lake County, Indiana.

Facility information on this list included company and parent company names, addresses, industry categorizations, and company descriptions. The CACHET team compiled industry categorizations based upon the US Census Bureau's North American Industry Classification System (NAICS), the federal government's standard for classifying business establishments for the purposes of releasing data regarding the health of the US economy.

After reformatting this list so as to enable mapping in ArcGIS, the research team reused the shapefile of the city of Chicago's industrial corridor boundaries. We then made preparations to map the 91 addresses using ArcMap's Geoprocessing Toolbar, and the ESRI ArcGIS Online 'World Geocoding Service'. We were able to successfully geocode all but 2 facilities on the list, both of which are located in Indiana: Arcelor Mittal (located at 3001 Dickey Rd, East Chicago, IN 46312), as well as Dover Chemical Corporation (located at 3000 Sheffield Ave, Hammond, IN 46327).

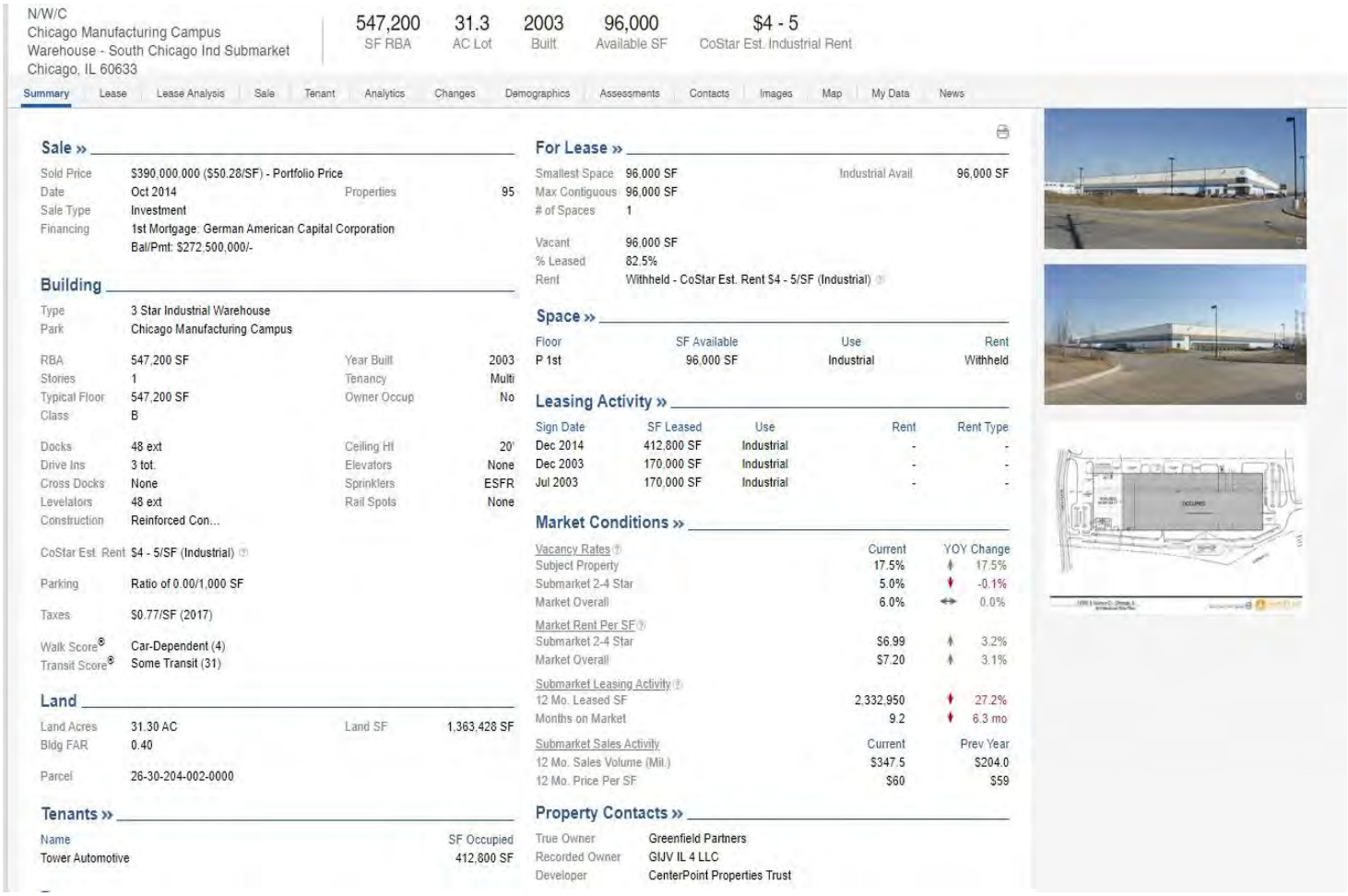
It should be noted that a total of 19 addresses from the CACHET list do not geographically fall within the study area boundaries. Despite this, the research team still opted to include these facilities (as well as the above 2 that we were unable to successfully geocode) in the various chemical release analyses that we conducted for the 'Permitting Violations' sub-section; see page 111 for the beginning of this section. We chose to include these facilities upon discovering that some companies on the CACHET list operate out of multiple buildings that house different operational arms of the same umbrella company. For instance, 'Kloeckner Metals Corporation' is listed on the CACHET list 3 separate times, with 2 of the adjoining addresses falling within the study area, and 1 falling outside. Likewise, 'Arcelor Mittal' is listed on the CACHET list twice, with an address inside and outside the study area boundary. The research team, therefore, felt comfortable assuming that the geographic reach (and, by extension, public health impact) of a facility extends beyond the study area boundaries. For more detail on these instances of duplicate facility listings, please visit the 'Data Limitations' sub-section, beginning on page 30, and refer to Table 3 for a listing of the 19 addresses.

After geocoding 89 of the 91 addresses on the CACHET list, we changed the symbology of the study area shapefile to reflect the various industries represented by each company. To see the corresponding industry type of each facility represented in Figures 8-13, consult the legend, as seen in Figure 7, on page 41, and consult Table 40 in the Appendix for a definition of each industry group or sub-sector category, as per the NAICS. Industry descriptions used to create this table came directly from the US Census Bureau's North American Industry Classification System 2017 Manual (see Table 1 row 10 for full source information). Any discrepancies between industry group or sub-sector names as listed on the CACHET list versus within the 2017 Manual are noted below Figure 7.

Industrial occupancy history

Following this initial visualization, the research team began exploring the occupancy history of each facility within/around the study area boundaries. In order to do so, we looked up tenant, owner, and occupancy duration information using CoStar, a proprietary real estate data aggregation platform for which MPC's research team has a paid organizational license. Licensed users can access property information--searchable by address--on asking rents, building sales prices, and other metrics across a number of different geographies and property types (i.e. retail, industrial, office, etc.). See Figure 1, below, for an example of a screenshot displaying some of the information available within a CoStar property record.

Figure 1. Screenshot of CoStar user interface and example property record; property address has been hidden for privacy



Based upon the primary property type in a geographic area, the CoStar Group divides up land into divisions called submarkets: areas defined by their market competitiveness with respect to their neighbors. As covered under MPC's license, all facilities that we investigated are part of the 'South Chicago' Industrial Submarket. See Table 1, row 11 for a map of these submarket boundaries, and Appendix Table 41 for a listing of industrial property sub-type definitions as created by CoStar.

The research team began our industrial occupation search by querying each geocoded address using CoStar's 'Property Search' feature. For every record we were able to find, the team noted the official tenant names and move-in dates associated with the searched address, and, in cases where tenant information was not available, noted the building sales date and owner name, both true and recorded owners. Of the 89 geocoded facilities, 36 of the associated addresses generated a CoStar address match. Of these 36, records, 27 contained tenant or owner information that matched the information provided on the CACHET generated list. For a listing of these 27 records and the accompanying occupancy information, see Table 10 on page 55 of the 'Research Findings' sub-section. Additionally, see Table 3 on page 32 of the 'Data Limitations' sub-section for a listing of the 9 CoStar records where we observed discrepancies around tenant and/or owner listing information as suggested by the CACHET list. Though CoStar is one of the highest quality proprietary real estate databases available to researchers, these discrepancies suggest that some of the information we came across may be outdated; this informed our recommendations in the 'Areas for Further Research' section (see page 108 for more detail).

Worker occupancy and industry change

To understand the current mix of workers and industry in the study area (as well as how this has changed over time), we downloaded data from OnTheMap's Area Profile feature. OnTheMap is an interactive application from the US Census Bureau's Longitudinal Employer-Household Dynamics program data (see Table 1, row 12 for full source information).The Longitudinal Employer-Household Dynamics (LEHD) program provides a comprehensive database of jobs data linked with spatial elements.

This dataset originated from the Local Employment Dynamics (LED) Partnership created in 1999, which created a system where states agree to share Unemployment Insurance earnings and data, and Quarterly Census of Employment and Wages (QCEW) data with the Census Bureau. The LEHD program then works to create statistics from these datasets and other administrative, census, and survey data on employment, earnings, job flows, geography, and industry for various demographic groups. The research team imported the study area boundary into OntheMap, and then proceeded to carry out an 'Area Profile' analysis.

After designating the study area as the 'Work' location, we selected 'All Jobs' and 'All Workers', and opted to compile data for the ten year period from 2007 to 2017. Visualizing this

downloaded data in Microsoft Excel resulted in the production of Figures 14 and 15 of the 'Research Findings' sub-section.

Residential occupancy and demographic change

Race/ethnic composition

The second set of demographic maps (Figures 18-27) display census tract level population proportions representing the four major ethnic and racial groups present in the study area. This data is presented, as is the case throughout this section, for 1990, and 2017--the most recent year for which American Community Survey (ACS) estimates for race/ethnic composition data was available. The data for the two time points allows for visualization of changes over time in the study areas.

Our first step in this visualization process was to download population count data from the IPUMS National Historic Geographic Information System (see Table 1, row 16 for full source information). While 'IPUMS' as an acronym once stood for 'Integrated Public Use Microdata Series', now the IPUMS nomenclature is a standard term used for all of NHGIS' project names, and is instead understood to be a census and survey data tool that integrates global data across time and space.

Once the research team found and retrieved data for the 1990 decennial Census, as well as the most recently available ACS 5-year estimates, we downloaded these count estimates as Comma Separated Value files; this most recent 5-year estimate data covers the period from 2013 to 2017. This racial and ethnic composition data is segmented into two overarching categories: races that had 'Non-Hispanic' origins, versus those that did not.

The research team noted that the count estimates for the populations that did not identify as having Hispanic origins were categorized as:

- White Non-Hispanic
- African American and Black Non-Hispanic
- Asian Non-Hispanic
- American Indian and Native Alaskan Non-Hispanic
- Native Hawaiian and Pacific Islander Non-Hispanic
- Other Non-Hispanic, and
- Two or More Races Non-Hispanic

Those that did identify as having Hispanic origins were categorized as:

- Hispanic - White
- Hispanic - African American and Black

- Hispanic - Asian
- Hispanic - American Indian and Native Alaskan
- Hispanic - Native Hawain and Pacific Islander
- Hispanic - Other, and
- Hispanic - Two or More Races

In both years, we noted extremely low values in both overarching categories for ‘American Indian and Native Alaskan’, ‘Native Hawaiian and Pacific Islander’, ‘Other’, and ‘Two or More Races’, to the point that we felt confident in excluding these values from our overall visualization process.

In order to consolidate the data and provide a cleaner table for use in ArcMap, the research team summed the demographic categories with Hispanic origin for both years into a generalized category of ‘Hispanic or Latino’, adding up the estimates for each Hispanic origin category per census tract.

We then performed a spatial join of this newly cleaned data with census tract shapefiles representing 1990 and 2010 boundaries; it should be noted that the 1990 tract file was for the entire United States (which we then clipped to Cook County boundaries), while the 2010 tract shapefile was for Cook County. Both shapefiles were created based upon 2008 TIGER/Line+ parameters.

In order to determine the proportion of the overall tract population that each racial/ethnic category comprised for each year, we first calculated the total area in square feet that each tract comprises overall. To do this, we created a new field in each shapefile’s attribute table, and used the ‘Calculate Geometry’ function within the attribute table Field options. From there, we performed a clip of each Cook County tract shapefile, so that only census tracts areas within the overall study area would be displayed. We again used the ‘Calculate Geometry’ function to determine the total area of each census tract that fell within the study area in both years. Following this, we created a new attribute field within the smaller clip area shapefiles called ‘Ratio’; this field value was based on the proportion of the earlier calculated values to one another. We then applied this ratio to each count category: ‘Total Population’, ‘Not Hispanic or Latino’, ‘White’, ‘Black’, ‘Asian’, and ‘Hispanic or Latino’. With these new count totals for each census tract portion in each year, we were able to calculate the final race/ethnic composition percentages within the overall shapefiles.

We used these newly edited shapefiles as the basis for creating the final color gradient maps by tract displaying the proportions of Hispanic, White (non-Hispanic), Black (non-Hispanic), and Asian (non-Hispanic) residents. We chose to display each gradient map with 4 ‘natural breaks’ (one of several display options in the ArcGIS ‘Symbology’ tab). Because we had already calculated the proportion of each tract’s population that was included in the study area boundary, we did not need to normalize our display values by the total population for each respective census tract.

Finally, we chose to display all population groups at once in the same map for each year, using the ‘dot density’ function within ArcGIS’ Symbology tab; this option is available under the ‘Quantities’ display legend.

Age

To understand the age distribution of residents in the study area currently and over time, the research team downloded age data from the IPUMS NHGIS, mentioned above. The 2017 downloaded data reported the age and gender composition of the population, while the 1990 data available reported age together with race and gender. The racial information was aggregated to only display gender by age.

The research team uploaded the age data into ArcMap, along with the study area boundary shapefile and Illinois census tracts. Then, we spatially joined the age data to the Illinois census tract shapefile and clipped this file to the study area boundary used in prior clip procedures. The resulting table was exported and uploaded into Microsoft Excel. From there, the “ratio” reflecting the proportion of each census tract inside the study area was calculated below in the Educational Attainment section, and joined according to each census tract ID (GISJOIN). Then, we multiplied each ‘gender by age’ category by these calculated ratios, and multiplied the result by 100 to yield final percentages.

From here, the research team created population pyramids to analyze the age and gender composition of the population, resulting in the figures on pages 74-75 of the Research Findings section, which display the proportion of females (on the left) and the proportion of males (on the right) by age groups. The shape of the pyramid reveals important information about the population’s composition, further explained in the narrative of that section.

Median Income

Similar to our analysis on race/ethnic composition, the team began by downloading median household income data from the IPUMS National Historic Geographic Information System (see Table 1, row 16 for full source information). Specifically, we downloaded IPUMS tract-level extracts for ‘Median Household Income in 1989’, as well as ‘Median Household Income in the Past 12 Months (in Inflation-Adjusted Dollars)’, derived from the American Community Survey; decennial data from the 1990 Census was not available for median household income, so we used the 1989 extract as a proxy, noting this as a data limitation.

Once the research team found and retrieved data for both years, we adjusted the 1989 numbers to 2017 dollars, to address changes in inflation over time. Using the previously mentioned census tract shapefiles, we performed spatial joins in ArcMap of the 1989 and 2017 data

extracts, clipping both shapefiles so that only tracts within the study area boundary would be displayed. Because median household income is a trait independent of population proportions, we did not need to perform land area calculations to adjust for the proportion of people within the study area boundary (versus the larger census tracts), as we had to do for other analyses. Under the ArcMap 'Symbology' tab, we chose to display information through color gradient maps using the natural breaks display feature, which resulted in the creation of Figures 30 and 31.

Educational Attainment

The research team examined educational attainment at the census tract level for 1990 and 2017. As was the case for the prior analyses, data was downloaded from the IPUMS NHGIS, where it was then uploaded along with a shapefile of all Illinois census tracts and the study area boundary shapefile into ArcMap. The research team then made preparations to calculate the area of each Illinois census tract. To do this, we created a new field 'Area_Total' in the shapefile attribute table, and used the 'Calculate Geometry' function. Then we spatially joined the educational attainment data spreadsheet to the Illinois census tract shapefile and clipped this file to the study area boundary shapefile. This way, only the tracts of the study area would be part of our visualization.

In the resulting table, the research team calculated the new area of the tracts contained within the study area. To do this, we created a new field 'Area_Clip' and used the 'Calculate Geometry' function. Then, we created a new field 'Ratio', where we calculated the proportion of each census tract inside the study area, using the formula 'Ratio=Area_Clip/Area_Total'. Then, the research team summed up selected columns of the educational attainment data in order to create the following educational attainment categories: Population 25+ with less than a high school degree, Population 25+ that have completed a high school degree, Population 25+ with some college or an associate's degree, Population 25+ with a bachelor's degree or higher. From here, we multiplied each category with the ratio calculated above and multiplied this by 100 to yield final percentages.

We changed the symbology to visualize each educational attainment category as the primary variable on a color gradient map. The resulting color gradient maps (Figures 32-39) can be found in the Research Findings section, on pages 81-88.

<u>Spatial distribution of pollution-generating properties</u>

In order to begin understanding the current and past spatial distribution of pollution-generating properties within the study area, the team gathered Environmental Protection Agency (EPA) data for 1990, 2016, and 2017 from TOXMAP (2004 version): a geographic information system (GIS) managed by The National Library of Medicine (see Table 1, row 17 for full source

information). It should be noted that TOXMAP was updated to a new version over the course of this project; see Table 1, row 18 for more information on this change.

Grounded in data from EPA's Superfund Enterprise Management System (SEMS) and Toxics Release Inventory (TRI), TOXMAP's online maps help users visualize the distribution of environmentally contaminated Superfund and hazardous waste production sites across the United States and Canada. Below, we offer brief descriptions of Superfund, SEMS and the TRI, the latter for which we expand upon in the 'Permitting Violations' methods sub-section. It should be noted that this more robust description of the Toxics Release Inventory is also accompanied by an explanation of other relevant environmental regulations and data platforms, like the Toxic Substances Control Act (TSCA), and ChemView.

> Established in 1980 by congressional mandate, the Superfund program has been responsible for 'managing the cleanup of the nation's worst hazardous waste sites and responding to local and nationally significant environmental emergencies'. Formerly called CERCLIS (Comprehensive Environmental Response, Compensation and Liability Information System) before being retired in November 2013, SEMS is the name of the EPA's hub for information regarding the current status of hazardous waste cleanup efforts, reported quantities of treated material at National Priorities List (NPL) sites, and future site maintenance information. Most Superfund sites are those that present fairly complex levels of environmental degradation, and therefore, require multi-year cleanup efforts, either conducted by a potentially responsible party (PRP), or the federal government (with state/tribal government involvement). Information on site location and cleanup status can be obtained by consulting the National Priorities List, the agency's official list of waste sites throughout the US that are eligible for long-term federal cleanup funds. See Table 1, row 19 for a link to the NPL website, and row 20 for the EPA's community guide to understanding the Superfund program.
>
> The EPA established the Toxics Release Inventory (TRI) Program as a response to Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA). According to the EPA, the program is "required to provide information to the public on releases and other waste management of EPCRA Section 313 chemicals in their communities and to provide EPA with release and other waste management information to assist the Agency in determining the need for future regulations". Under this reporting structure, industrial facilities that exceed set thresholds in their use, manufacturing, or processing of toxic chemicals must report this information to the agency annually. Under Section 313, the program covers chemicals "that may cause chronic health and environmental effects, as well as, in some cases, acute effects. Reporting requirements pertain to 1) companies employing 10 or more full-time employees, and 2) industries categorized under a specific range of NAICS codes. See Table 1, row 21 for a

link to the most recently updated list of applicable NAICS industry codes, and row 22 for the 2017 reporting year list of chemicals that submissions were required for.

Under EPCRA, a facility is obligated to report 'Form R' or 'Form A' information for *each chemical* that meets thresholds set by EPA, which are based on the total weight of the compound. It is important to note that even if a facility has not released toxic chemicals into the environment on-site or off-site, *it must still submit a TRI reporting form if it meets the employee and chemical activity use thresholds, and falls into the covered NAICS code*. All facility submissions for on-site and off-site releases are aggregated by the EPA within TRI Explorer (see Table 1, row 23 for full source information), and then on-site release information is pulled into TOXMAP for visualization.

TRI Explorer is the EPA's publicly available database, allowing users to search for industrial facility data records by: year (1988-2017), geographic location (by either ZIP code, state and county, or EPA region), chemical (by either a core chemical list, chemical group list, or a specific chemical), and industry (by NAICS code).

The research team began its site exploration process by performing a search by ZIP code within TOXMAP, using the 4 ZIP codes intersecting the study area: 60617, 60633, 60628, and 60827. It should be noted that the research team prioritized our search using these 4 ZIP codes because of their location in the study area proper; other facilities on the CACHET list located outside of the study area belong to the surrounding Illinois ZIP codes (60409, 60419) and Indiana ZIP codes (46394, 46312, 46327, and 46320).

Because TOXMAP had not yet been updated with 2017 reporting year data at the time of our initial investigation into pollution-generating sites, we used a combination of TOXMAP data as well as on-site release data reports directly from TRI Explorer. Within TRI Explorer, we also performed a search by the same 4 ZIP codes, and then verified the accuracy of all facility and address information in 1) CoStar, 2) ECHO, the EPA's Enforcement and Compliance History Online (ECHO) database, and 3) the EPA's Facility Registry Service (FRS). See Table 1, rows 24 and 25 for full source information for ECHO and the Facility Registry Service. For a summary description of address or facility name inconsistencies between the above tools, see the 'Data Limitations' sub-section on pages 30-33.

After downloading all records for 1990, 2016, and 2017, the research team compiled address information in Microsoft Excel for all TRI facilities and Superfund sites that matched CACHET List addresses, and were located within the study area. Using ArcMap's 'Geoprocessing' toolbox, we then mapped the location of each facility which, when combined with land use data (see methods description below), resulted in the production of Figures 52 and 53 on pages 106-107. It should be noted that the research team used the same geocoding process as

previously described in this sub-section. Additionally, we used the same study area shapefile that we had created for initial visualization of facilities, as described on page 12.

Land allocation/proximity of pollution-generating properties to residential land

After mapping the spatial distribution of environmentally contaminated sites, we aimed to understand the proximity of each of these facilities to residentially allocated parcels and occupants, meaning we first had to map the land allocation classes within the study area as a whole. Because we also wanted to see whether the proximity of each facility to residentially allocated land had changed significantly over time, we needed to ensure that we created land allocation maps using both historic and current data.

For this reason, the research team turned to the land use inventory curated by the Chicago Metropolitan Agency for Planning (CMAP), the governmental metropolitan planning organization (MPO) serving the 7-county Chicagoland region: Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will counties. From CMAP's official database, we downloaded a shapefile of regional land cover and zoning classes reflecting 2013 boundaries (see Table 1, row 28 for full source information), which is the most recent year for which this data was available. Given that CMAP creates regional shapefiles, this dataset was far larger than what was necessary for our analysis. After uploading this shapefile as well as the general study area shapefile to a clean ArcMap interface, we performed a clip so that the land use boundaries reflected our study area only. The research team then custom-created symbology for various land use classifications so that it would be visually consistent with the viewer's expectations; green open space areas are displayed as varying shades of green, while black is used for vacant land parcels, and blue for areas of water. We also created a land use map reflecting 1990 data--using the same series of steps, beginning with CMAP's 1990 land use shapefile.

This final visuals can be seen on pages 90-101; note that Figures 42, 43, 44, and 45 as well as Figures 48, 49, 50, and 51 are the zoomed-in cross-sections of Figure 41 and 47, respectively, meant to allow viewers to see a more detailed view of land use within the study area over time.

Once these maps were made, the research team changed the symbology in ArcMap to only display parcels within residential land classes (i.e. 'Single Family Detached', 'Single Family Attached', 'Multi-Family Residential' and 'Vacant Residential'). After uploading the previously created shapefiles of geocoded TRI/Superfund facility sites from 1990 and 2016/2017 to the same ArcMap interface, we gave each facility its own ¼ mile buffer, and performed a clip so that the land use information would only display within those ¼ mile areas. This ultimately led to the production of Figures 52 and 53, the Toxics Release Inventory (TRI) and Superfund site maps shown in the 'Research Findings' sub-section on page 104.

Data Sources

Table 1. Table of data sources used in section analysis

Table Row	Data/Source	Description	Link	Year(s) Available/ Covered	Date Retrieved
1	South Chicago's Commercial Avenue Revitalization Plan	Culmination of a 12-month community-based planning process with South Chicago stakeholders; resulting plan outlines a vision, design, and actions for the revitalization of Commercial Avenue	https://greatcities.uic.edu/wp-content/uploads/2015/10/UIC-GCI-Commercial-Avenue-Revitalization-Plan-LowRes.pdf	Released July 2016	May 2019
2	Calumet River Communities Planning Framework - South Chicago, East Side, and South Deering: A Guide for Equitable Development	Community-informed framework for future planning efforts in the Southeast Chicago area; serves as part of larger strategy to address environmental and economic issues in Calumet River communities	https://greatcities.uic.edu/wp-content/uploads/2019/05/CalumetRiverCommunitiesPlan_Web.pdf	Released February 2019	May 2019
3	Southeast Chicago Business List; Chicago Center for Health and Environment	List of businesses within the Calumet Industrial Corridor, and along the Calumet River	N/A; see Appendix Table 39, on page 212	Compiled June 2018	April 2019

4	Shapefile of city of Chicago industrial corridors; Chicago Data Portal	Spatial data file of Chicago industrial corridor boundaries, as provided by the City of Chicago	https://data.cityofchicago.org/Community-Economic-Development/Boundaries-Industrial-Corridors/vdsr-p25b	Created December 2010; updated August 2011	April 2019
5	Shapefile of city of Chicago community areas; Chicago Data Portal	Spatial data file of Chicago community areas, as provided by the City of Chicago	https://data.cityofchicago.org/Facilities-Geographic-Boundaries/Boundaries-Community-Areas-current-/cauq-8yn6	Created January 2013; updated December 2018	April 2019
6	Shapefile of state of Illinois census tracts; US Department of Commerce	TIGER/Line shapefile of Illinois census tracts, extracted from the US Census Bureau's Master Address File	https://catalog.data.gov/dataset/tiger-line-shapefile-2013-state-illinois-current-census-tract-state-based	Created September 2013; updated November 2013	May 2019
7	Shapefile of state of Indiana census tracts; US Department of Commerce	TIGER/Line shapefile of Indiana census tracts, extracted from the US Census Bureau's Master Address File	https://catalog.data.gov/dataset/tiger-line-shapefile-2015-state-indiana-current-census-tract-state-based-shapefile524fe	Created April 2016; updated November 2016	May 2019
8	Shapefile of city of Chicago streets; Chicago Data Portal	Spatial data file of Chicago street center lines	https://data.cityofchicago.org/Transportation/Street-Center-Lines/6imu-meau	Created July 2013; updated July 2017	April 2019
9	Tenant, owner, and occupancy duration data; CoStar Group	Available tenant data: name, industry, occupancy area (in square footage and floors), move-in date Available owner data: recorded owner, true owner, seller name, sales	Available by license only	All current data in CoStar is verified daily; availability of data varies by property	May 2019

		date, sales price			
10	North American Industry Classification System (NAICS) 2017 Manual; US Census Bureau	Explanation of the US Census Bureau's 2017 standards for classifying business establishments for statistical purposes	https://www.census.gov/eos/www/naics/2017NAICS/2017_NAICS_Manual.pdf	Last updated/revised August 8, 2016	June 2019
11	South Chicago Industrial Submarket Map; CoStar Group	Map displaying geographic boundary of CoStar's 'South Chicago' Industrial submarket	http://gateway.costar.com/imageviewer/GetImage.aspx?webpdf=682F09D44AD6DCF7765982C497B3D364A55A8AD3E1D80C1CBDB8380F850D9DF4	Created January 2014	May 2019
12	OntheMap; Longitudinal Employer-Household Dynamics Program (United States Census Bureau)	Program that combines federal, state, and Census Bureau data to show statistics about longitudinally linked employment data.	https://lehd.ces.census.gov/#	2002 - 2017 available; 2017 used	October 2019
13	United States Census Bureau; Maps; TIGER/Line Shapefiles	Shapefile of all legal boundaries and names of Illinois Census Tracts as of January 1, 2017	https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.2017.html	Covers years from 2007 to Present; 2017 Used	November 2019
14	American Fact Finder; 2013-2017 American Community Survey 5-Year Estimates	Data Portal from the U.S. Census Bureau providing American Community Survey data for the 5 years from 2013 - 2017	https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml	Covers 2000 - Present; 2013-2017 5 Year Estimate Used	November 2019

15	University of California Berkeley; UA Census Tracts, 1990	Shapefile of all legal boundaries and names of Illinois Census Tracts as of January 1, 1990	https://geodata.lib.berkeley.edu/catalog/TG00ILTRT	Data from January 1, 1990	December 2019
16	National Historical Geographic Information System (NHGIS)	Data portal from the NHGIS providing summarized and detailed tables and time series for population demographics regarding US population counts, race, age, median income, and educational attainment	https://www.nhgis.org/	1990, 2017	December 2019, September 2020
17	TOXMAP database; US National Library of Medicine/Environmental Protection Agency	Data portal from the U.S. National Library of Medicine. Shows TRI facilities, Superfund Sites, and other toxic release spatial information across the US and Canada.	https://toxmap.nlm.nih.gov/toxmap/faq/2009/08/what-is-toxmap.html	Data available for 1988-2016	May 2019
18	Why is This Federal Pollution Tracker Shutting Down?; Mother Jones	Overview of the National Library of Medicine's decision to retire TOXMAP	https://www.motherjones.com/environment/2019/12/why-is-this-federal-pollution-tracker-shutting-down/	December 2019	December 2019
19	National Priorities List; US Environmental Protection Agency	Website listing Superfund site information, including: site name, Site ID,	https://www.epa.gov/superfund/national-priorities-list-npl-sites-state#IL	Data available for 1983-2019	August 2019

		listing date, and site score.			
20	This is Superfund: A Community Guide to EPA's Superfund Program; US Environmental Protection Agency	Official community guide to understanding the Superfund program, including information on discovering Superfund sites, responsibility for site cleanup, and site cleanup maintenance	https://semspub.epa.gov/work/HQ/175197.pdf	Created August 2011	June 2019
21	Toxics Release Inventory (TRI) Program Table 1: NAICS Codes List; US Environmental Protection Agency	2017 reporting year requirements for industry categories	https://ofmpub.epa.gov/apex/guideme_ext/f?p=guideme:rfi::::rfi:table_i	For reporting year 2017	August 2019
22	Toxics Release Inventory (TRI) Program Chemical List for Reporting Year 2017; US Environmental Protection Agency	2017 reporting year requirements for chemicals	https://www.epa.gov/sites/production/files/2018-04/documents/ry_2017_tri_chemical_list_4_24_2018.pdf	For reporting year 2017	August 2019
23	TRI Explorer database; US Environmental Protection Agency	Annually updated database containing TRI-reported information, searchable by: geography, industry/NAICS code, chemical name, and/or facility name	https://iaspub.epa.gov/triexplorer/tri_release.facility	Data available for 1988-2017 reporting years; map includes facility information for 2016 and 2017 reporting years	May 2019

24	ECHO (Enforcement and Compliance History Online) database; US Environmental Protection Agency	Database containing enforcement and compliance information for EPA-regulated facilities across the US; information typically covers 4 major environmental statute regulations	https://echo.epa.gov/resources/general-info/learn-more-about-echo	Formal enforcement action data: all years EPA has on record; Facility inspection data: past 5 years only; Facility compliance data: past 3 years only	June 2019
25	Facility Registry Service; US Environmental Protection Agency	Query database system that allows users to search for regulated facility information by name, Registry ID, industry (by SIC or NAIC code), or program category (i.e. groundwater, solid waste, drinking water, etc.)	https://www.epa.gov/frs	varies	June 2019
26	Land Use Inventory; Chicago Metropolitan Agency for Planning (CMAP)	Land Use codes for all of the CMAP region.	https://datahub.cmap.illinois.gov/group/land-use-inventories	Data available for 1990, 2001, 2005, 2010, and 2013. Map displaying data from 1990 and 2013	May 2019

26	1990 Land Use Inventory: Metadata; Chicago Metropolitan Agency for Planning (CMAP)	Data dictionary containing descriptions of 1990 land use categories.	https://datahub.cmap.illinois.gov/dataset/efbfdc0b-ebb0-4215-9a4f-fc0258c0bb8c/resource/da0e9870-443d-49ff-b9b6-ac2f464e1214/download/lu90v4meta.htm	Created June 1995	November 2019
27	2013 Land Use Inventory: Classification Scheme; Chicago Metropolitan Agency for Planning (CMAP)	Document containing descriptions of 2013 land use categories.	https://datahub.cmap.illinois.gov/dataset/0e0a83c9-e089-4fea-89ab-389adaf7888a/resource/1a59097a-56c0-419c-a223-e9bf0da99d21/download/Classifications2013.pdf	Created April 2015	November 2019
28	Shapefiles of Land Use Cover in CMAP Region: 7 county region of Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will counties	Spatial data file from CMAP data portal	https://datahub.cmap.illinois.gov/group/land-use-inventories	Data available for 1990, 2001, 2005, 2010, and 2013. Map displaying data from 2013	May 2019
29	Detailed Facility Report for 'Pullman Innovations'; US Environmental Protection Agency's ECHO database	ECHO's 'Detailed Facility Report' for 'Pullman Innovations' record search	https://echo.epa.gov/detailed-facility-report?fid=110000434343	Varies; most ECHO data available for 2014 and on	June 2019
30	FRS Facility Query Results; US Environmental Protection Agency	Facility Registry Service's query results for search of 'Agri-Fine Corp'	http://bit.ly/32V2Zy4	N/A	July 2019

31	TOXMAP FAQ; US Environmental Protection Agency	EPA 'Frequently Asked Questions' page on TOXMAP, covering topics such as underlying data sources and site location accuracy	https://toxmap.nlm.nih.gov/toxmap/faq/	Last updated July 2018	August 2019

Data Limitations

Study area boundary and current industrial occupancy/industrial occupancy history

As alluded to in the previous sub-section, we noted several instances in which facilities on CACHET's Southeast Chicago Business List were listed more than once by name. In other cases, we noted that some companies shared the same address with facilities of a different name. In the first case, we suspected this was because many facilities exist as multi-operational entities that house each of their operations (i.e. manufacturing, distribution, etc.) out of different buildings. We observed 7 total instances of duplicate names on the CACHET list, and used CoStar--searching by facility name *and* address-- with some success, to verify the existence of multi-operational sites. For this reason--as described earlier in the 'Methods' sub-section on page 21--we also used various EPA tools (ECHO, TOXMAP, and the Facility Registry Service) for verification.

As an example, 'Kloeckner Metals Corporation' appears on the CACHET list 3 separate times, all listed at different addresses: 141st St., S Metron Dr, and Torrence Ave. In CoStar, when a name search for 'Kloeckner'' was done, 3 clickable entries were pulled up, yet only 2 of them (the ones at S Metron and 141st St) matched the exact addresses listed on the CACHET list. When we tried to obtain tenant information at each of these two addresses, we noted that 'Kloeckner' was not listed anywhere. Further, when we entered the Torrence Ave address into CoStar, though we found a record with a matching address, it did not contain available tenant information.

Similarly, we observed 16 instances of duplicate addresses (i.e. 32 companies sharing 16 addresses). Through CoStar, we were able to verify that many of these facilities are co-tenants in large warehouses, or are based in separate buildings of large industrial parks and shipping yards. While we were able to clarify information for 3 instances (see Table 2, below), this still left 5 others in which we were unable to confidently determine the exact unit location of facility occupants.

Table 2. Companies with duplicate address information, and corresponding CoStar listing information, as available

CACHET Listing	Duplicate Address	CoStar Information
Ford Motor Company	Ford Chicago Assembly Plant	Only tenant listed as Ford Motor Company; occupant since July 2013
Kloeckner Metals Corporation	Great Lakes Reloading	Great Lakes Reloading listed as a tenant of building R since May 2015
One Shot LLC	PPG Industries	N/A
Norfolk Southern Calumet Rail Yard	Canadian Pacific Railway	N/A
Tower Automotive	ZF Chassis Systems	Tower Automotive listed as a tenant of building 4 since June 2004
Calumet Tank & Equipment Co Inc	Calumet Container Corp	N/A
Reserve Ftl, LLC	Regency Technologies, Ltd.; Napuck Salvage of Waupaca; South Shore Recycling / Reserve management group	N/A
National Material L.P.	Emesco Marine Services Corp	N/A

In both cases (duplicate addresses or duplicate name listings), we encountered information in CoStar that directly contradicted information from the Southeast Chicago Business list. As previously mentioned in the ‘Methods’ sub-section, we noted 36 instances in which one of our 89 geocoded facilities generated an address match record in CoStar. However, of these 36, 9 records displayed tenant or owner information that did not match the information listed on the Southeast list. As an example, while we know from Table 2, above, that ‘ZF Chassis Systems Chicago LLC’ and ‘Tower Automotive’ supposedly share the same address, when we searched CoStar for the associated address (3400 E 126th Pl, Chicago, IL 60633), the *only* listed tenant is ‘Tower Automotive’. Table 3, below, displays all of the discrepancies we encountered.

Table 3. Discrepancies between Southeast list and CoStar records for tenants/owners. Note, the 'Study Area Label' refers to each facility's label number as shown in Figures 8-13 on pages 42-52.

Study Area Label	Southeast Business Listing	Address	CoStar Tenant/Owner Listing
4	Arcelor Mittal	3133 E 106th St, Chicago, IL 60633	Tenant: Bayou Steel Group
24	Dri-Rite	11600 S Avenue O, Chicago, IL 60617	Owner: NorthPoint Development
32	Great Lakes Reloading	13535 S Torrence Ave, Chicago, IL 60633	Tenant: CRRC Sifang America
35	Kinder Morgan Liquids Terminals LLC	12200 S Stony Island Ave, Chicago, IL 60633	Tenant: Stolthaven Chicago Inc
37	Kloeckner Metals Corporation	13535 S Torrence Ave #C, Chicago, IL 60633	Tenant: CRRC Sifang America
38	Kloeckner Metals Corporation	141 141st St, Hammond, IN 46327	Tenant: Service Steel Warehouse Co LP/Capital Industrial Coatings
48	Nidera	11700 S Torrence Ave, Chicago, IL 60617	Tenant: Chicago & Illinois River Marketing LLC
52	North America Stevedoring Company, LLC (Nasco)	12700 S Butler Dr, Chicago, IL 60633	Tenant: Abatement Materials Inc
88	ZF Chassis Systems Chicago LLC	3400 E 126th Pl, Chicago, IL 60633	Tenant: Tower Automotive

Lastly, the research team noted the accuracy limitations of the geocoding process, whether within ESRI ArcMap or other spatial visualization software. The geocoding process assigns latitude and longitude coordinates to addresses based on spatial reference data. This spatial reference data aggregates the locations of physical infrastructure in the location of interest. In our case, this dataset contained the locations of Chicago area street segments. Though we

tested quite a few addresses for location accuracy comparing between ArcMap as well as Google Maps, we acknowledge that certain addresses in Figures 8-13 may appear slightly off from their real locations due to minor errors in the spatial reference data.

Spatial distribution of pollution-generating properties

Though the EPA's Toxics Release Inventory (TRI) program is one of the most comprehensive publicly available sources of chemical release information, the data as reported in TOXMAP and TRI Explorer present 1) consistency concerns, 2) scope limitations, and 3) accuracy uncertainties.

Regarding the first, we found a number of examples using CoStar, TOXMAP, ECHO, and the EPA Facility Registry Service (FRS) that appeared to illustrate that facilities within the study area may have moved addresses, changed their names, or reported inconsistent name or address information over the years to the various record-keeping bodies within the EPA. As an example, we found that some facilities as reported on the Southeast Chicago Business list did actually have EPA enforcement/compliance records, but these records were listed under their parent company name, rather than the subsidiary company name. Below, we detail such a case for the facility located at '2701 E. 100th St, Chicago, IL 60617'.

> On the CACHET list, the company matching this address is listed as 'Pullman Innovations', with Agri-Fine Corp listed as the parent company. An **address** search in CoStar, however, led to some confusion. In CoStar, the true owner of the building matching this address is listed as 'Pullman Sugar', and the sale record shows that the property was bought by Pullman Sugar from Agri-Fine Inc in April 2016.
>
> While a CoStar **name** search for 'Pullman Innovations' yielded no records, a **name** search for 'Pullman Sugar' yielded a record for a property located at 700 E 107th St. At this property, one of the 4 listed tenants is 'Pullman Sugar', which, according to the listed record, has been a tenant since June 2016.
>
> When we conducted an **address** search for '2701 E. 100th St., Chicago, IL 60617' in the TOXMAP search interface, no record results were displayed. Similarly, no results were generated when we performed a **name** search for 'Pullman Innovations'. TOXMAP did display a record, however, for a facility matching this address when we performed a **name** search for 'Agri-Fine Corp'.
>
> All of this is further complicated when we consulted ECHO and FRS. In ECHO, a **name** search for 'Pullman Sugar' yields no records, but a **name** search for 'Pullman Innovations' yields a record with 'Agri-Fine Corp' listed as the facility name, and an address match for '2701 E. 100th St.' (see Table 1, row 29 for a detailed facility report). In FRS, an **address** search yielded no matching records, while, similarly, a **name** search

for both ‘Pullman Sugar’ and ‘Pullman Innovations’ yielded no records. However, a **name** search for ‘Agri-Fine Corp’ yielded 1 record with an address match for ‘2701 E. 100th St.’ (see Table 1, row 30 for the FRS query record).

In short, because of the inconsistencies in the listing of the parent company and/or company subsidiary, and addresses between different data tools, the research team had to exercise caution in the culling of TRI data. In total, we found at least 22 examples of inconsistent record-keeping or reporting information between CoStar, TRI Explorer, ECHO, and the FRS. It should be noted that while the research team also wanted to be able to draw comparisons between these 4 data platforms and TOXMAP, as already mentioned, the EPA discontinued use of TOXMAP in late 2019.

Regarding point 2--scope limitations--it is important to keep in mind that current reporting requirements for the TRI/Superfund Program only apply to industrial sources, and exclude other entities that may contribute toxic chemical releases.

Finally, according to TOXMAP’s Frequently Asked Questions page (see Table 1, row 31 for full source information), by federal law, facilities that meet previously mentioned requirements are asked to use “best available data” in their submissions, however, the actual reported data “can be based on both actual measurements and on estimates”. Therefore, it is quite possible that federal facilities that report data to the Toxics Release Inventory should appear on TOXMAP, yet do not because of inaccuracies in their reported submissions.

Land allocation/proximity of pollution-generating properties to residential land

It should be noted that a rigorous comparison between the 1990 and 2013 land use maps (Figures 41-45 and 47-51 on pages 90-94 and 97-101, respectively), is not possible, given differences in methodology and definition of the land use categories as created by CMAP. As per the Land Use Inventory, land use polygons of the 2013 inventory are based on county parcel boundaries, while earlier inventories, such as the 1990 one, are polygon-based. Land uses in polygon-based inventories rely on the manual drafting of land use boundaries that would extend to road centerlines, ignoring rights-of-way (ROWs) except for very large roadways. Using a parcel-base, land uses no longer extend beyond property boundaries. Because streets are assumed within the 1990 categories, it is not possible to make comparisons in the case of land uses where streets might expect to make up a major portion of the category. Such categories include residential, commercial and industrial uses.

Switching to a “parcel-base” inventory allows for greater accuracy, and as a result, some land use categories from the 1990 inventory were retired or modified. For example: the category ‘4110 - Vacant Forest or Grassland’ is no longer in use because it rarely conforms to property boundaries. Also, Road ROW and many water bodies are not represented by parcels; to fill in

these gaps, CMAP created a series of “non-parcel” polygons representing these un-parceled areas. In the 2013 inventory, categories such as ‘Non Parcel Open Space’, ‘Non Parcel Water’, and ‘Non Parcel Other’ are now included.

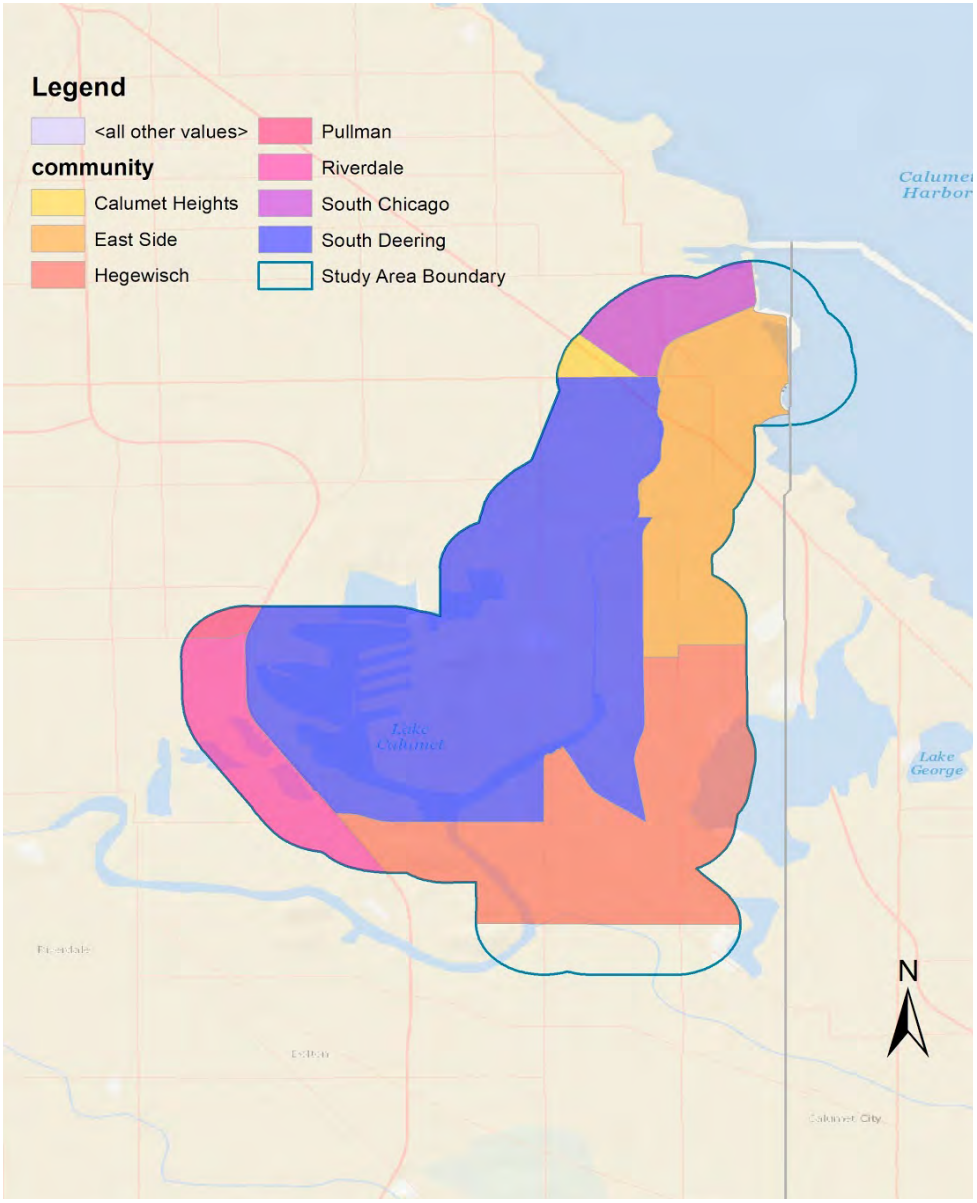
Research Findings

The research team began its initial exploration of land use within the study area by mapping both the area boundary, as well as the industrial facilities within and in close proximity to this boundary. Immediately below, see Figures 2, and 3, depicting the study area (Calumet Industrial Corridor and surrounding half mile), as well as the corridor alone. The research team opted to display both land areas over their underlying community areas, which can be seen on the map legends. Figure 4 displays the study area and underlying streets, while Figures 8-13 display the current spread of industrial facilities within the area, and surrounding area. Finally, Figure 6 displays the boundaries of all 26 official City of Chicago industrial corridors. Note the industrial corridor legend on page 39 (Figure 5) is to be used when viewing this map.

Shortly after beginning these study area visualizations, the research team noted that 19 facilities from the CACHET list are located outside the study area boundary. For a listing of facility names and their CACHET-listed industry categories, see Tables 4-9 on pages 44-55, as well as the dot legend (Figure 7), below. Finally, for a description of industry group and sub-sector definitions (as per the North American Industry Classification System), see Appendix Table 40, on page 217.

Study area boundary and current industrial occupancy

Figure 2. Map of study area boundary and underlying community areas; includes the official City of Chicago 'Calumet Industrial Corridor' and surrounding ½ mile buffer



As can be seen above in Figure 2, our study area is comprised of 7 distinct Chicago community areas: South Deering (community area #51), Hegewisch (community area #55), East Side (community area #52), Riverdale (community area #54), South Chicago (community area #46), and small portions of Calumet Heights (community area #48) and Pullman (community area #50). The southernmost portion of the study area lies outside of the official city boundary; due to this, we made sure to collect census tract data for the entirety of Cook County (and not just the city of Chicago) for most, if not all of our analyses in the 'Health Outcomes and Services'

section, beginning on page 150. As can be seen in the map directly below, the Calumet Industrial corridor alone is made up of the community areas above, excepting Riverdale, Pullman, and Calumet Heights.

Figure 3. Map of the official City of Chicago Calumet Industrial Corridor, and underlying community areas

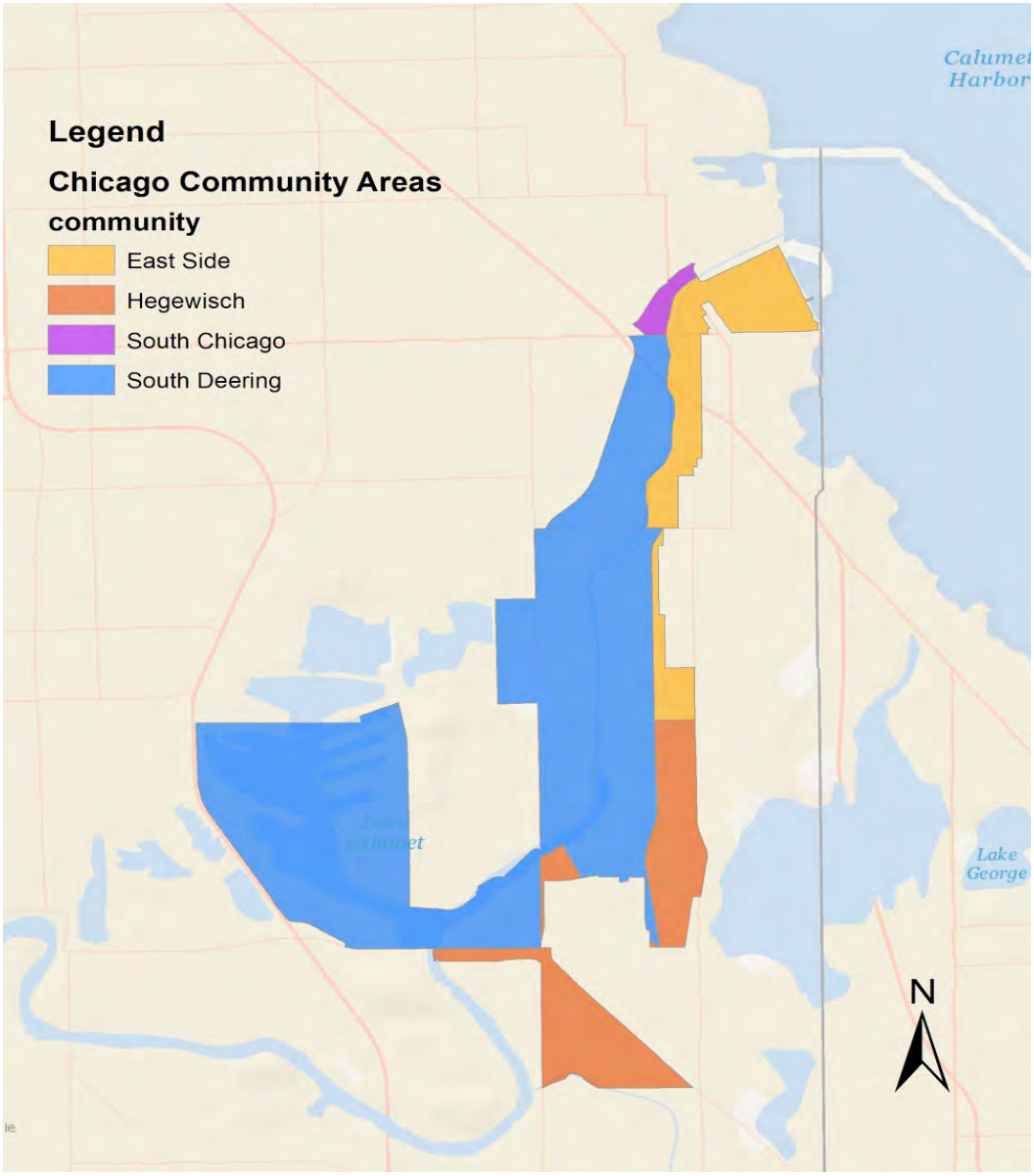


Figure 4. Map of study area boundary and underlying streets; includes the official City of Chicago ‘Calumet Industrial Corridor’ and surrounding ½ mile buffer

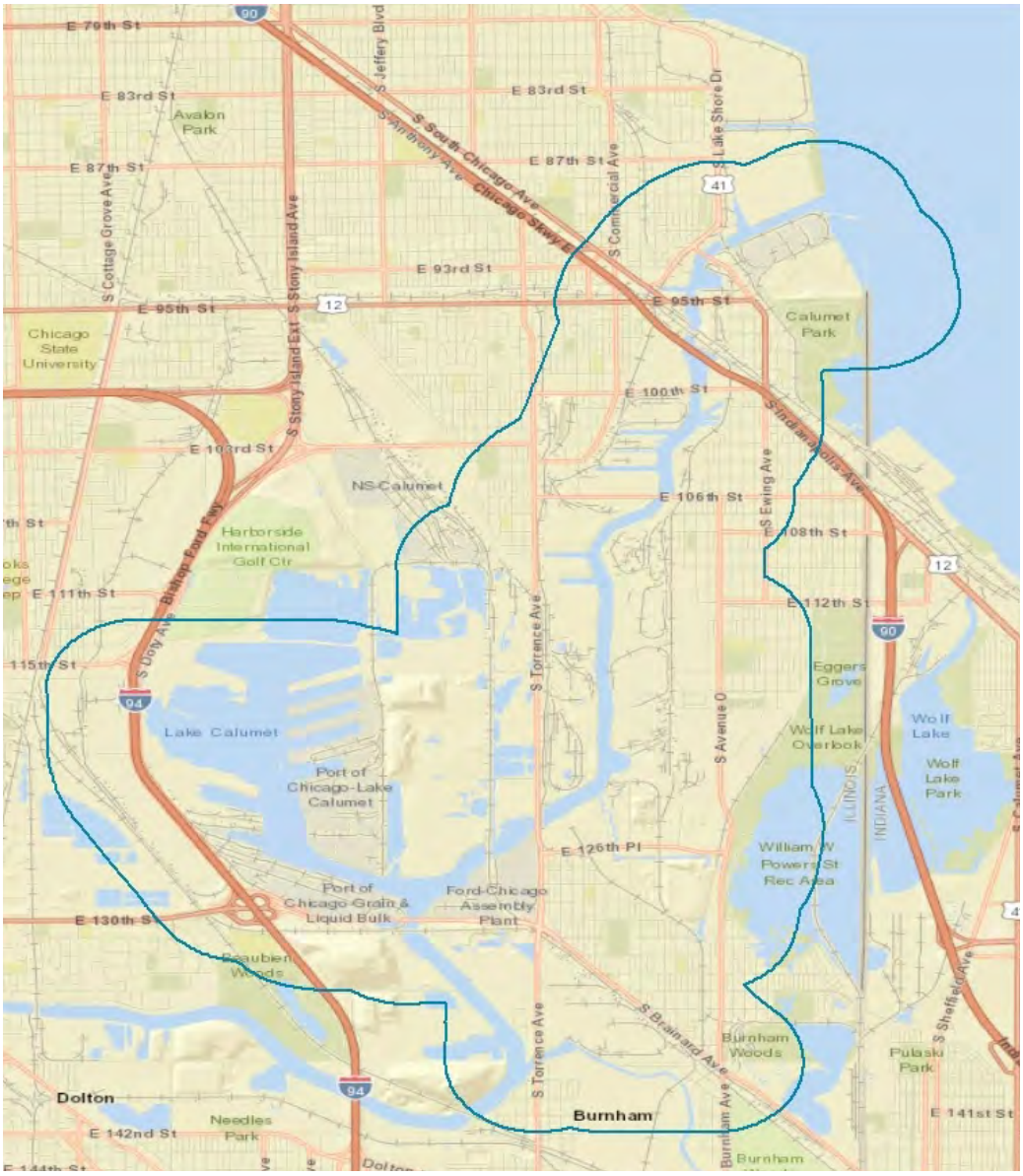


Figure 5. Legend display of all City of Chicago industrial corridors, to be used with Figure 6, immediately below

Figure 6. Map of all City of Chicago industrial corridors (and underlying community area boundaries)

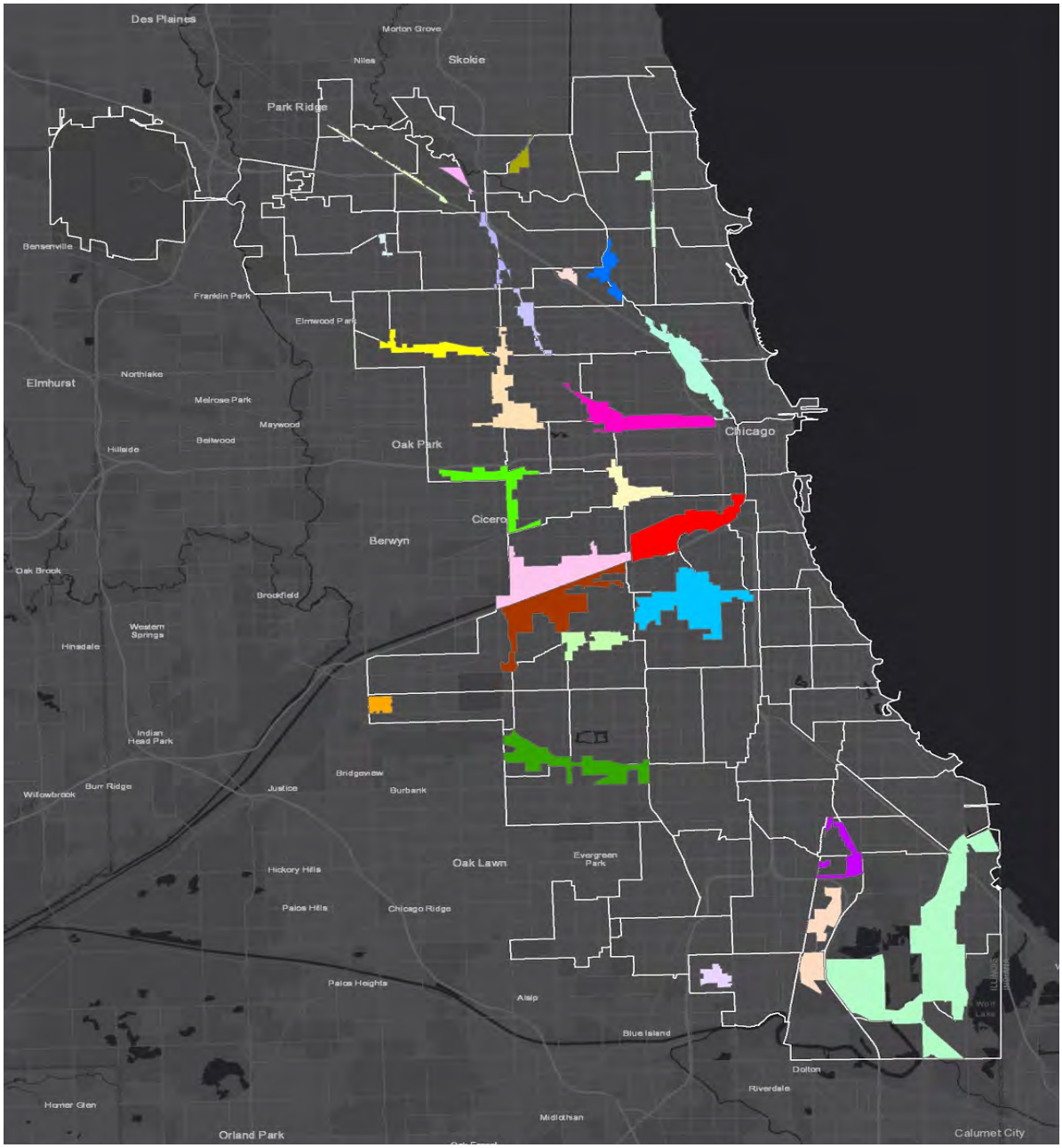


Figure 7. Dot legend display of all facility industry types as per the CACHET list (for use with Figures 8 to 13, below)

Regarding the dot legend above and its correspondence with the North American Industrial Classification System (NAICS) industry group/sub-sector definitions (as listed in Appendix Table 40), the research team notes the following: 1) 'Chemical Wholesale' per the CACHET listing, is equivalent to 'Chemical and Allied Products Merchant Wholesalers', per the NAICS; 2) 'Commercial Real Estate Leasing' per the CACHET listing, is equivalent to 'Lessors of Nonresidential Buildings (except Miniwarehouses)', per the NAICS; 3) 'Metal Products Manufacturing' per the CACHET listing, is equivalent to 'Primary Metal Manufacturing', per the NAICS; 4) 'Miscellaneous Wholesale' per the CACHET listing, is equivalent to 'All Other Miscellaneous Chemical Product and Preparation Manufacturing', per the NAICS; 5) 'Plastic Fabrication Company' per the CACHET listing, is equivalent to 'Plastics Material and Resin Manufacturing', per the NAICS; 6) 'Residential and Commercial Building Construction' per the CACHET listing, is split up into 'Residential Building Construction (industry group 2361) and

‘Nonresidential Building Construction’ (industry group 2362), per the NAICS; 7) ‘Road Transportation Services’ per the CACHET listing, is equivalent to ‘General Freight Trucking, Local’, per the NAICS; 8) ‘Shipping and Water Transportation Services’ per the CACHET listing, is equivalent to ‘Water Transportation’, per the NAICS; 9) ‘Synthetic Chemical Manufacturing’ per the CACHET listing, is equivalent to ‘Synthetic Dye and Pigment Manufacturing’, per the NAICS; 9) ‘Trucking’ per the CACHET listing, is equivalent to ‘General Freight Trucking, Long-Distance’, per the NAICS

Figure 8. Map of all CACHET list facilities. Note, dot label numbers can be seen in Figures 9-13, and in Tables 4-9, below

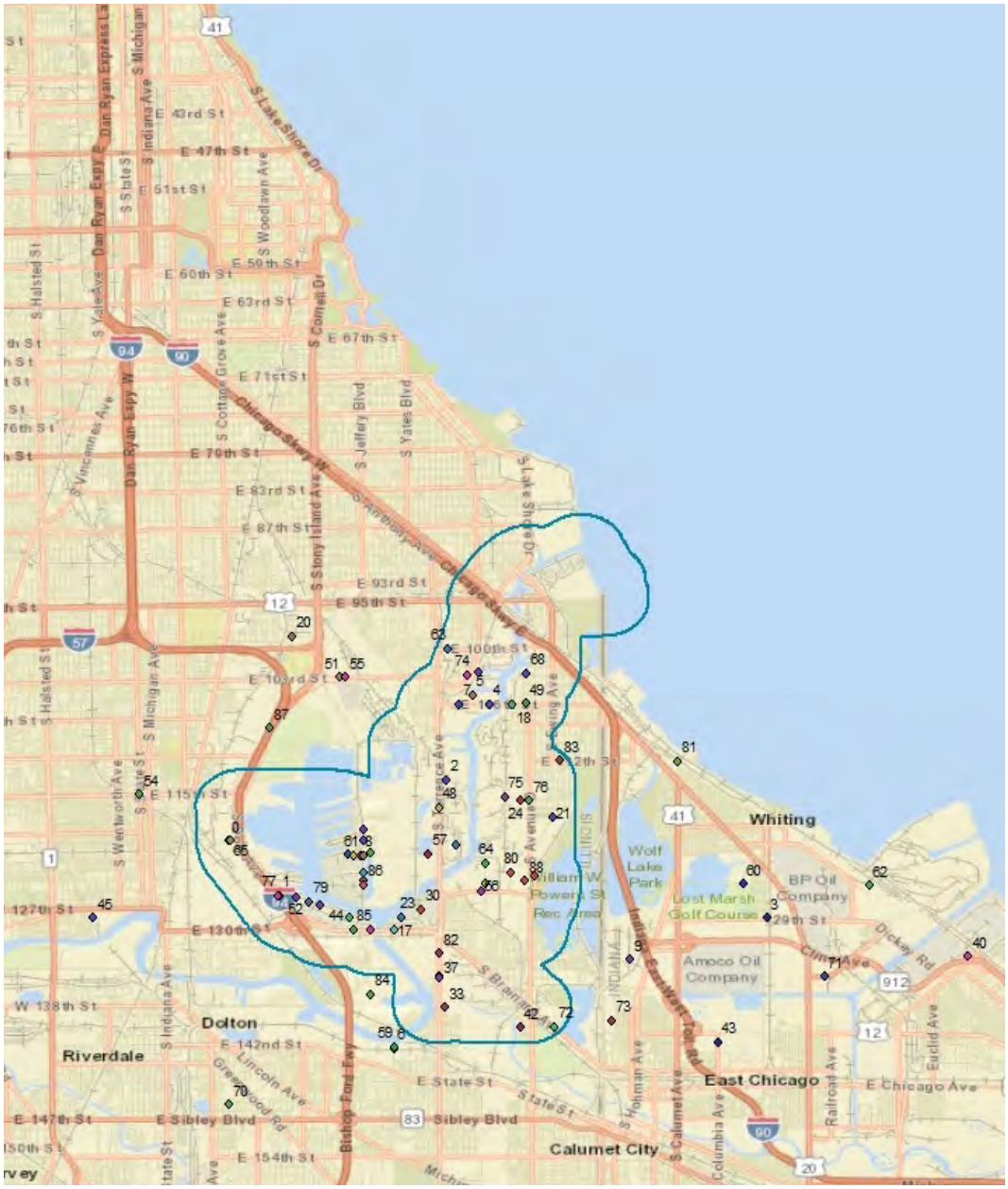


Figure 9. Map of CACHET list facilities, cross-section 1; each mapped facility is represented by 1 dot, colored to correspond to the business industry type (see Figure 7 above for color codes)

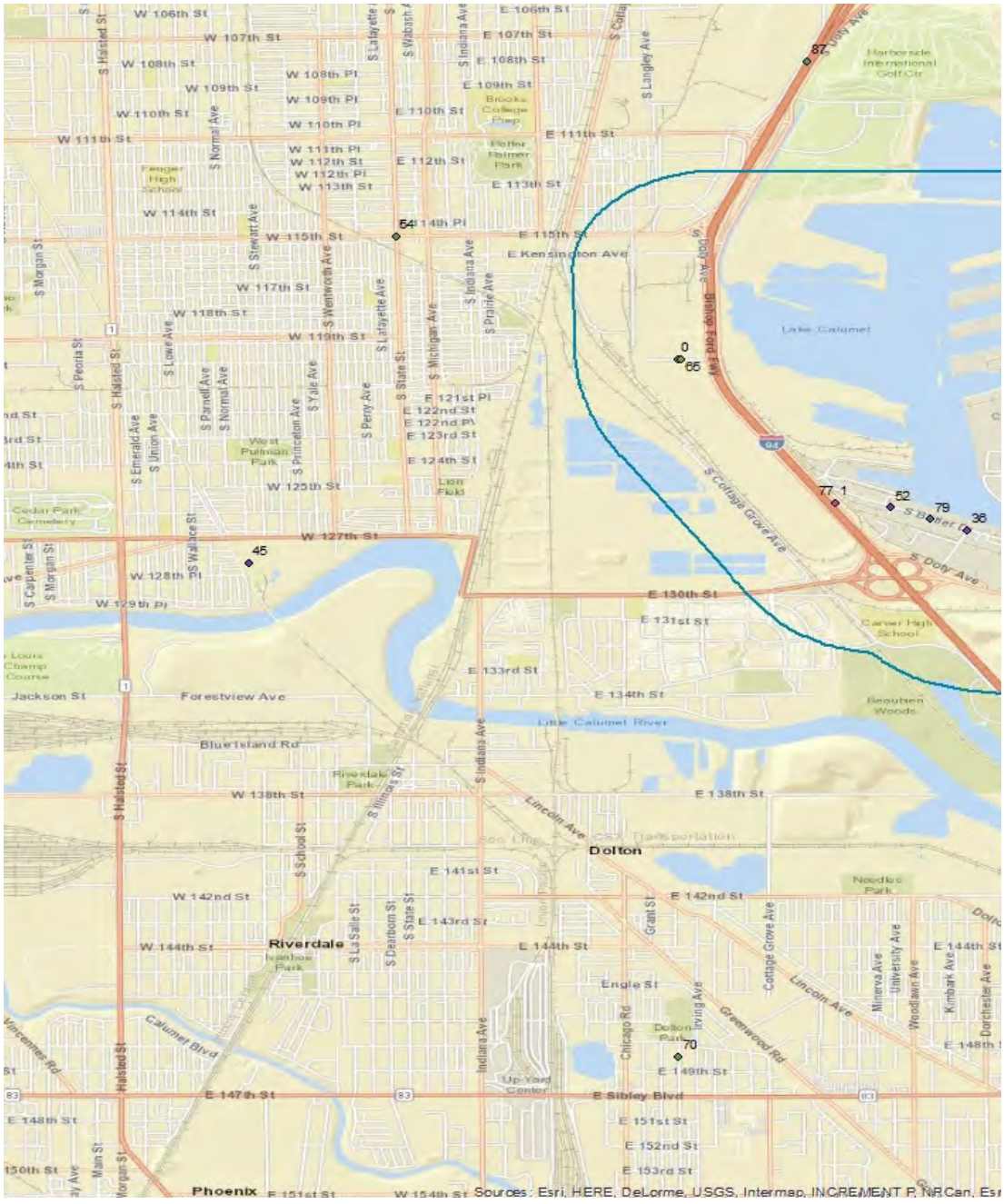


Table 4. Table of facility information, corresponding to Figure 9, above

Study Area Label	Company Name	Industry
45	Nacme Steel Processing, LLC	Metal Products Manufacturing
54	Optimus Recycling	Waste Management
70	Safety-Kleen Systems	Waste Management
87	WMI CID Recycling and Disposal	Waste Management
0	Ade Inc	Rubber and Plastic Product Manufacturing
65	Qualawash Holding LLC	Miscellaneous Chemical Manufacturing
77	St. Mary's Cement	Cement and Concrete Product Manufacturing
1	All Star Powder Coating	Metal Products Manufacturing
52	North America Stevedoring Company, LLC (Nasco)	Metals and Minerals Wholesale
79	Transfer Logistics, Inc.	Shipping and Water Transportation Services
36	Kloeckner Metals Corporation	Metals and Minerals Wholesale

Figure 10. Map of CACHET list facilities, cross-section 2; each mapped facility is represented by 1 dot, colored to correspond to the business' industry type (see Figure 7 above for color codes)

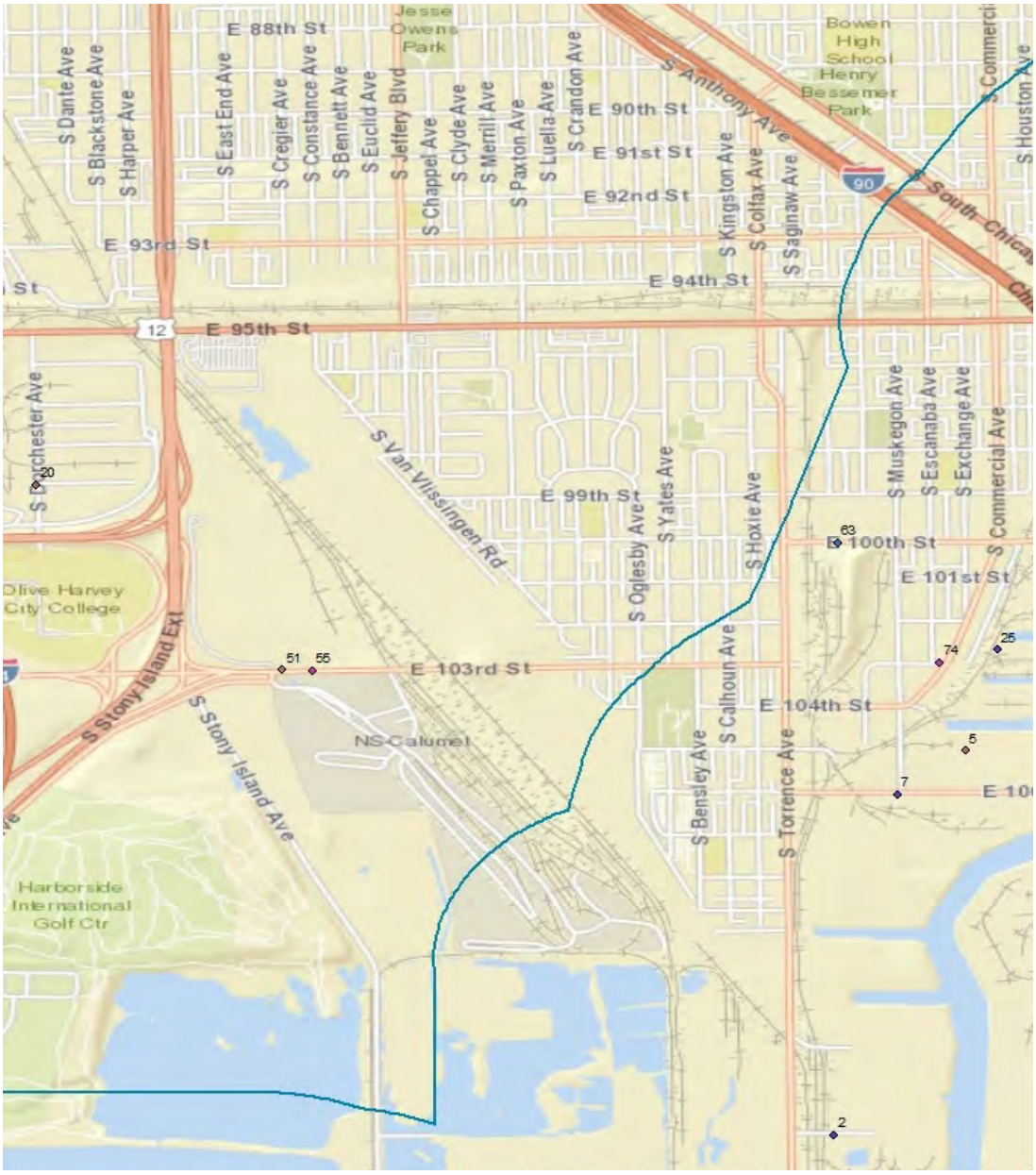


Table 5. Table of facility information, corresponding to Figure 10, above

Study Area Label	Company Name	Industry
20	Del Monte Fresh Produce Company	Grocery Wholesale
51	Norfolk Southern Thoroughbred Bulk Transfer Terminal	Storage and Warehousing
55	Ozinga Chicago Ready Mix Concrete, Inc	Cement and Concrete Product Manufacturing
2	American Zinc Recycling Corp. (Horsehead)	Metal Products Manufacturing
7	Asphalt Operating Services of Chicago, LLC	Specialty Construction Trade Contractors
5	Arro Corporation	Grocery Wholesale
74	Skyway Cement Company, LLC	Cement and Concrete Product Manufacturing
25	ELG Metals, Inc.	Metal Products Manufacturing
63	Pullman Innovations	Food Manufacturing

Figure 11. Map of CACHET list facilities, cross-section 3; each mapped facility is represented by 1 dot, colored to correspond to the business' industry type (see Figure 7 above for color codes)

Table 6. Table of facility information, corresponding to Figure 11, above

Study Area Label	Company Name	Industry
84	South Chicago Recycle Center	Waste Management
44	Maryland Pig Iron of Illinois	Miscellaneous Wholesale
85	Waste Management of Illinois, Inc	Waste Management
39	Lafarge North America	Cement and Concrete Product Manufacturing
17	Chemtrade Refinery Services Inc	Chemical Wholesale
23	Domino Foods Inc	Food Manufacturing
30	Ford Motor Company	Motor Vehicle Parts Manufacturing
31	GMI Packaging	Machinery and Equipment Manufacturing
61	PPG Industries, Inc	Paint, Coating, and Adhesive Manufacturing
8	Atlas Tube	Metal Products Manufacturing
35	Kinder Morgan Liquids Terminals LLC	Road Transportation Services
41	Liquid Environmental Solutions	Waste Management
10	Blackhawk Steel Corp. (Dockside Steel Processing)	Metals and Minerals Wholesale
47	National Material L.P. (Interstate Steel Processing)	Metal Products Manufacturing
26	Emesco Marine Services Corp	Shipping and Water Transportation Services
13	Calumet Tank & Equipment Co Inc.	Industrial Machinery Repair and Maintenance
27	First Choice Logistics, Inc	Trucking
86	Watco Transloading LLC - Chicago Arrow Terminal	Commercial Real Estate Leasing

33	JWK Enterprise Inc	Trucking
16	Cassens Transport Co	Trucking
37	Kloeckner Metals Corporation	Metals and Minerals Wholesale
80	Troy Design & Manufacturing Co.	Motor Vehicle Parts Manufacturing
48	Nidera	Machinery Wholesale; Construction and Hardware Materials Wholesale
82	United Road Services	Trucking
57	Peoples Energy Corporation	Natural Gas Distribution
15	Cargill Inc	Food Manufacturing
64	PVS Chemical Solutions Inc	Basic Chemical Manufacturing
19	Dakkota Integrated Systems, LLC	Motor Vehicle Manufacturing
56	Peco Pallet, Chicago	Wood Product Manufacturing

Figure 12. Map of CACHET list facilities, cross-section 4; each mapped facility is represented by 1 dot, colored to correspond to the business' industry type (see Figure 7 above for color codes)

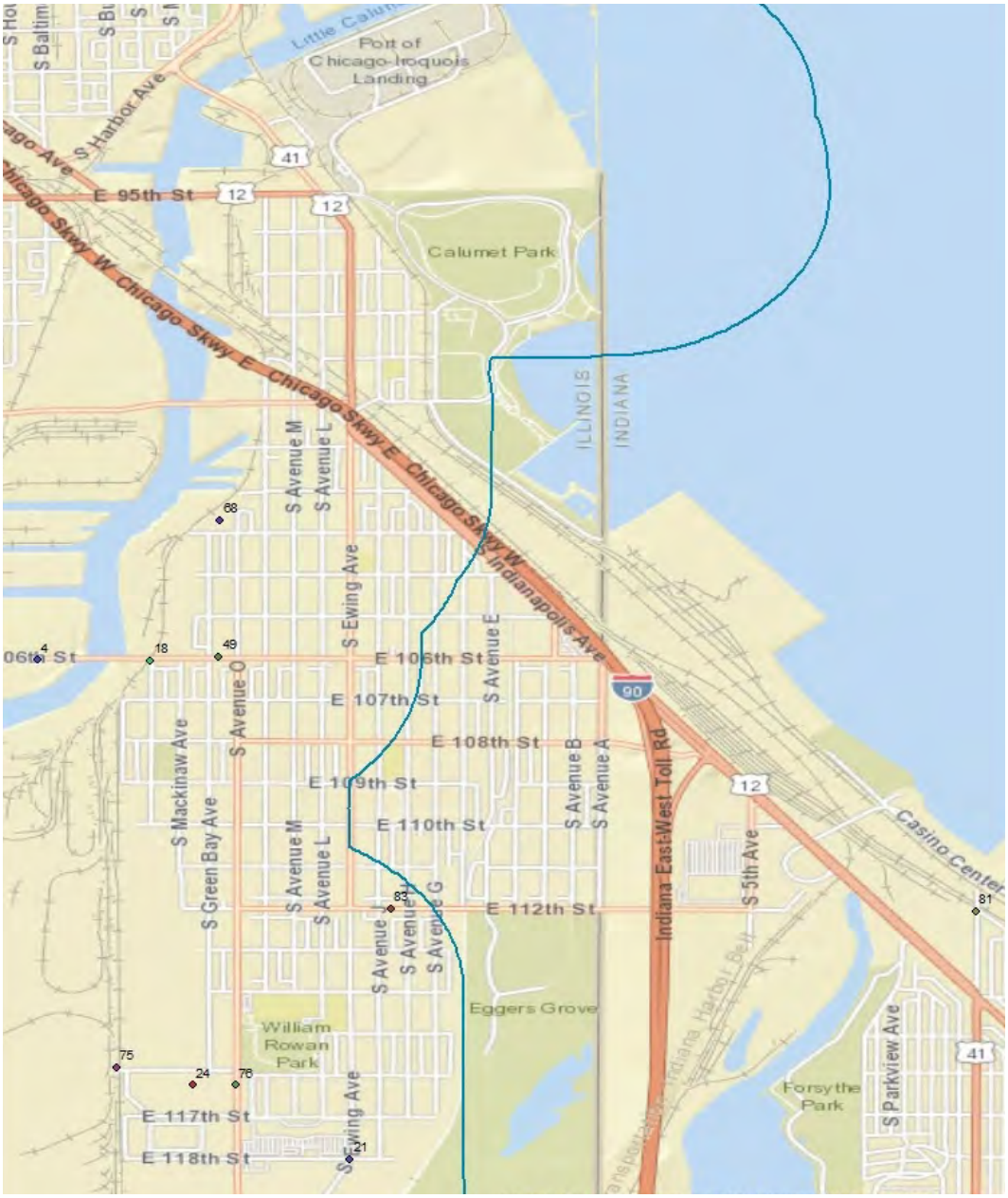


Table 7. Table of facility information, corresponding to Figure 12, above

Study Area Label	Company Name	Industry
4	Arcelor Mittal	Metal Products Manufacturing
68	S.H. Bell Company	Metal Products Manufacturing
18	Cronimet Corporation	Miscellaneous Wholesale
49	Norfolk Southern Calumet Rail Yard	Railroad Transport
81	Unilever United States, Inc	Miscellaneous Chemical Manufacturing
83	Walsh Construction	Residential and Commercial Building Construction
75	South Shore Recycling/Reserve management group	Waste management
24	Dri-Rite	Non-Metallic Mineral Product Manufacturing
76	South Shore Recycling/Reserve management group	Waste management
21	Diamond Coring Company	Specialty Construction Trade Contractors

Figure 13. Map of CACHET list facilities, cross-section 5; each mapped facility is represented by 1 dot, colored to correspond to the business' industry type (see Figure 7 above for color codes). Note, facility numbers 78 and 88 (in the top left corner of the figure) are already represented in Figure 9 and Table 4, above.

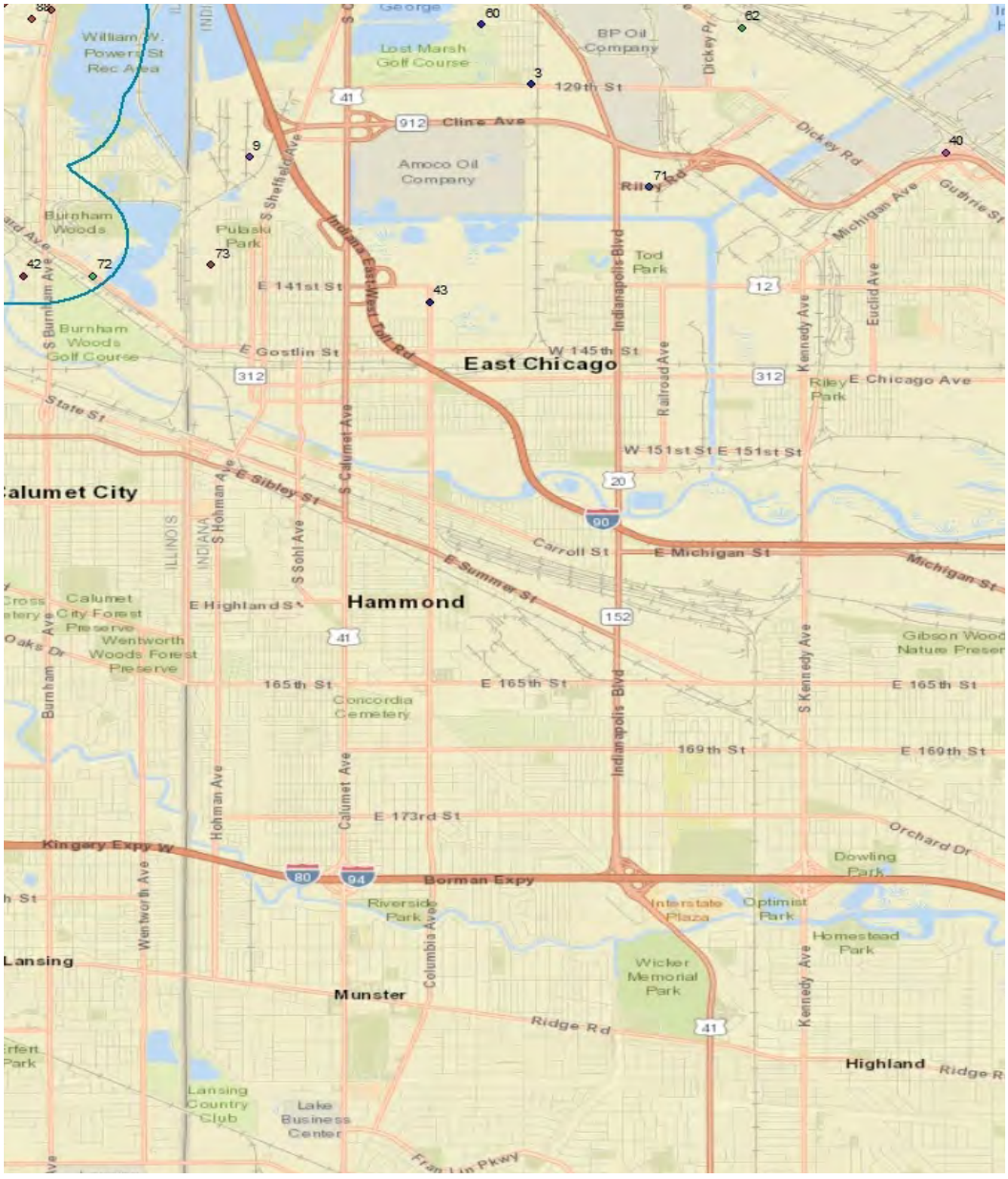


Table 8. Table of facility information, corresponding to Figure 13, above

Study Area Label	Company Name	Industry
42	Lub-Tek Petroleum Products Corp	Petroleum Product Manufacturing
72	Scrap Metal Services, LLC	Miscellaneous Wholesale
73	Service Steel Warehouse	Residential and Commercial Building Construction
9	Berlin Metals, LLC	Metals and Minerals Wholesale
43	Marathon Petroleum Corporation	Gasoline Stations, and Fuel Dealers
71	Safety-Kleen Systems	Machinery and Equipment Manufacturing
3	Amoco Pipeline Co	Gasoline Stations, and Fuel Dealers
60	Polyjohn Enterprises Corporation	Plastic Fabrication Company
62	Praxair Inc	Basic Chemical Manufacturing
40	Lafarge North America (Cokenergy LLC)	Cement and Concrete Product Manufacturing

Table 9. Table of all CACHET list facilities located outside of the study area boundary. Note, all facilities below are represented visually above in Figures 9-13

Study Area Label	Company Name	Industry
45	Nacme Steel Processing, LLC	Metal Products Manufacturing
54	Optimus Recycling	Waste Management
20	Del Monte Fresh Produce Company	Grocery Wholesale
51	Norfolk Southern Thoroughbred Bulk Transfer Terminal	Storage and Warehousing
55	Ozinga Chicago Ready Mix Concrete, Inc	Cement and Concrete Product Manufacturing
70	Safety-Kleen Systems	Waste Management
84	South Chicago Recycle Center	Waste Management
59	Plastics Color Corporation	Rubber and Plastic Product Manufacturing
6	Ashland Chemical Incorporated	Synthetic Chemical Manufacturing
81	Unilever United States, Inc	Miscellaneous Chemical Manufacturing
60	Polyjohn Enterprises Corporation	Plastic Fabrication Company
3	Amoco Pipeline Co	Gasoline Stations, and Fuel Dealers
9	Berlin Metals, LLC	Metals and Minerals Wholesale
73	Service Steel Warehouse	Residential and Commercial Building Construction
43	Marathon Petroleum Corporation	Gasoline Stations, and Fuel Dealers
71	Safety-Kleen Systems	Machinery and Equipment Manufacturing

62	Praxair Inc	Basic Chemical Manufacturing
40	Lafarge North America (Cokenergy LLC)	Cement and Concrete Product Manufacturing

Corridor occupancy history and environmental activism

As outlined in the Calumet River Communities Planning Framework (see Table 1, row 2 for full source information)--the Great Cities Institute's framework for Southeast Chicago planning efforts--the Calumet River has served a historic role in the local economy of the area. Its importance to shipping and industry, however, has meant that the river (and the larger river system including the Grand Calumet River, the Little Calumet River, and the Cal-Sag Channel) has been a long-time depository for the toxic runoff and pollutants produced daily by the various industries in the surrounding communities.

With the establishment of the Lake Calumet Planned Manufacturing District (PMD) in 2004, the City of Chicago affirmed the role of industry in the area for the foreseeable future; according to the Planning Framework (see page 8), the Calumet Industrial Corridor is the largest of the city's 26 industrial corridors, with the Planned Manufacturing District (PMD) comprising 71 percent of the corridor land area.

Below, in Table 10, we note the information gathered from CoStar regarding the occupancy history periods of each company on the CACHET list. It should be noted that while several companies likely have occupied the study area for longer than listed by CoStar, the CoStar group's information may only reflect the occupancy as listed under the most recently available lease. Because of time/capacity constraints, we were not able to access Recorder of Deeds information for each company to verify longer occupancy periods, and as such, we include this exploration as a point 'for further research' by the Department of Planning and Development, and Department of Public Health.

Table 10. CoStar occupancy history records for Southeast Chicago Business List facilities

Study Area Label	CACHET-listed Company Name	Address	CoStar Address Occupancy Info
2	American Zinc Recycling Corp. (Horsehead)	2701 E 114th St, Chicago, IL 60617	Jul-08
5	Arro Corporation	10459 S Muskegon Ave, Chicago, IL 60617	Oct-18

8	Atlas Tube	1855 E 122nd St, Chicago, IL 60633	May-04
9	Berlin Metals, LLC	3200 Sheffield Ave, Hammond, IN 46327	Apr-04
15	Cargill Inc	12201 S Torrence Ave, Chicago, IL 60617	Jul-40
16	Cassens Transport Co	13511 S Torrence Ave, Chicago, IL 60633	Oct-09
17	Chemtrade Refinery Services Inc.	2250 E 130th St, Chicago, IL 60633	Jun-89
19	Dakkota Integrated Systems, LLC	12525 S Carondolet Ave, Chicago, IL 60633	Apr-15
20	Del Monte Fresh Produce Company	9880 S Dorchester Ave, Chicago, IL 60628	Apr-06
21	Diamond Coring Company	11800 S Ewing Ave, Chicago, IL 60617	Oct-09
23	Domino Foods Inc.	2400 E 130th St, Chicago, IL 60633	Jun-06
28	Flex-N-Gate Corporation	2924 E 126th Pl, Chicago, IL 60633	Feb-18
29	Ford Chicago Assembly Plant	12600 S Torrence Ave, Chicago, IL 60633	Jul-13
30	Ford Motor Company	12600 S Torrence Ave, Chicago, IL 60633	Jul-13
36	Kloeckner Metals Corporation	12900 S Metron Dr, Chicago, IL 60633	Jan-69
39	Lafarge North America	2150 E 130th St, Chicago, IL 60633	Nov-88
40	Lafarge North America (Cokenergy LLC)	3210 Watling St, East Chicago, IN 46312	Aug-19
43	Marathon Petroleum Corporation	4206 Columbia Ave, Hammond, IN 46327	Jun-16
56	Peco Pallet, Chicago	2924 E 126th Pl, Chicago, IL 60633	Jun-14
58	Plastics Color Corporation	14201 Paxton Ave, Calumet City, IL 60409	Jan-10

59	Plastics Color Corporation	14201 Paxton Ave, Calumet City, IL 60409	Jan-10
60	Polyjohn Enterprises Corporation	2500 Gaspar Ave, Whiting, IN 46394	Oct-09
63	Pullman Innovations	2701 E. 100th St, Chicago, IL 60617	Apr-16
64	PVS Chemical Solutions Inc	12260 S Carondolet Ave, Chicago, IL 60633	Jan-18
65	Qualawash Holding LLC	803 E 120th St, Chicago, IL 60628	Jul-16
73	Service Steel Warehouse	141 141st St, Hammond, IN 46327	Dec-09
76	South Shore Recycling/Reserve management group	11610 S Avenue O, Chicago, IL 60617-7329	Oct-09

Worker occupancy and industry change

In addition to investigating the occupancy history of study area industrial facilities, the working group was eager to gain an understanding of large-scale job and employment trends impacting study area workers and industries. The research team in particular was interested in looking at job growth as well as jobs by industry in recent years, as well as over a multi-year span.

Figure 14, below, shows the change in the total number of jobs in the study area over time from 2007 to 2017. Absent the years in between, we noted that the study area observed a change of around 2,000 jobs over this ten year period. We noted a drop of just over 3,000 jobs from 2007 to 2009 (coinciding with the economic recession), followed by steady job growth that has occurred in the years since. Most recently, the research team observed a slight decrease year-over-year of 151 jobs, representing a 1.2 percent decrease from 2016 to 2017.

When looking at these changes in terms of industry breakdown (as shown also below, in Figure 15), we observed that trend lines representing job totals by industry moved in very similar directions over this ten-year time period. As an example, all industries represented in the study area observed a similar decline in job totals from 2007 to 2009. Construction jobs--the gray section along the bottom of the chart--is the only industry to have maintained a steady job share from 2007 to 2017.

Figure 14. Total jobs within the study area, 2007-2017

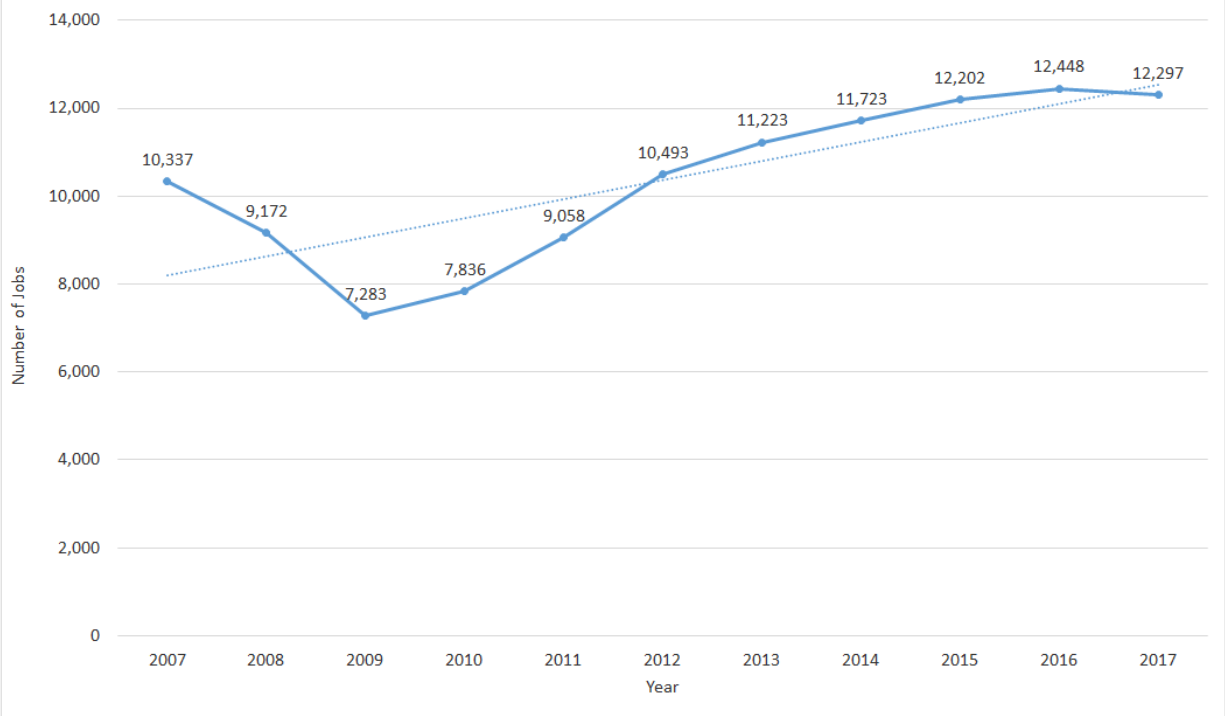
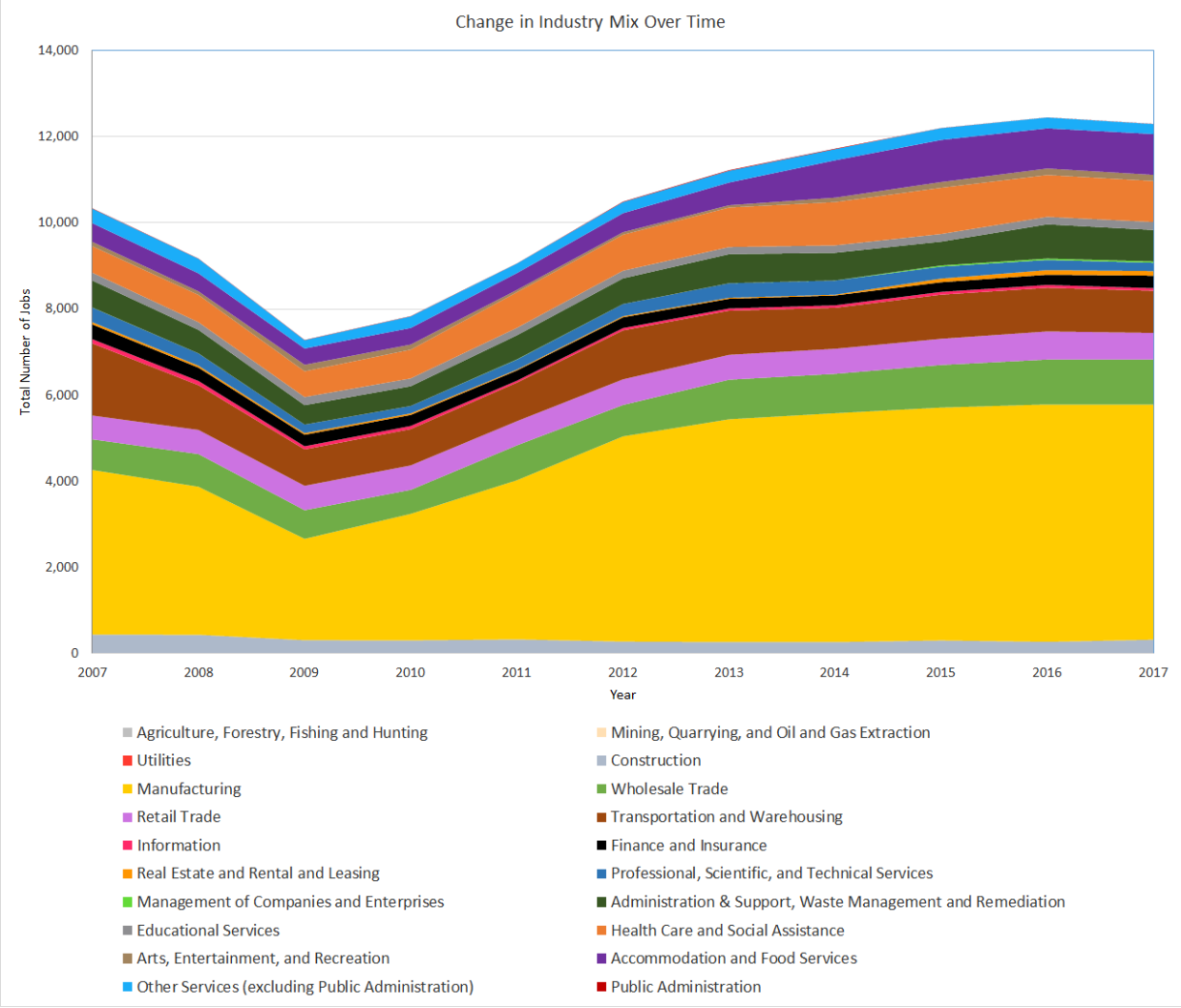


Figure 15. Change in industry mix over time for study area jobs



Residential occupancy and demographic change

In order to ground our exploration of environmental and public health--detailed in the 'Permitting Violations' and 'Health Outcomes and Services' sections beginning on pages 111 and 150, respectively-- the research team first aimed to understand the residential population of the study area. Specifically, we aimed to understand major demographic characteristics of the residential population currently and over time as it relates to descriptors like race/ethnicity, educational attainment, and age. Whenever possible, the research team aimed to visualize these descriptors by census tract *proportion* within the study area for the same two years: 1990, as well as 2017--the most recent year for which most population demographic data is available

from the American Community Survey (ACS) 5-year estimates collection. Below, we visualize tract level data depicting overall population, race/ethnic composition, age, educational attainment, and median income for both years, calculated based on the proportion of each census tract that falls within the study area boundary (see the ‘Methods’ sub-section for more detail). For each set of maps, we offer high-level findings, illustrative of the most note-worthy demographic changes that we observed.

Overall population

Figures 16-17, below, display the overall population counts at the census tract level for 1990 and 2017. The total population within the study area decreased from 45,373 in 1990 to around 42,301 in 2017. The census tracts concentrated around the central section of the study area became more populated while the south west fringes lost population.

Figure 16. Overall population count by tract, based on 1990 estimates

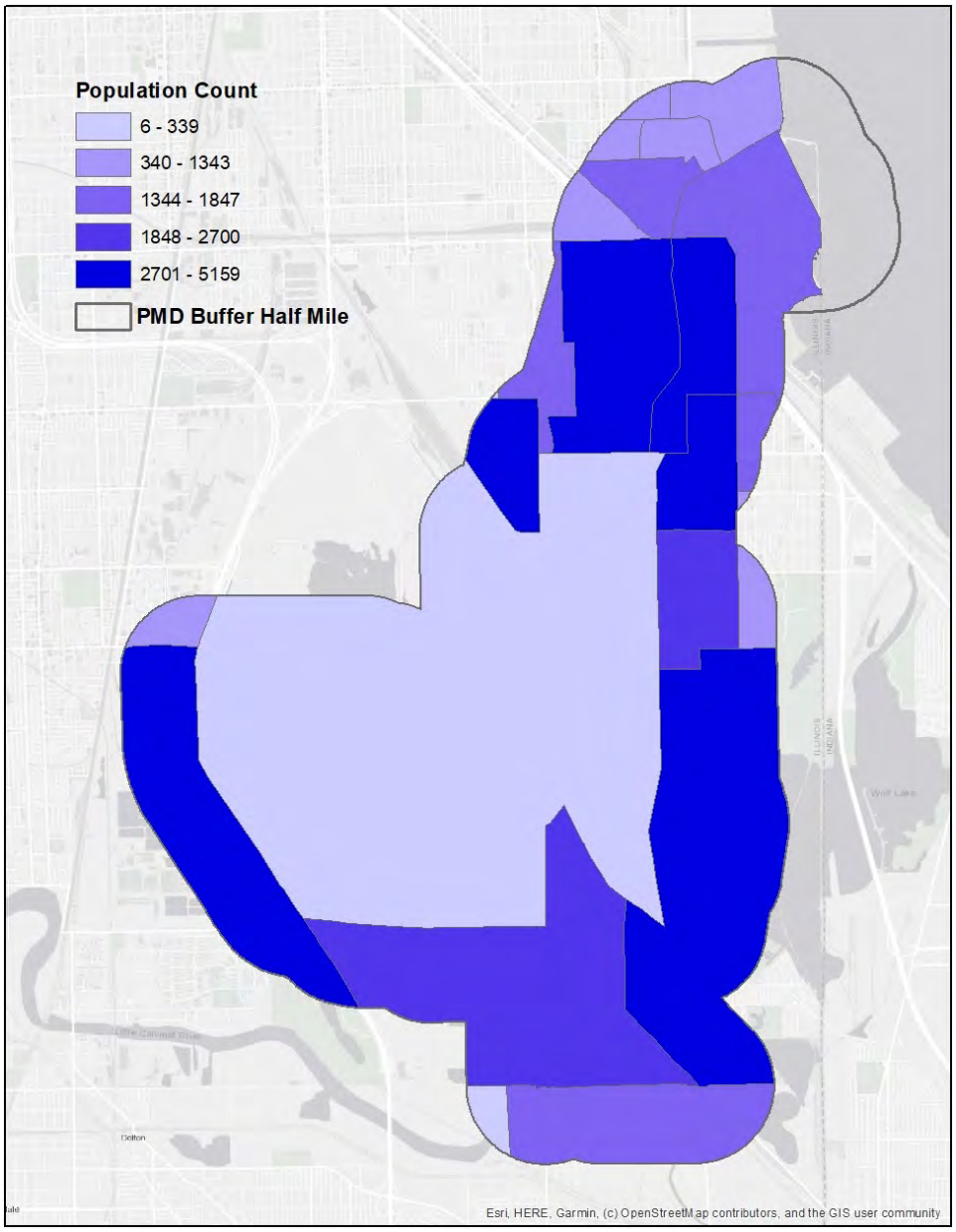
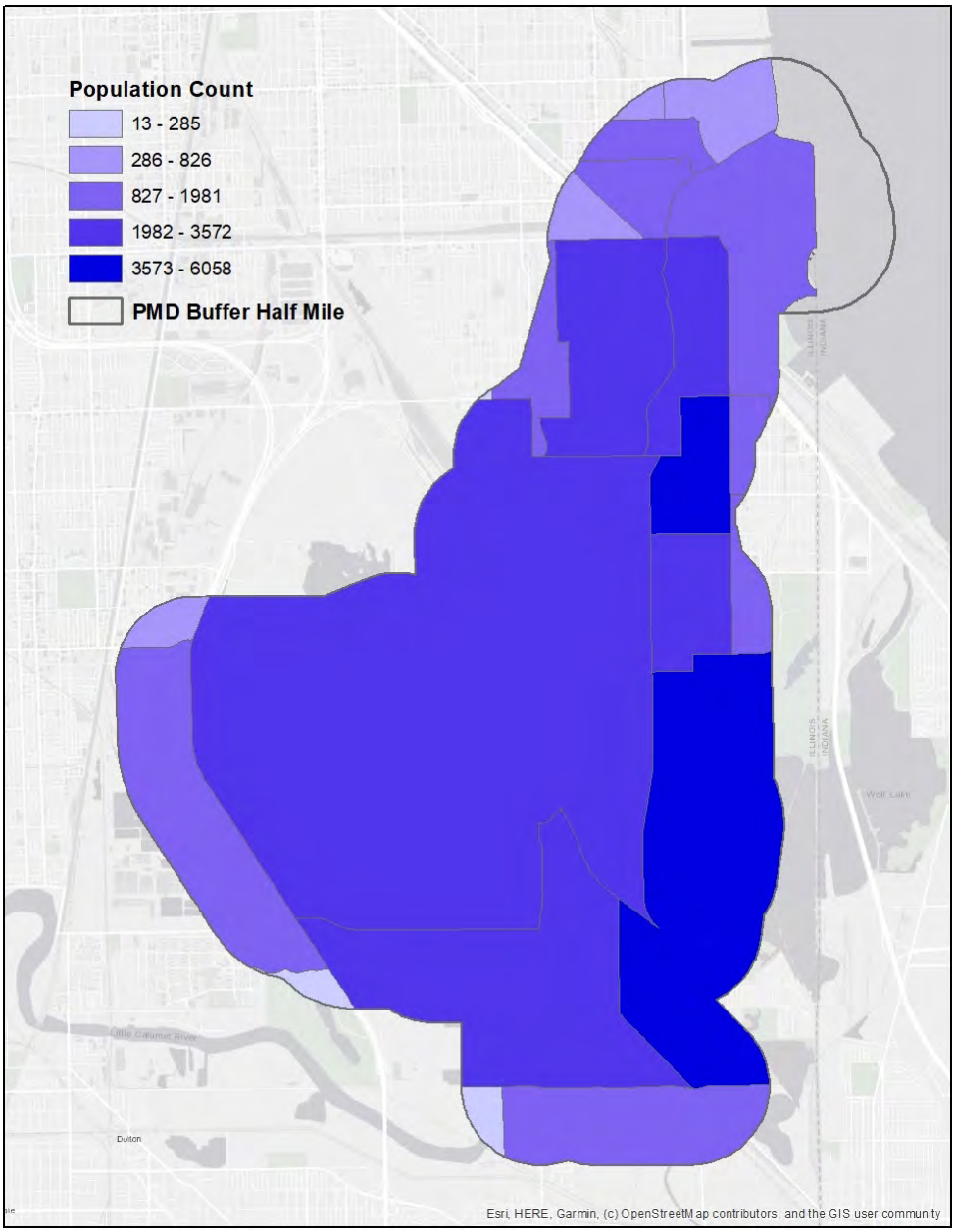


Figure 17. Overall population count by tract, based on 2017 estimates



Race/ethnic composition

As seen below in Table 11, and in Figures 18 to 27, the study area residential population has changed notably from 1990 to 2017 in its race/ethnic group compositions. As can be seen when comparing the population proportions of each major racial/ethnic group in Table 11, the white

population has decreased considerably, while the Hispanic/Latino population has grown; while white residents made up the largest racial/ethnic group share by category in 1990, the Hispanic/Latino population has grown to become the largest racial/ethnic group within the area. As of 2017, Hispanic/Latino residents make up more than half of the study area population (58.96%), followed by Black/African-American residents (25.02%). This demographic shift is notable, considering the fact that environmental justice communities tend to be made up of residents of color, as is the case with the study area.

Table 11. Population proportions for all 4 major racial/ethnic groups within the study area, based on 1990 and 2017 Census estimates

1990		2017	
White	42.03%	White	15.42%
Black/African-American	21.98%	Black/African-American	25.02%
Hispanic/Latino	35.47%	Hispanic/Latino	58.96%
Asian	0.23%	Asian	.19%

Figure 18. Population counts for all 4 major racial/ethnic groups within the study area, based on 1990 Census estimates (1 dot = 100 people); for comparison with Figure 23

Figure 19. ‘White’ population proportion by tract in study area, based on 1990 Census estimates; for comparison with Figure 24

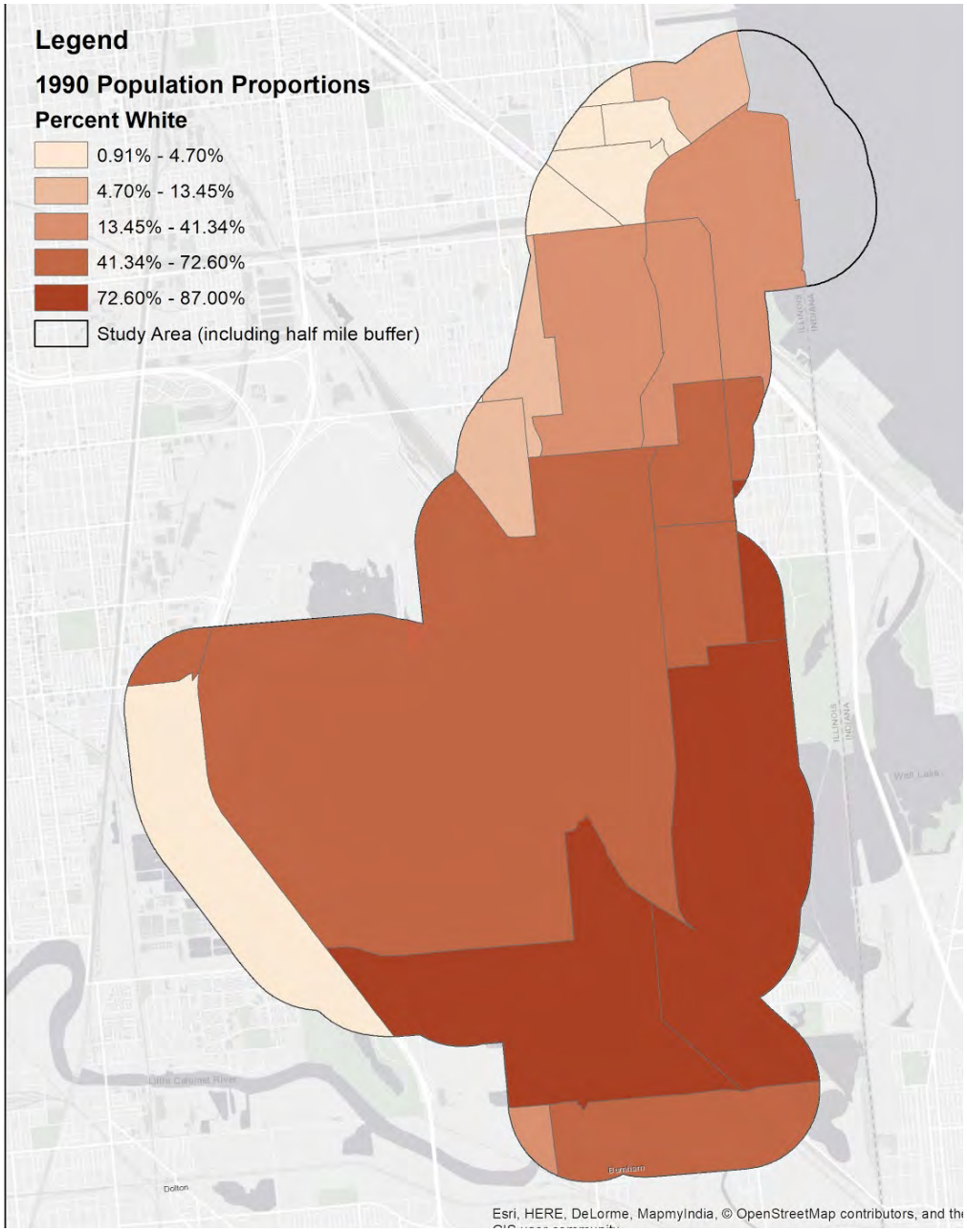


Figure 20. ‘Black’ population proportion by tract within the study area, based on 1990 Census estimates; for comparison with Figure 25

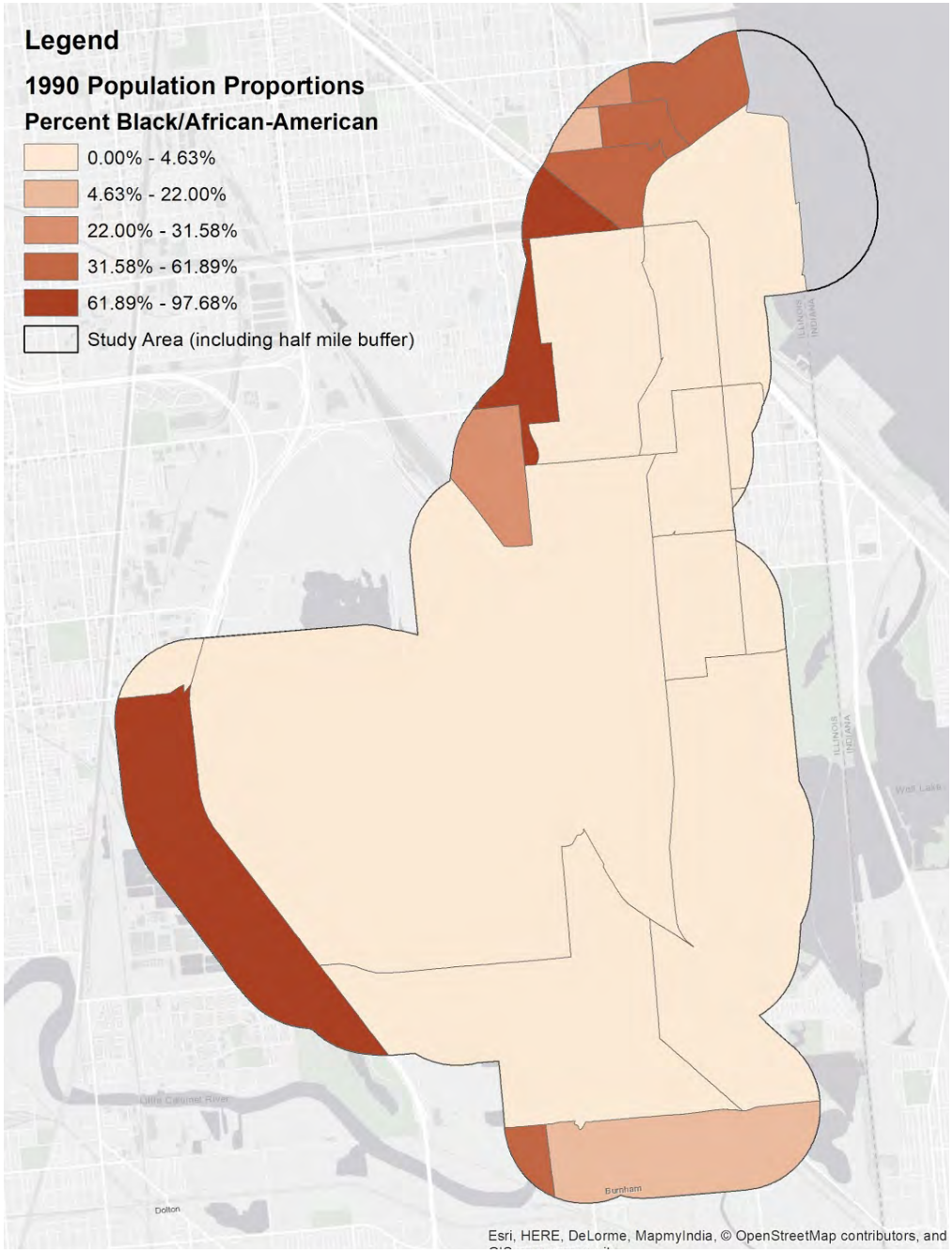


Figure 21. ‘Hispanic/Latino’ population proportion by tract within the study area, based on 1990 Census estimates; for comparison with Figure 26

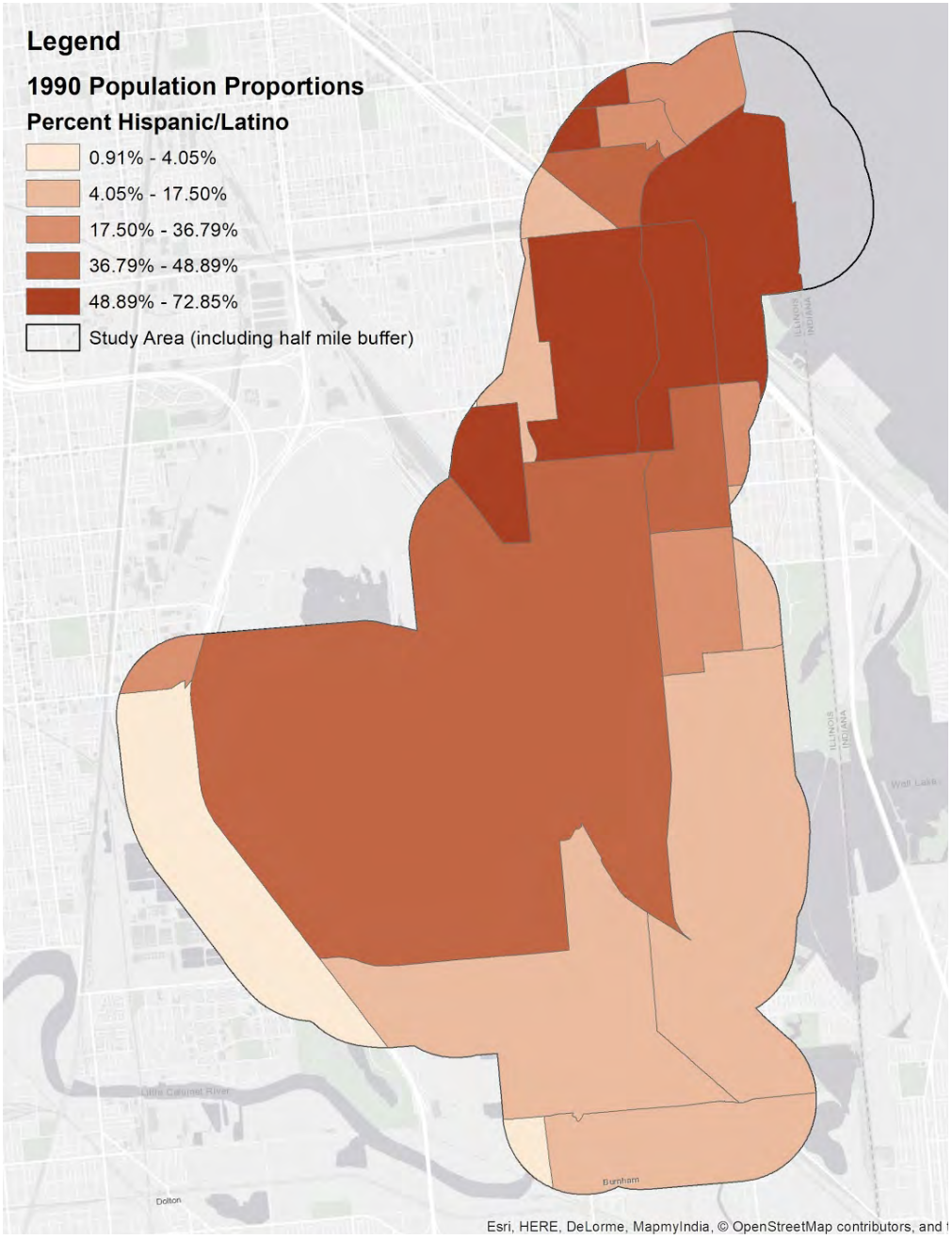


Figure 22. ‘Asian’ population proportion by tract within the study area, based on 1990 Census estimates; for comparison with Figure 27

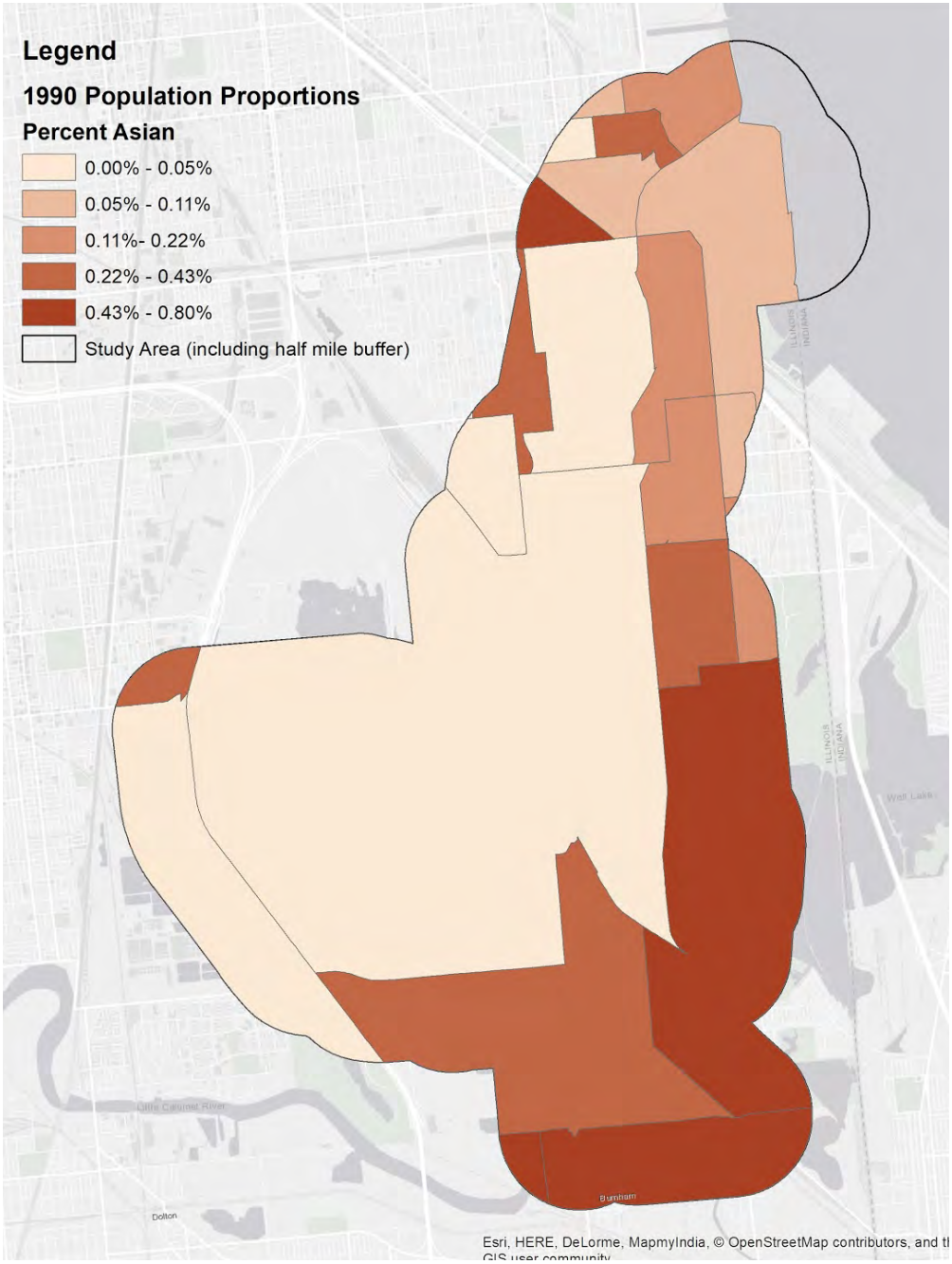


Figure 23. Population counts for all 4 major racial/ethnic groups within the study area, based on 2017 Census estimates (1 dot = 100 people)

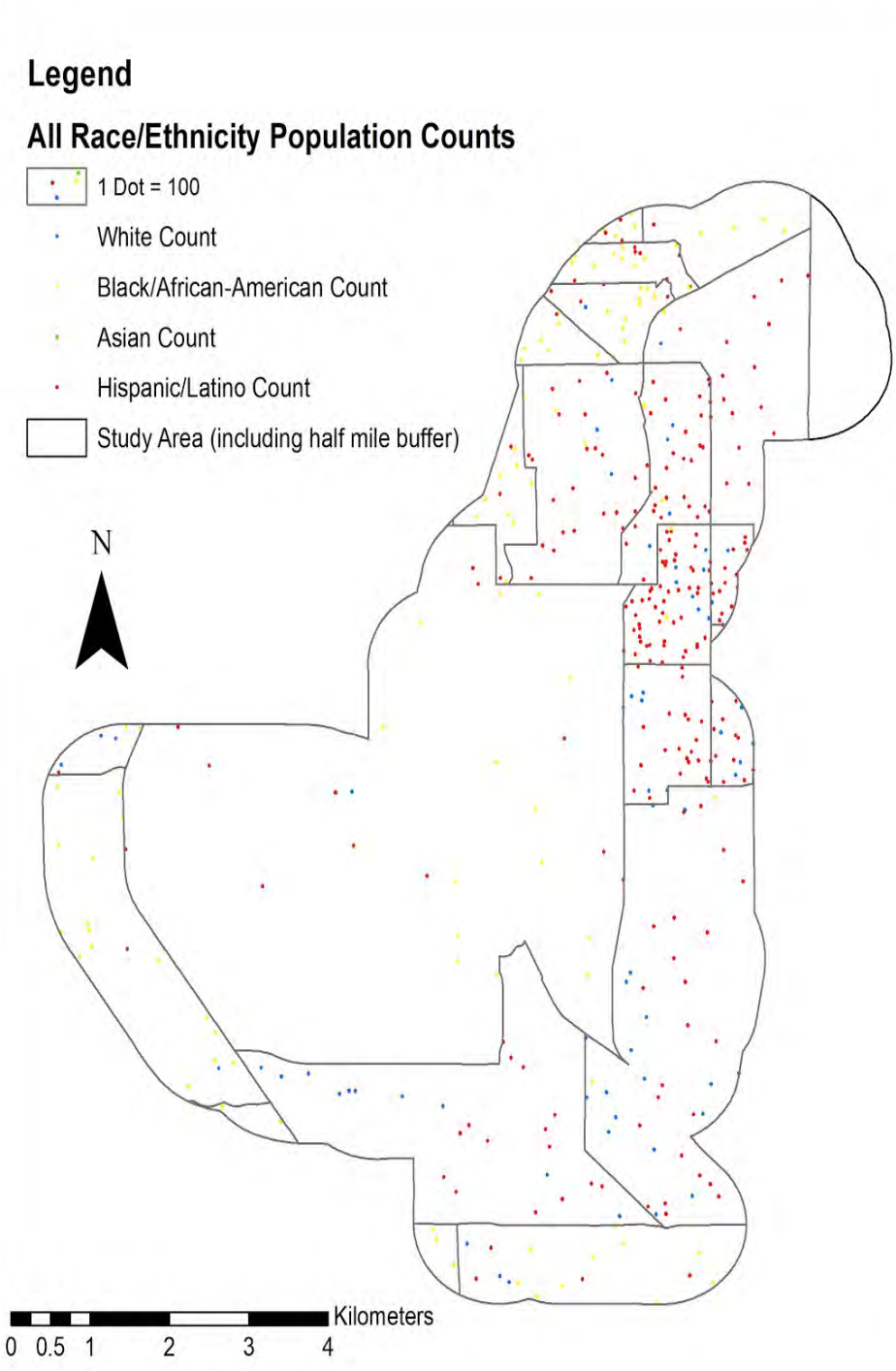


Figure 24. ‘White’ population proportion by tract within the study area, based on 2017 Census estimates

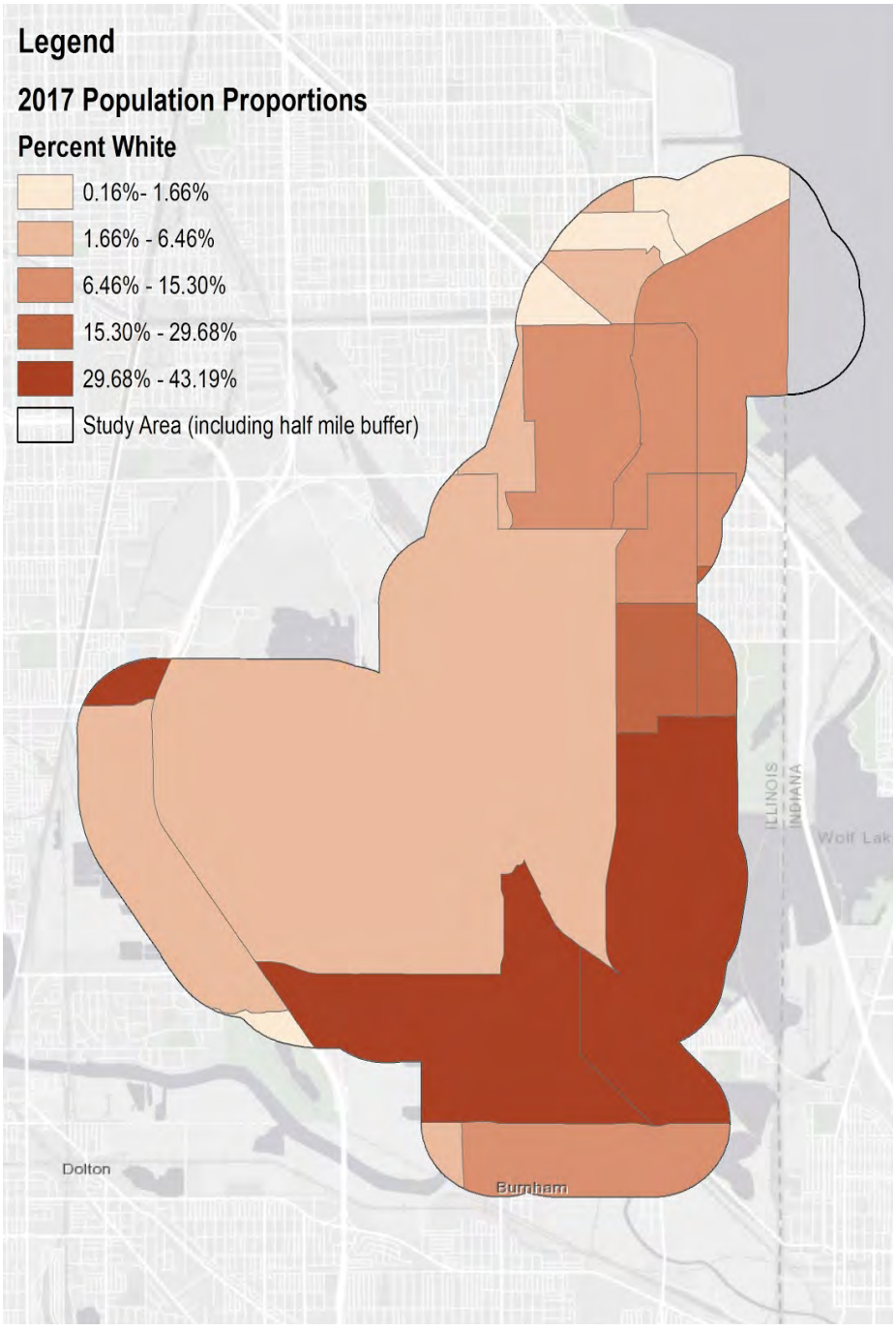


Figure 25. 'Black/African-American' population proportion by tract within the study area, based on 2017 Census estimates

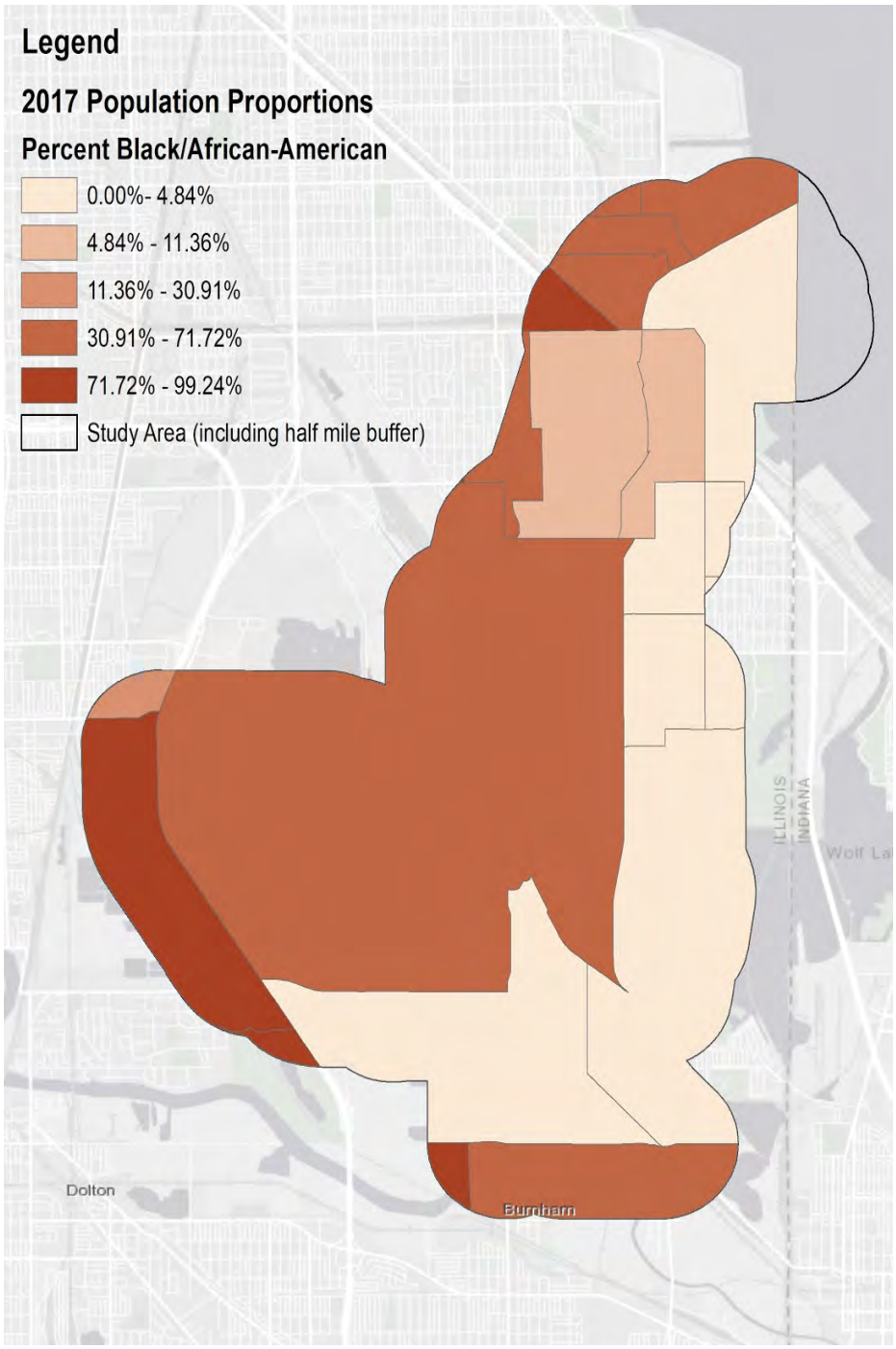


Figure 26. 'Hispanic/Latino' population proportion by tract within the study area, based on 2017 Census estimates

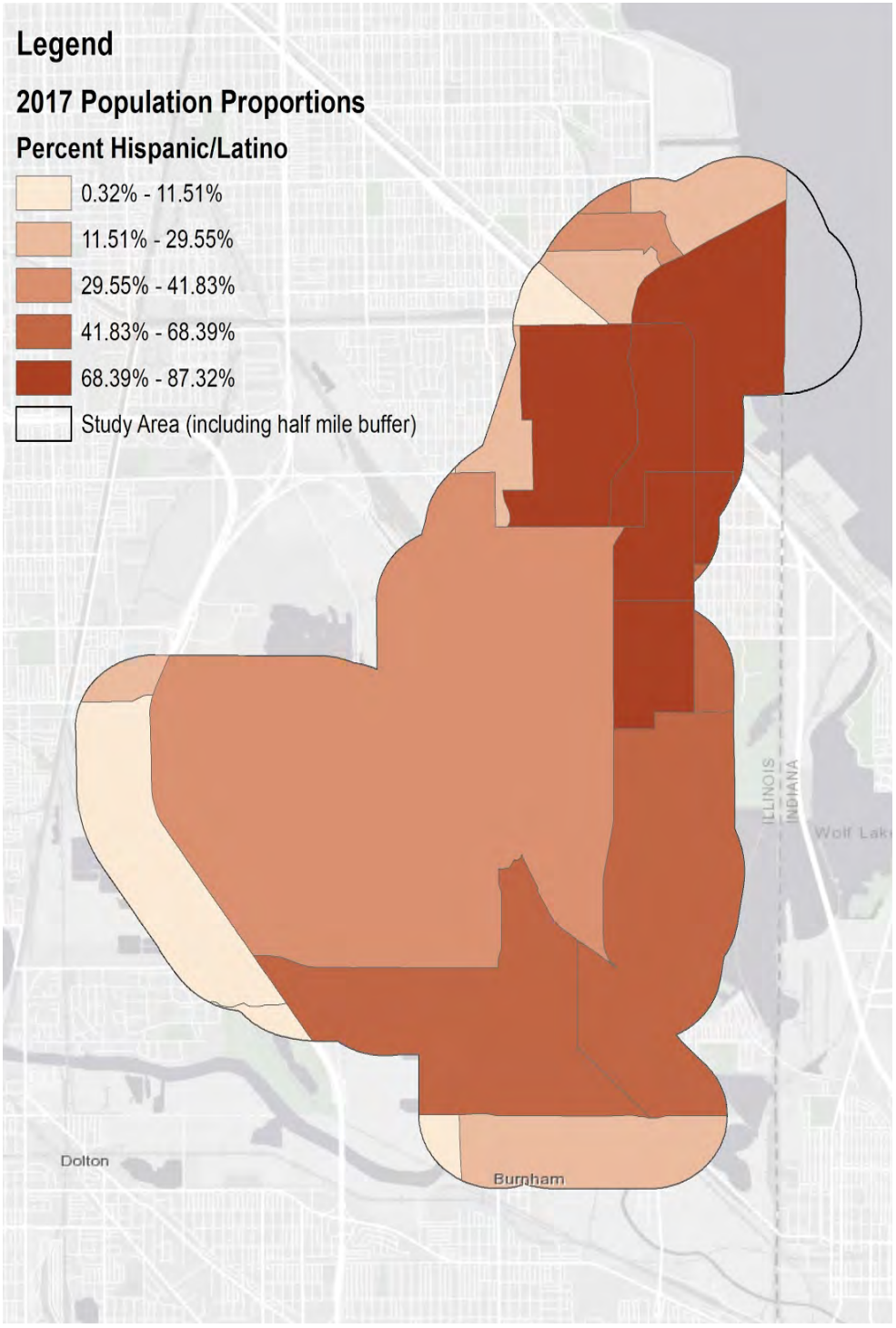
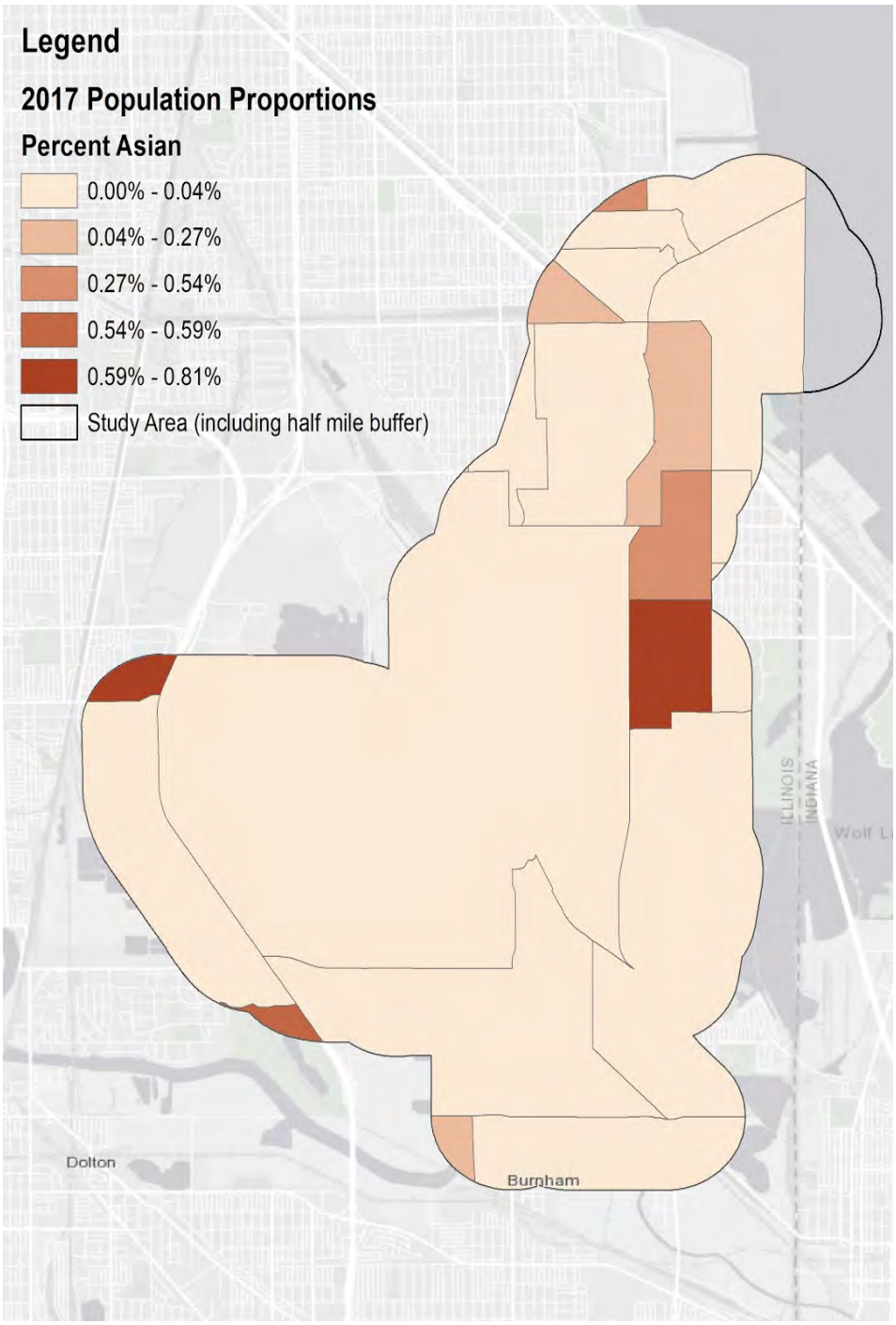


Figure 27. ‘Asian’ population proportion by tract within the study area, based on 2017 Census estimates



Age

The population pyramids below shows how the size of the study area's age groups, broken down by gender, was distributed in 1990, and again in 2017. In 1990, the study area had a large population under the age of 35 (young adults and children), while the age structure in 2017 had two distinct groups, those under the age of 20 and those aged 45 to 59.

Figure 28. Population distribution within the study area by gender/age, based on 1990 estimates; for comparison with Figure 29

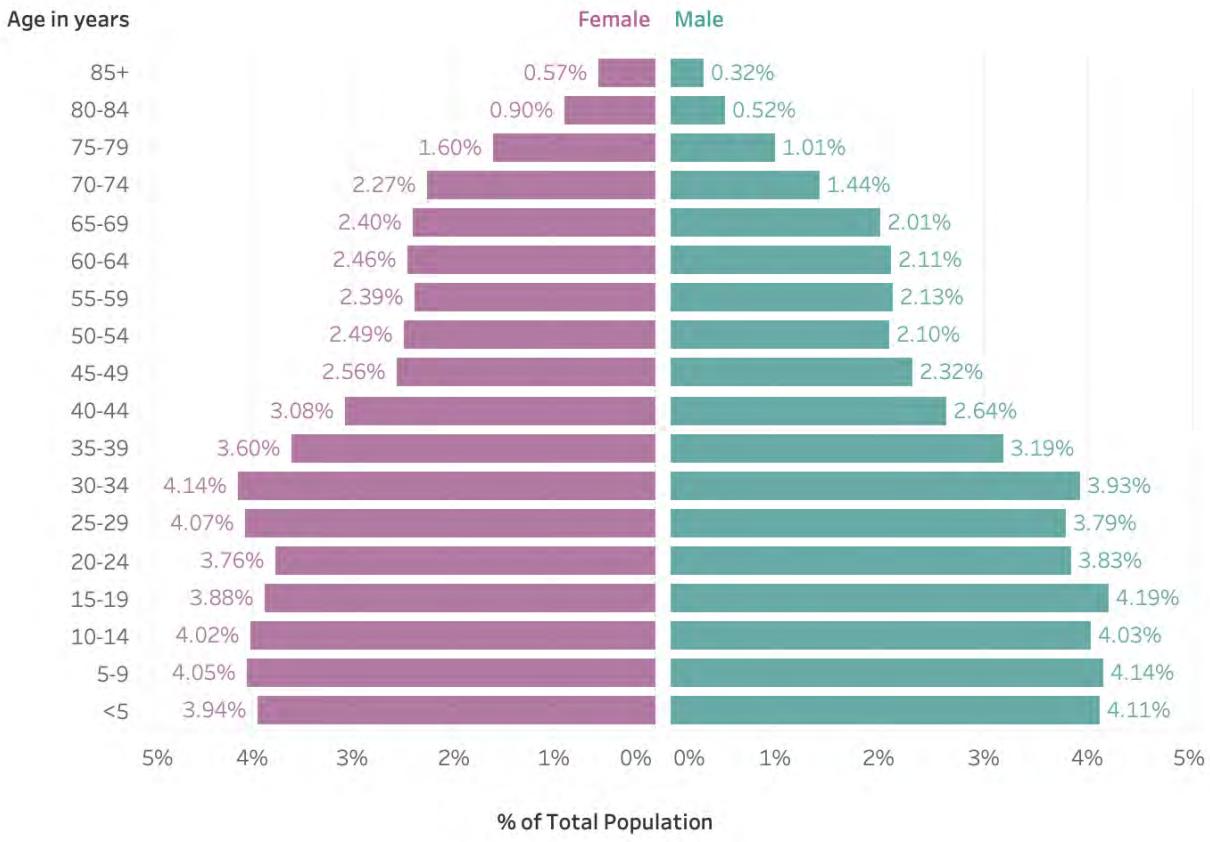
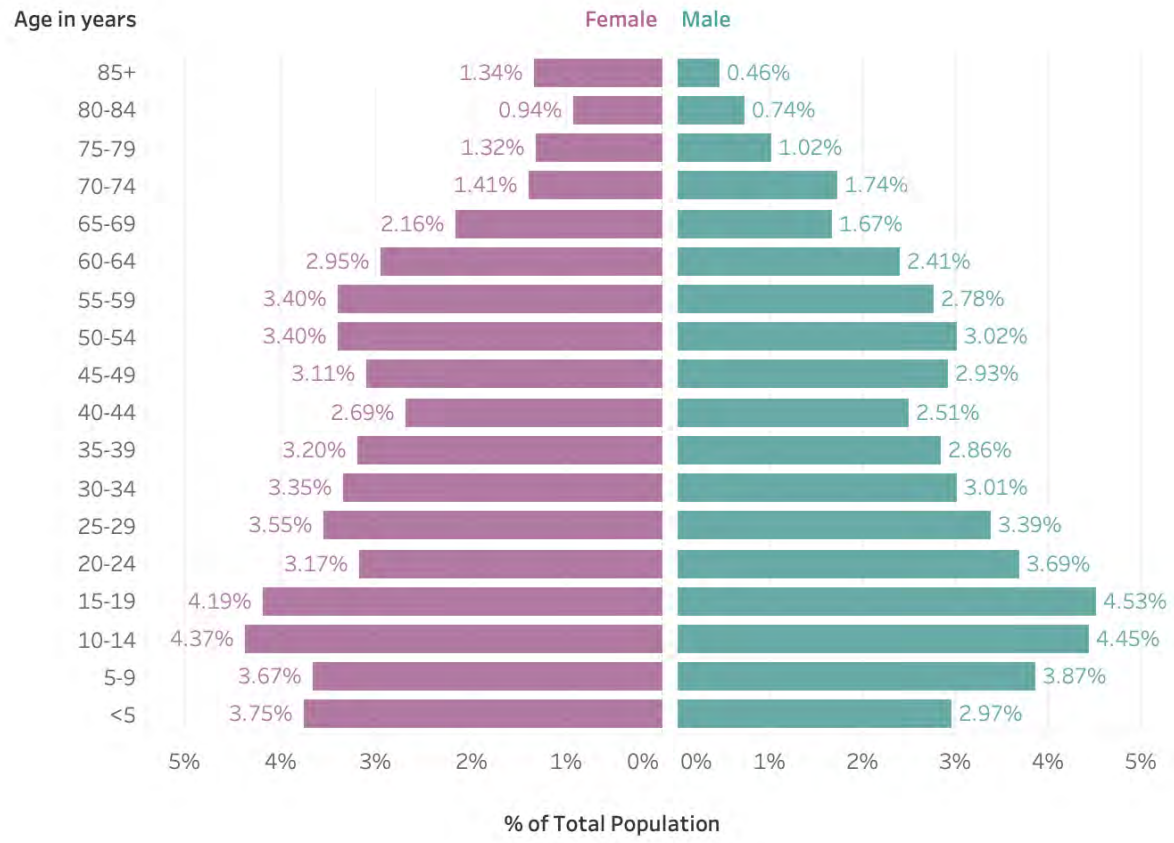


Figure 29. Population distribution within the study area by gender/age, based on 2017 estimates



The data presented in the table below also include the distribution of the study area's population by age and gender. The various shades of orange indicate percent increases in the population, while percent decreases are displayed in shades of blue. Between 1990 and 2017, women aged 85 years and over was the group with the largest percent increase (136.28%), followed by men between 50 to 54 years (44.03%). The population of women aged 70-74 experienced the largest percentage decrease (-37.91%), followed by men under the age of 5 years (-27.74%). We can also appreciate that the population aged 45 to 64 grew at a faster rate than the population under age 44. A key section of the labor force--those aged 20 to 44--have seen an overall decline in their share of the population between the two time periods.

Table 12. Population within the study area by age/gender: 1990 and 2017

	1990		2017		Percent Change, 1990 to 2017	
Age	Female	Male	Female	Male	Female	Male
Under 5 years	3.94%	4.11%	3.75%	2.97%	-4.66%	-27.74%
5-9	4.05%	4.14%	3.67%	3.87%	-9.39%	-6.72%
10-14	4.02%	4.03%	4.37%	4.45%	8.93%	10.58%
15-19	3.88%	4.19%	4.19%	4.53%	7.94%	7.99%
20-24	3.76%	3.83%	3.17%	3.69%	-15.74%	-3.69%
25-29	4.07%	3.79%	3.55%	3.39%	-12.73%	-10.58%
30-34	4.14%	3.93%	3.35%	3.01%	-19.24%	-23.32%
35-39	3.60%	3.19%	3.20%	2.86%	-11.25%	-10.35%
40-44	3.08%	2.64%	2.69%	2.51%	-12.62%	-4.98%
45-49	2.56%	2.32%	3.11%	2.93%	21.38%	26.10%
50-54	2.49%	2.10%	3.40%	3.02%	36.67%	44.03%
55-59	2.39%	2.13%	3.40%	2.78%	41.99%	30.75%
60-64	2.46%	2.11%	2.95%	2.41%	19.98%	14.15%
65-69	2.40%	2.01%	2.16%	1.67%	-9.93%	-17.19%
70-74	2.27%	1.44%	1.41%	1.74%	-37.91%	20.79%
75-79	1.60%	1.01%	1.32%	1.02%	-17.44%	0.43%
80-84	0.90%	0.52%	0.94%	0.74%	4.13%	40.53%
85 years and over	0.57%	0.32%	1.34%	0.46%	136.28%	42.63%

Median Income

The below Figures (30 and 31) depict the tract-specific median household income (MHI) levels within the study area in 1989, as well as 2017. It is important to note that median household income levels as calculated according to the American Community Survey are not adjusted for tract-size; therefore, though there are several partial tracts included in our study area, these tract estimates reflect the median level for the entire tract, not just the portion of the tract that is part of our study area.

As is noted from the upper bands of each figure ($72,546 in 1989 vs. $62,203 in 2017), the overall range for median household income has decreased by around $10,000 inflation-adjusted dollars over the period in between. The most dramatic difference between the two periods can be noted by looking at the largest tract by land area, located in the central part of the corridor. In

1989, this tract had an MHI somewhere in the range between $41,401 and $47,910 inflation-adjusted dollars. By 2017, however, this tract's MHI had dropped considerably, to somewhere between $12,660 and $21,306 inflation-adjusted dollars; even if we assume that in 1989, this tract was at the lower end of the band, this still means that MHI within this tract dropped by at least $20,000 inflation-adjusted dollars.

The distribution of wealth between the two time periods also appears to have shifted within the study area as a whole; for example, if we look at the two tracts just above the largest, most centrally located tract in the study area, we note that both in 1989 had MHI's somewhere in the range between $47,911 and $61,136 inflation-adjusted dollars, while by 2017, these two tracts had MHI's somewhere in the range between $39,330 and $43,342 inflation-adjusted dollars. Additionally, while the highest-earning tract in 1989 was located in the southern-most part of the study area, by 2017, this had slightly shifted.

Figure 30. Median Household Income by tract in 1989 (adjusted for inflation to 2017 US Dollars), based on 1990 Census estimates

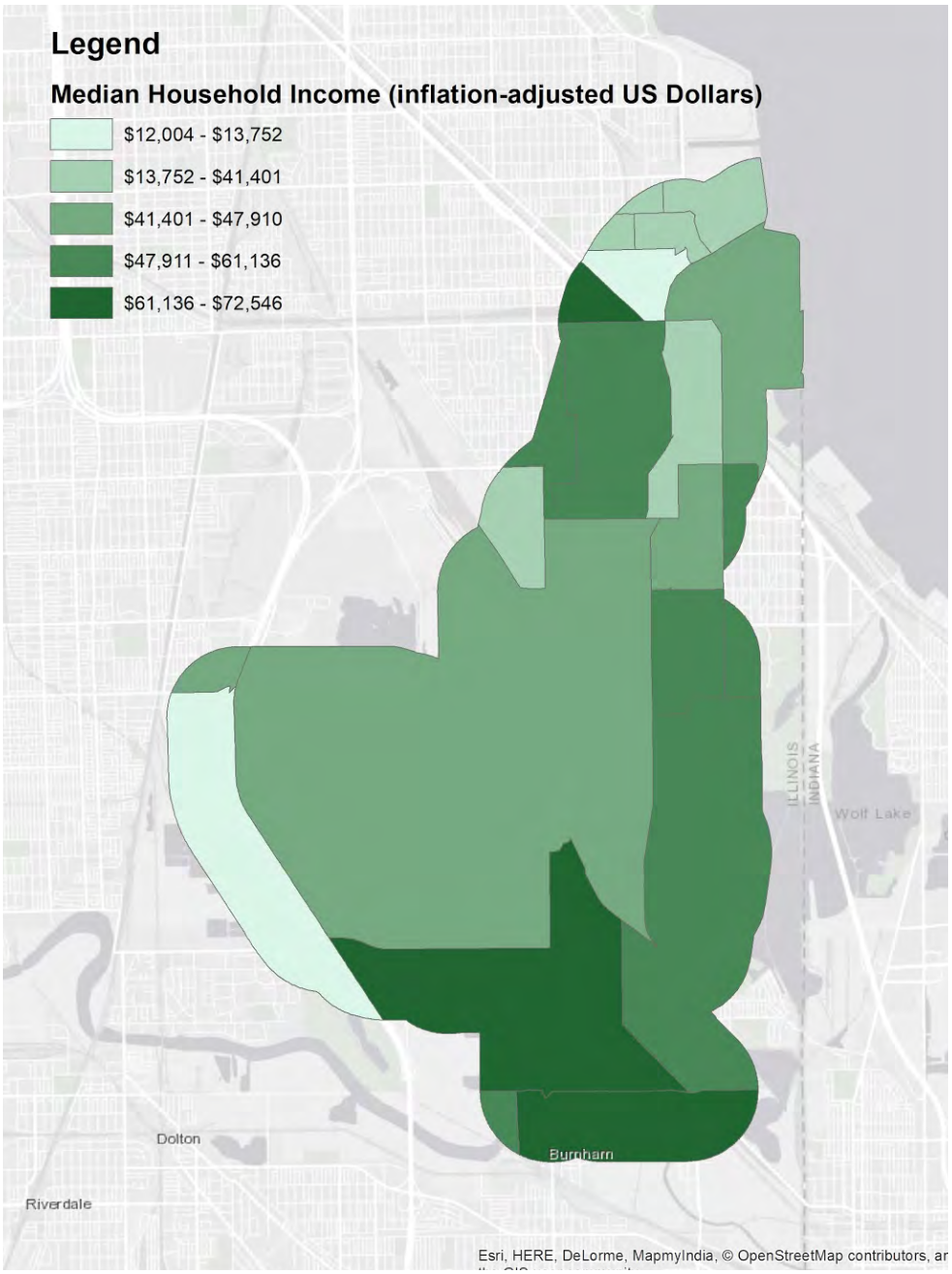
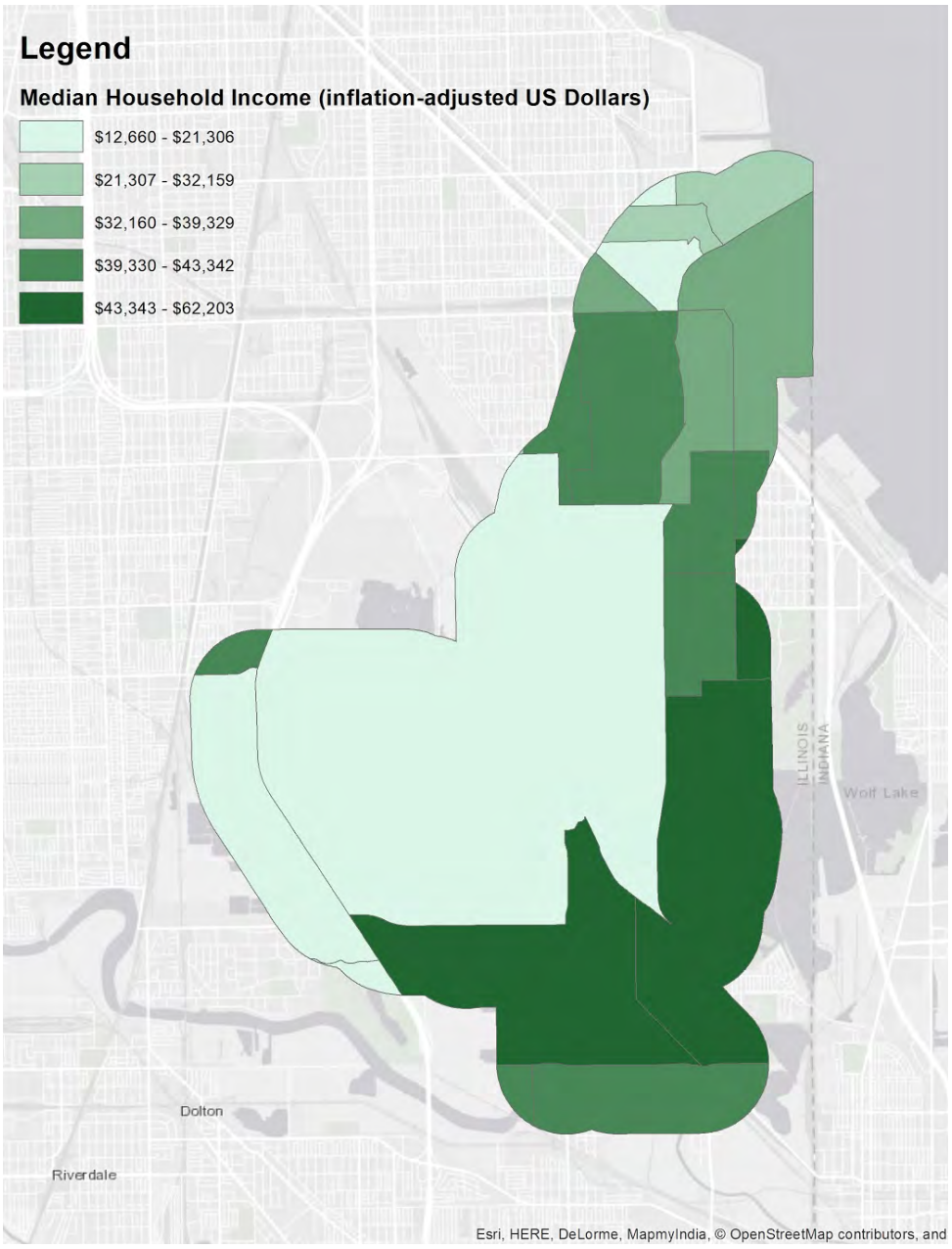


Figure 31. Median Household Income by tract in 2017 (adjusted for inflation to 2017 US Dollars), based on 2013-2017 American Community Survey estimates



Educational Attainment

Figures 32 to 39 below display educational attainment at the census tract level for 1990 and 2017. In 1990, the census tracts concentrated in the north side of the study area had the highest percentages of population with less than high school, with more than 30% of the population over age 25 with less than a high school education. Census tracts within the central section of the study area had the highest percentages of the population aged 25 and older that had completed high school. It also had the highest percentages with a bachelor degree or higher. Part of the south side had the highest concentration of population with some college or associate's degree.

By 2017, the north side remained the area with the highest percentages of population with less than high school but these percentages have declined (with 67% being the highest in 1990 and 39.6% in 2017). The census tracts concentrated in the central, south, and east side of the study area have seen increases in the percentages of population with some college or associate's degree. Census tracts in the east and south side of the study area have experienced increases in the percentages of population with a bachelor's degree or higher. They have become areas of high educational attainment and high income as seen in the previous section.

Figure 32. Percentage of the population 25 years of age or older with less than a high school degree by tract, based on 1990 estimates

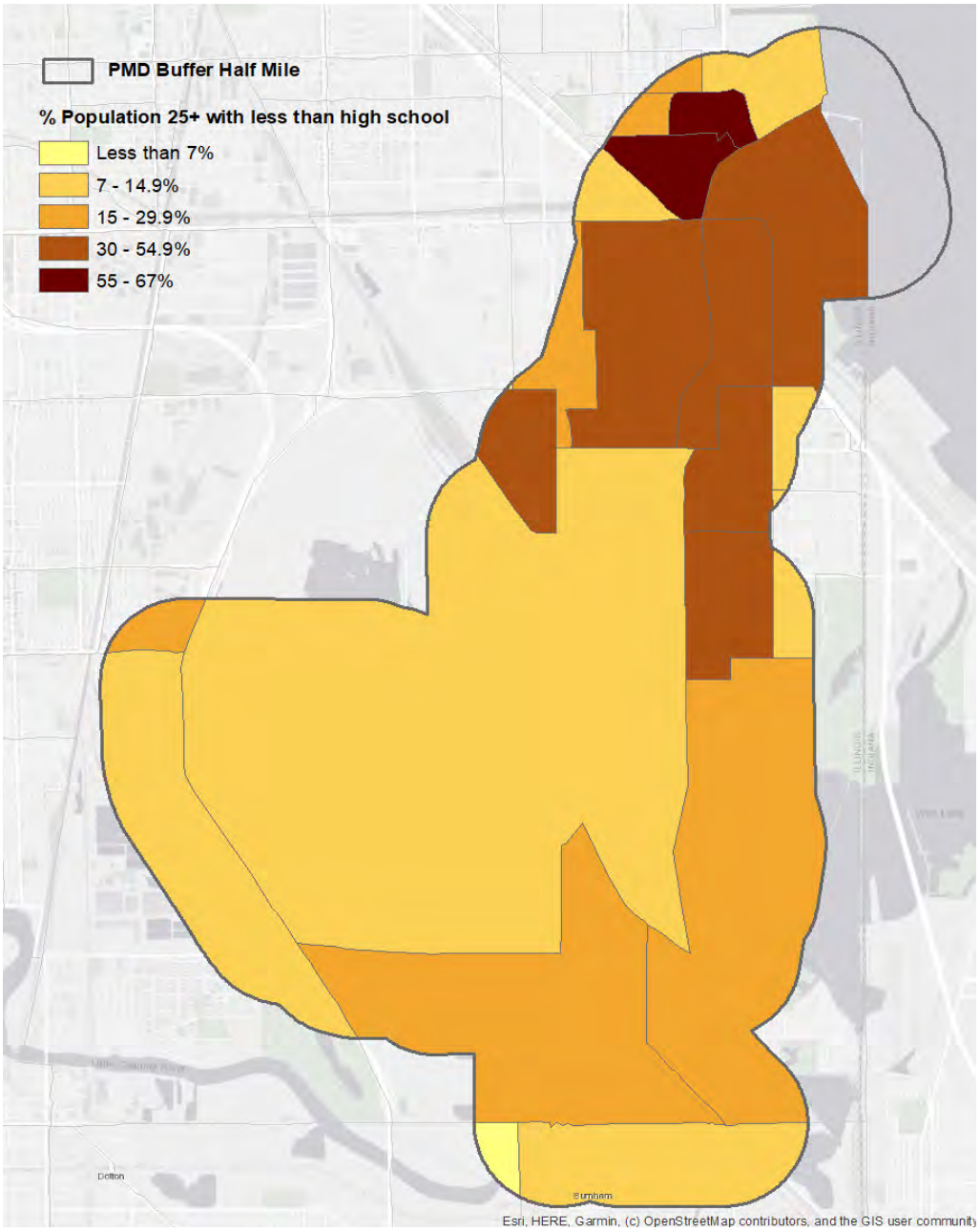


Figure 33. Percentage of the population 25 years of age or older with less than a high school degree by tract, based on 2017 estimates

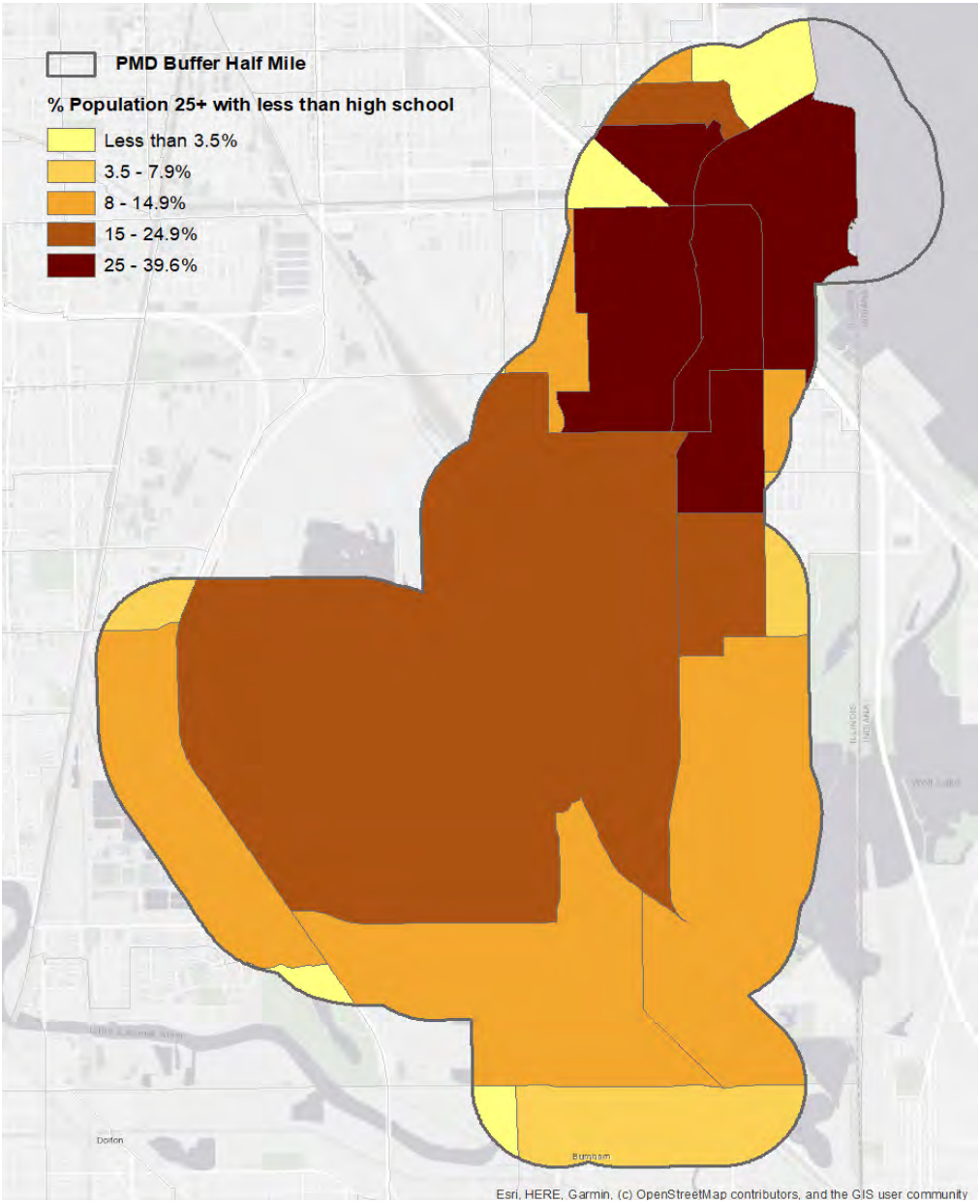


Figure 34. Percentage of the population 25 years of age or older that have earned a high school degree by tract, based on 1990 estimates

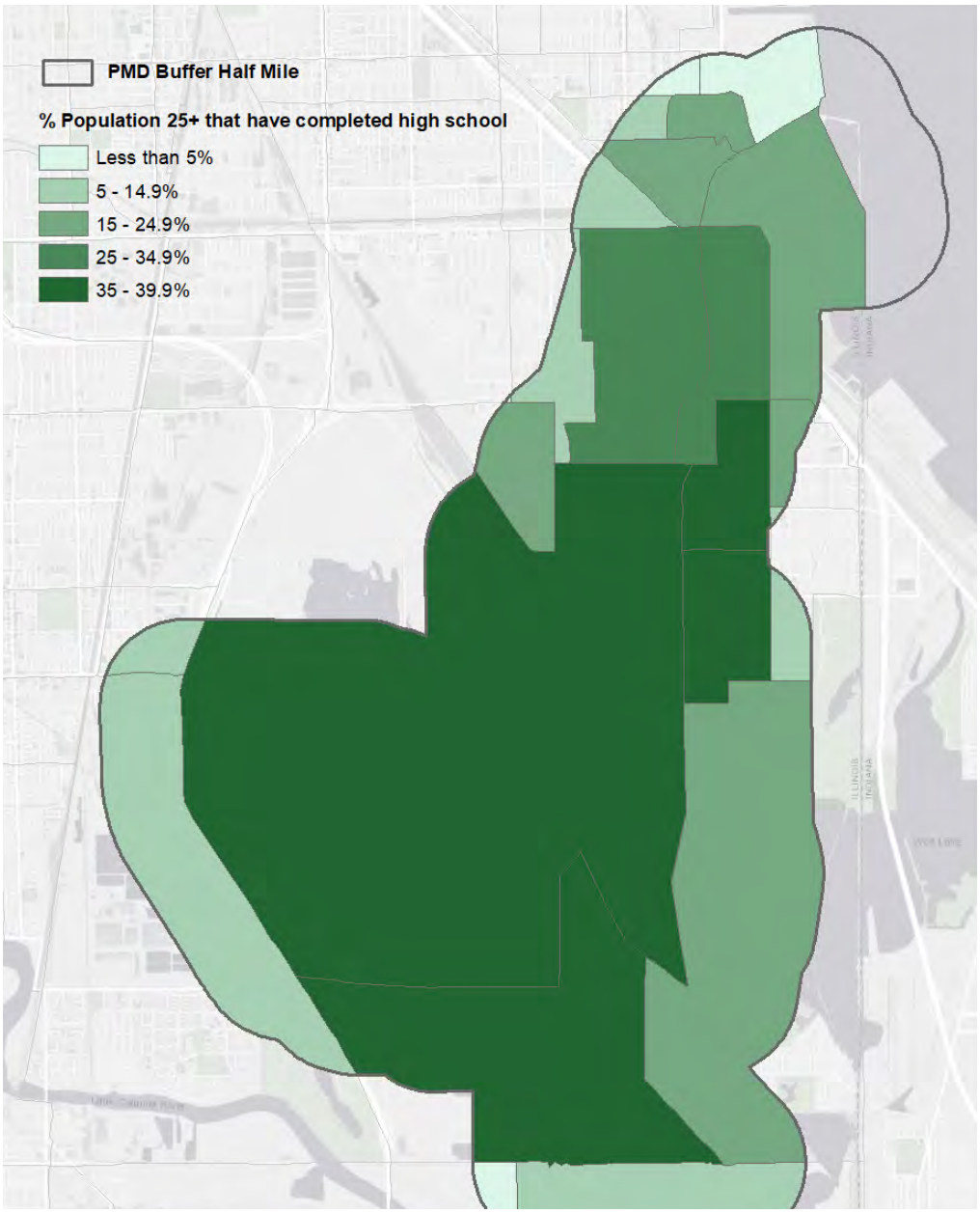


Figure 35. Percentage of the population 25 years of age or older that have earned a high school degree by tract, based on 2017 estimates

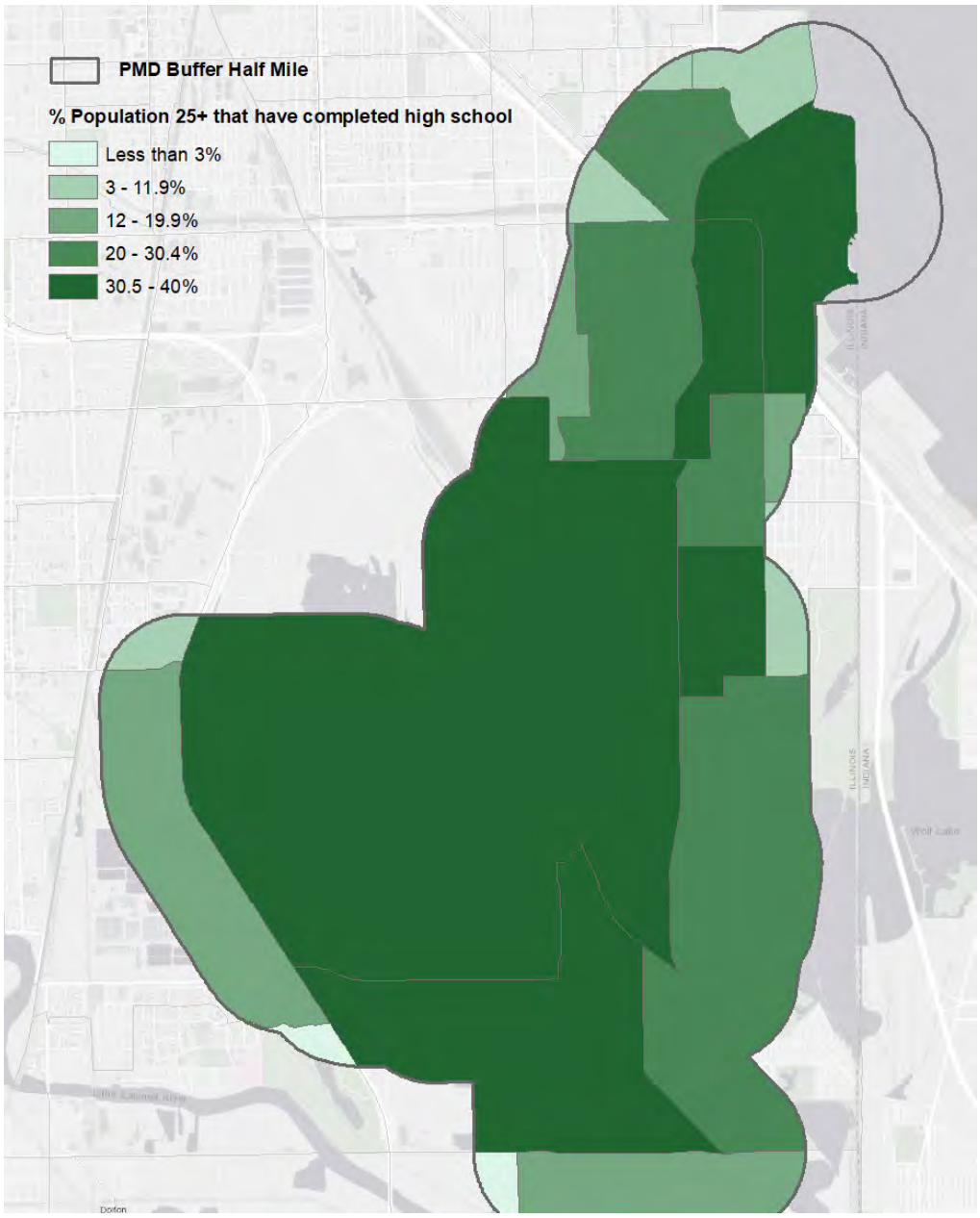


Figure 36. Percentage of the population 25 years of age or older with some college and/or an associate's degree by tract, based on 1990 estimates

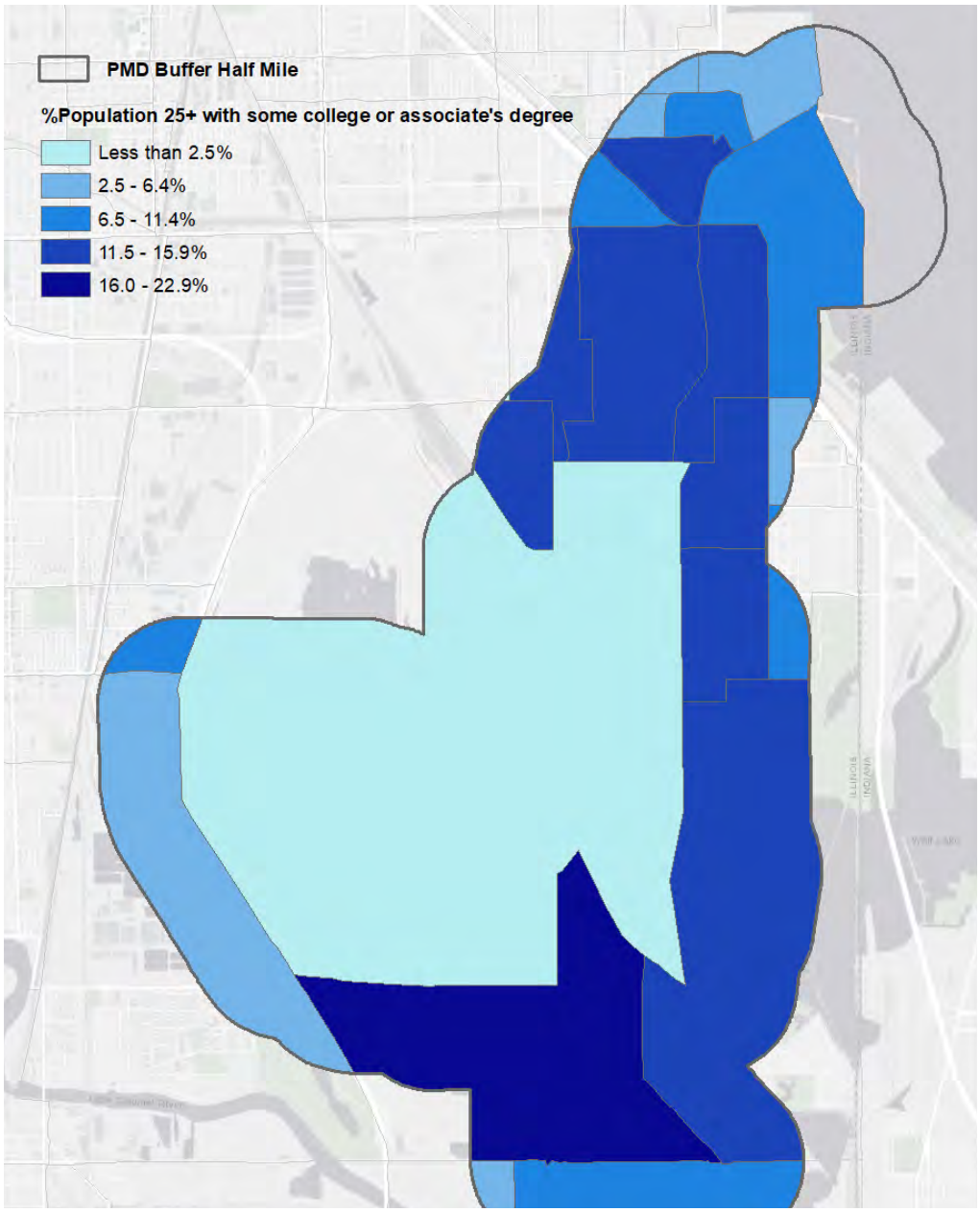


Figure 37. Percentage of the population 25 years of age or older with some college and/or an associate degree by tract, based on 2017 estimates

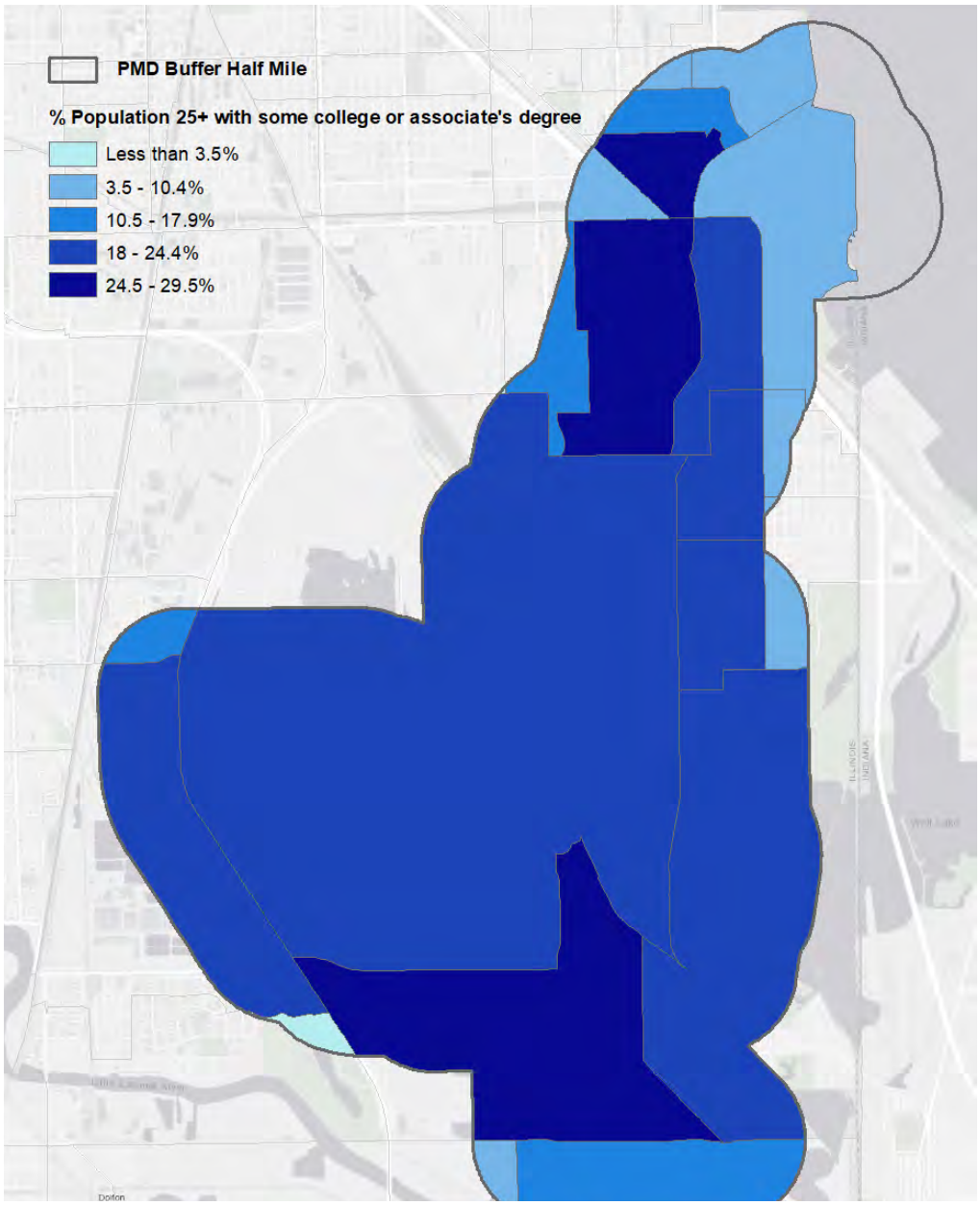


Figure 38. Percentage of the population 25 years of age or older with a bachelor's degree or higher by tract, based on 1990 estimates

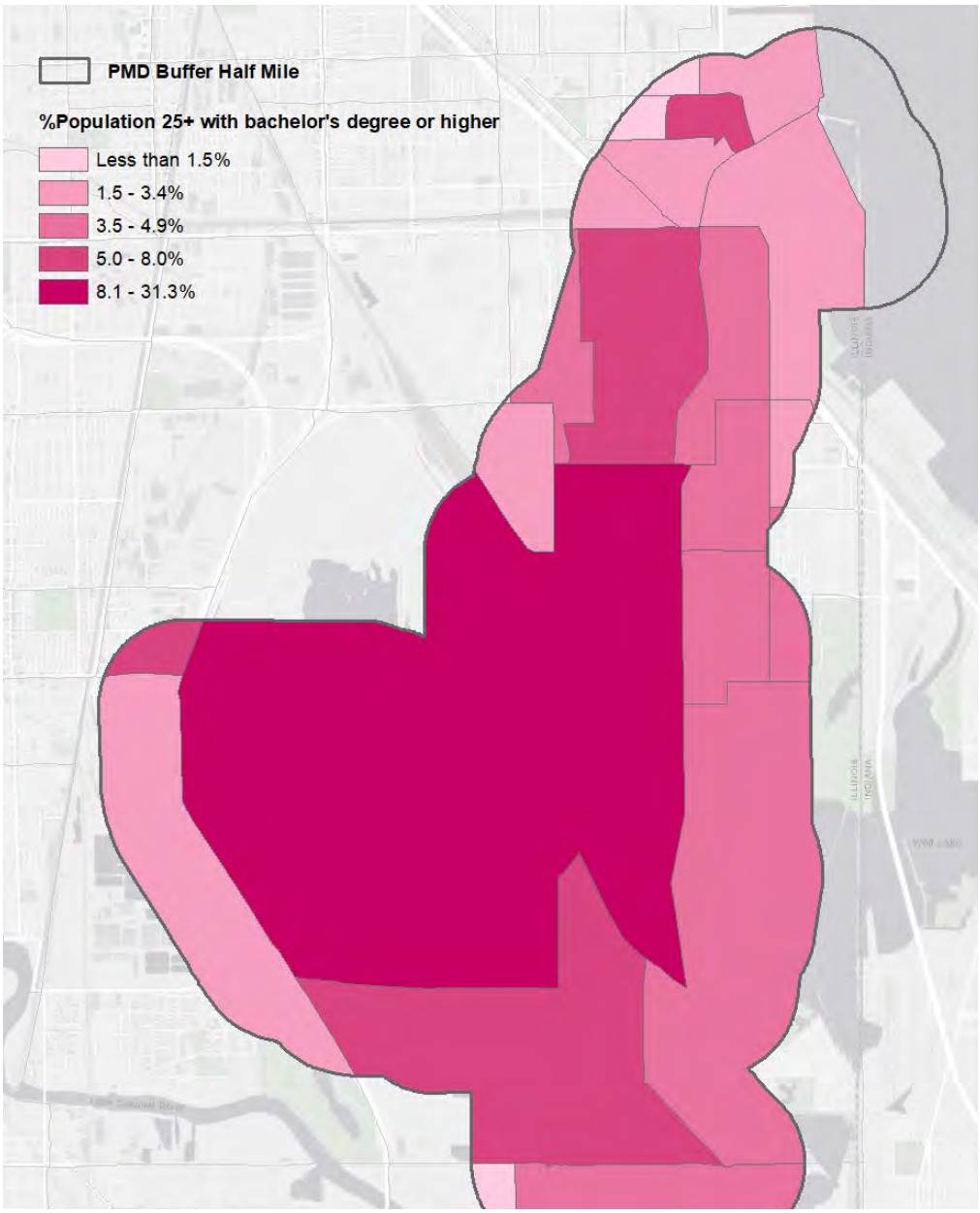
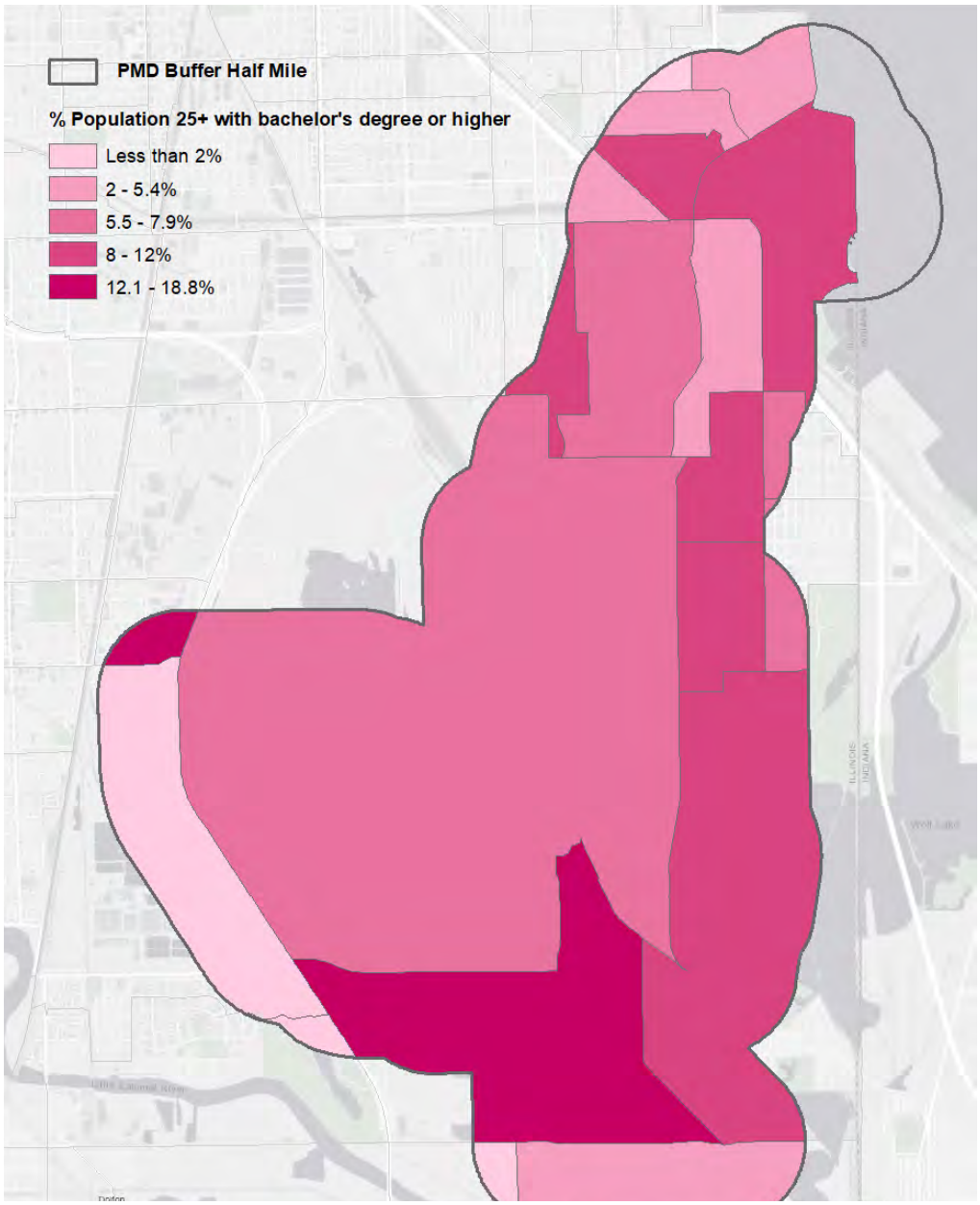


Figure 39. Percentage of the population 25 years of age or older with a bachelor's degree or higher by tract, based on 2017 estimates



Land use allocation

The research team mapped the distribution of land uses in the study area in 1990 as well as 2013, the results of which can be seen below, in Figures 41 to 45, and 47 to 51. Tables 13 and 14 display the top 5 land area classes in each year, by the share each class makes up of the total land acreage of the study area. Finally, Tables X,X, and X, as well as the accompanying narrative, highlight the main differences between land use distribution in each year.

Figure 40. Legend displaying 1990 land use allocation classes within the study area; to be viewed in tandem with Figures 41 to 45 (on subsequent pages)

Figure 41. Map of land use allocation within the Calumet Industrial Corridor and surrounding ½ mile buffer area, as of 1990

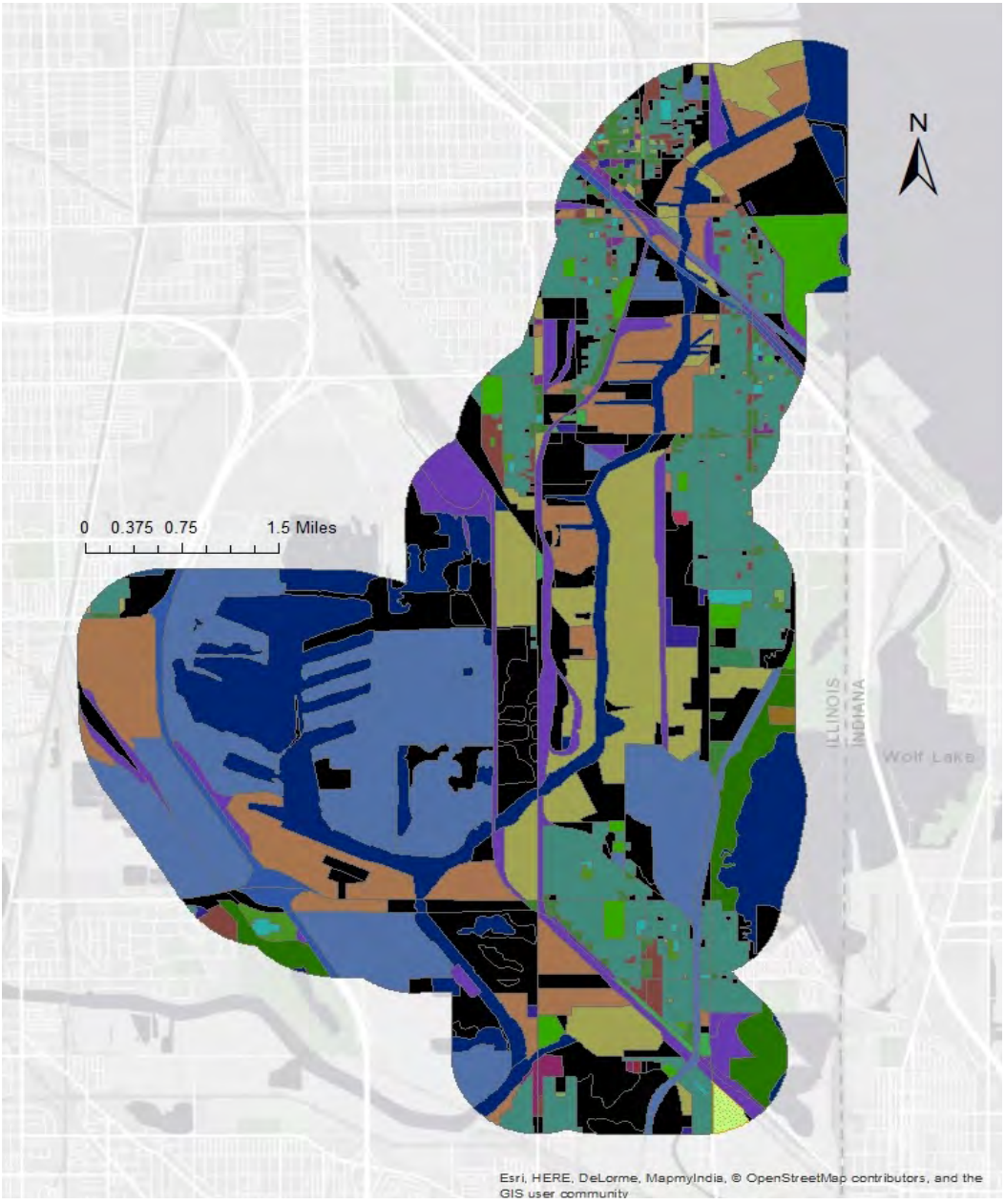


Figure 42. Map of 1990 land use allocation, cross-section 1; to be viewed in tandem with land use class legend (Figure 40, above)

Figure 43. Map of 1990 land use allocation, cross-section 2; to be viewed in tandem with land use class legend (Figure 40, above)

Figure 44. Map of 1990 land use allocation, cross-section 3; to be viewed in tandem with land use class legend (Figure 40, above)

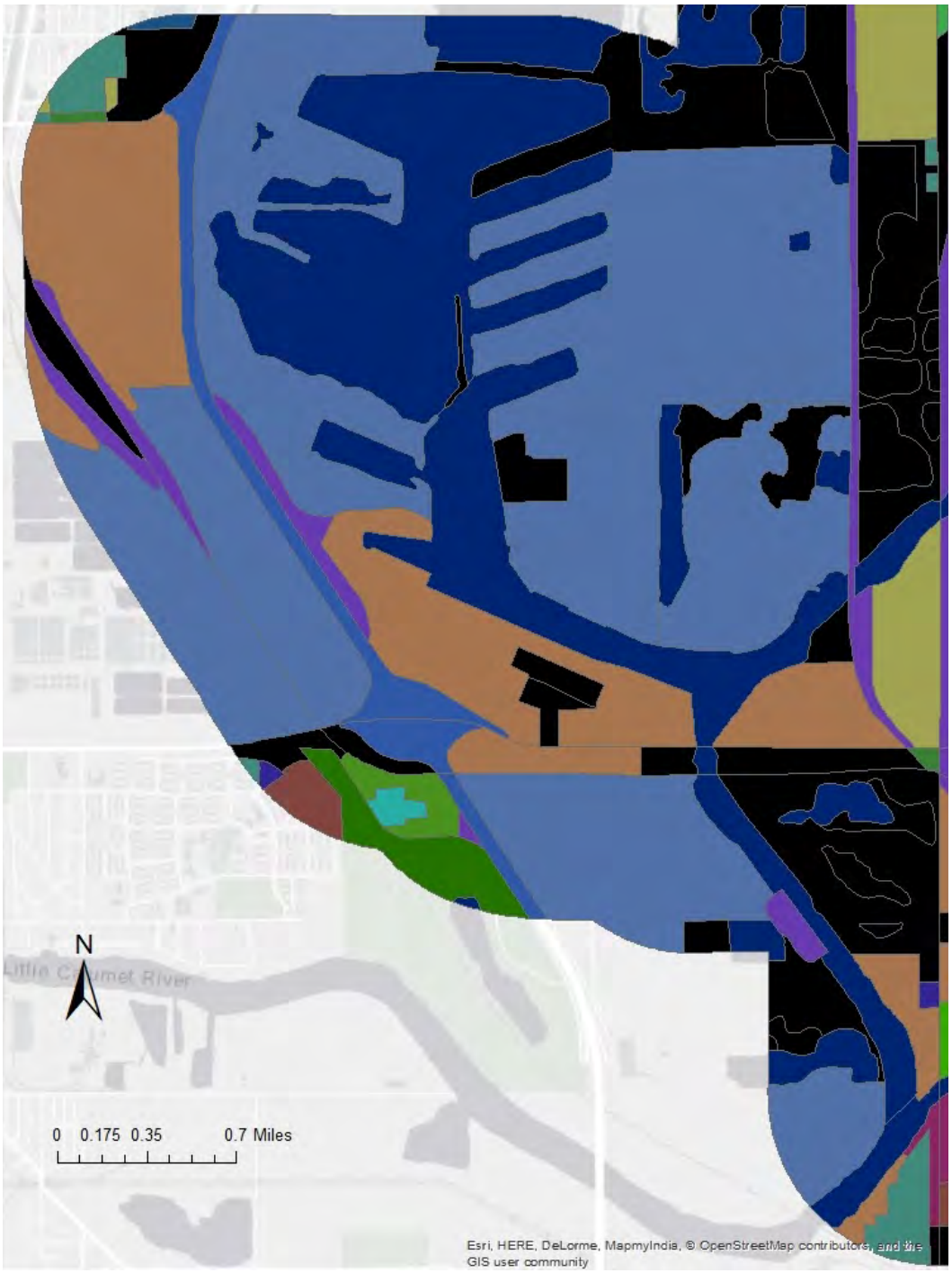


Figure 45. Map of 1990 land use allocation, cross-section 4; to be viewed in tandem with land use class legend (Figure 40, above)

Table 13. Table representing top 5 land use classes, by percentage of total study area land (1990)

Land Use Code (as per 1990)	Zoning Class	Square Miles	Acres	Percent of Study Area Land
1560	Utilities and Waste Facilities	3.123495	1999.036665	17.73%
1110	Single, Duplex, and Townhouse Units	2.348128	1502.801841	13.33%
4110	Vacant Forest or Grassland	1.920483	1229.109416	10.90%
1430	Warehousing/Distribution Center	1.728903	1106.498124	9.81%
1420	Manufacturing and Processing	1.622303	1038.273924	9.21%

The table above shows the top 5 largest land uses within the study area in 1990. When combined, they account for almost 61% of the total study area land. To understand these categories and what they represent, the research team turned to the Chicago Metropolitan Agency for Planning's 1990 Land Use Inventory Metadata, which provided the following descriptions about these land use categories:

> '**1560 - Utilities and Waste Facilities**' includes electric, gas, water, sewage, solid waste, and other pipelines. Also includes electric generation plants and substations, natural gas production plants and storage tanks, water treatment plants, water towers and accompanying land, sewage treatment plants, refuse and garbage plants, incinerators, and sanitary landfills.
>
> '**1110 - Single, Duplex, and Townhouse Units**' indicates all single-family housing as well as multi-unit structures whose units do not share a common entryway.
>
> The category '**4110 - Vacant Forest or Grassland**' includes bands of vacant forested land or grassland along streams (riparian corridors) when sustained width of corridor is larger than 200 feet summing both sides of stream.
>
> '**1430 - Warehousing/Distribution Center**' includes general warehousing and storage, junkyards with tires and other auto parts, and wholesaling of retail goods operations.

The category '**1420 - Manufacturing and Processing**' allows food manufacturing, lumber and wood product manufacturing, petroleum refining, primary metal industries, and fabricated metal product manufacturing.

Figure 46. Legend displaying 2013 land use allocation classes within study area; to be viewed in tandem with Figures 47 to 51 (on subsequent pages)

Figure 47. Map of land use allocation within the Calumet Industrial Corridor and surrounding ½ mile buffer area, as of 2013

Figure 48. Map of 2013 land use allocation, cross-section 1; to be viewed in tandem with land use class legend (Figure 46, above)

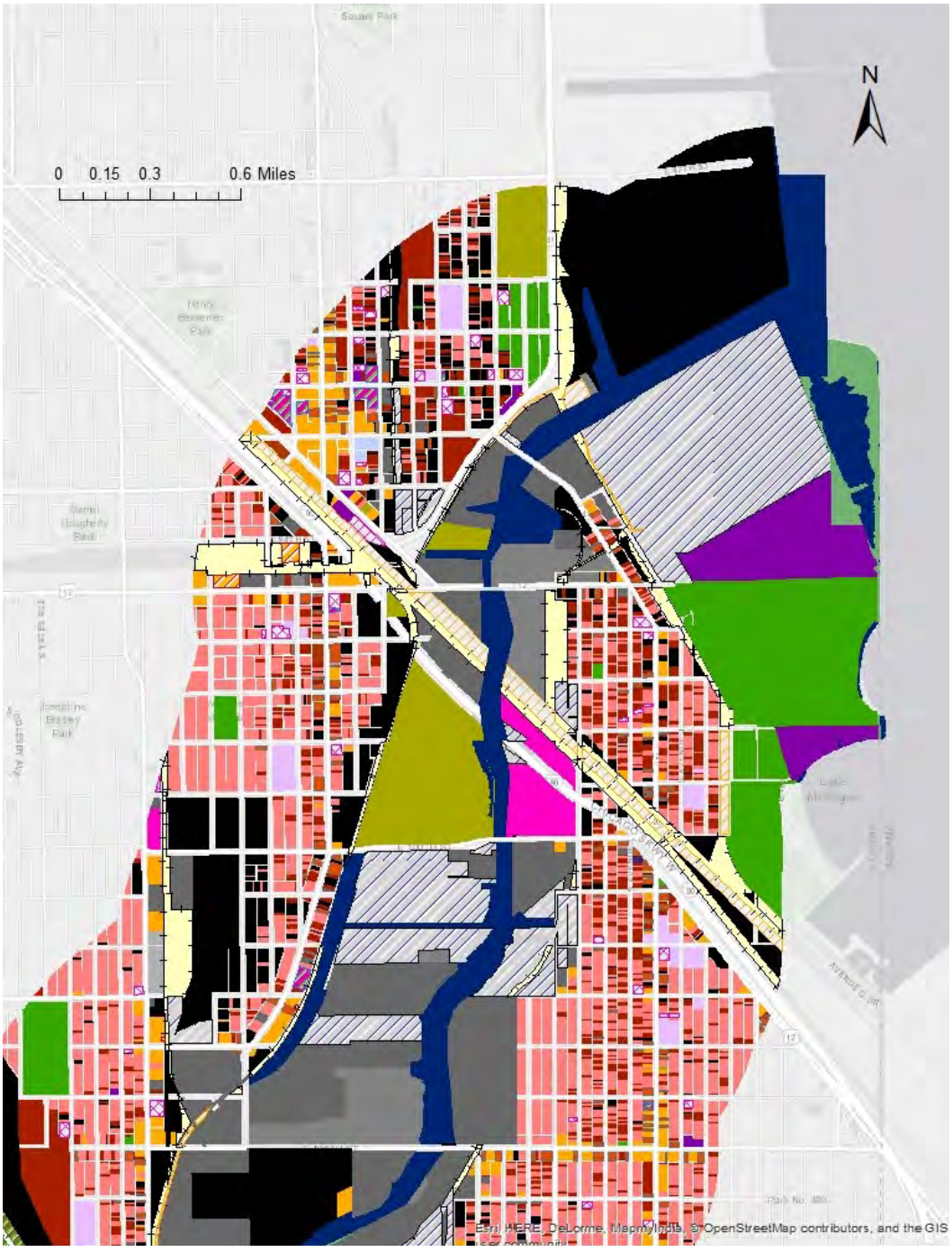


Figure 49. Map of 2013 land use allocation, cross-section 2; to be viewed in tandem with land use class legend (Figure 46, above)

Figure 50. Map of 2013 land use allocation, cross-section 3; to be viewed in tandem with land use class legend (Figure 46, above)

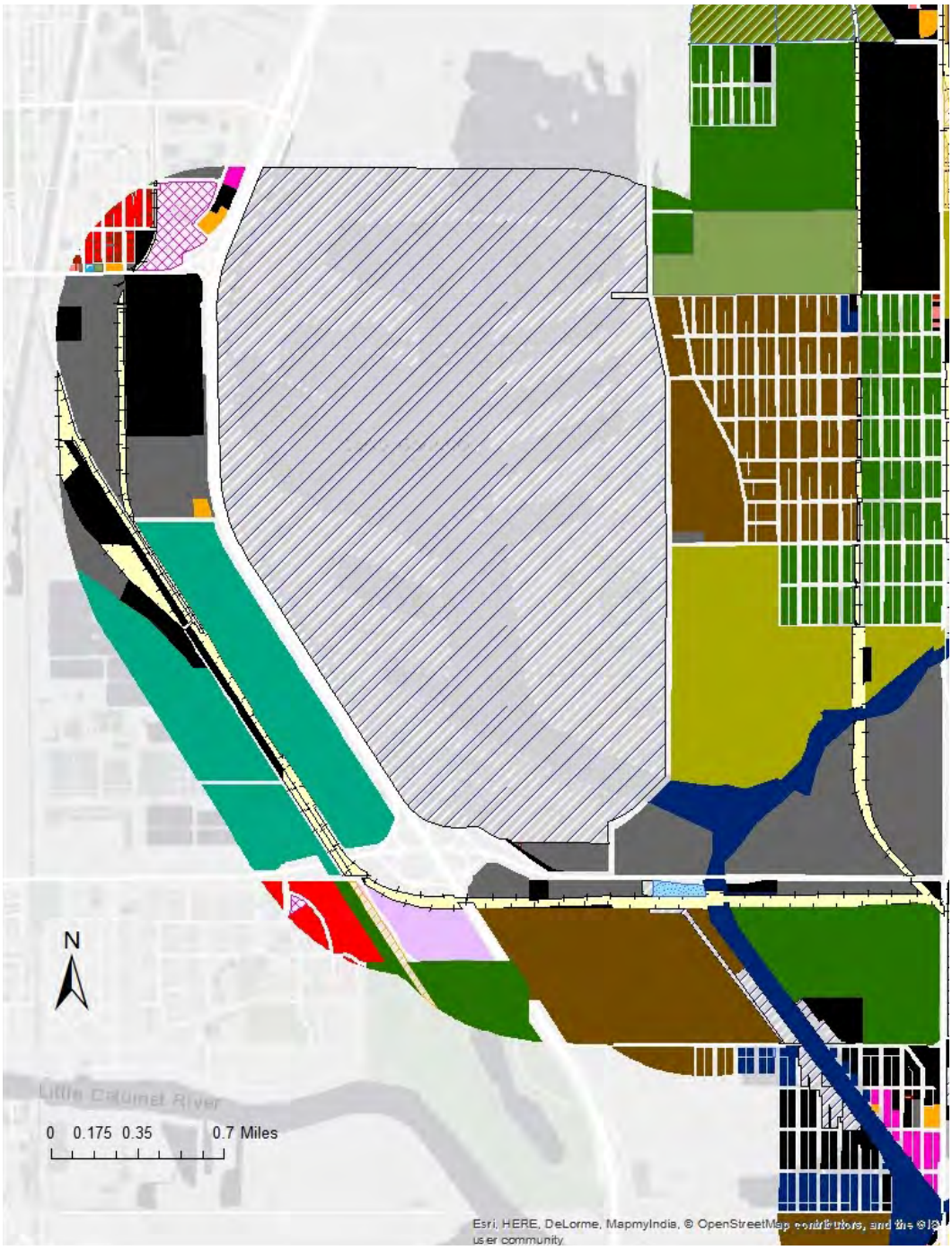


Figure 51. Map of 2013 land use allocation, cross-section 4; to be viewed in tandem with land use class legend (Figure 46, above)

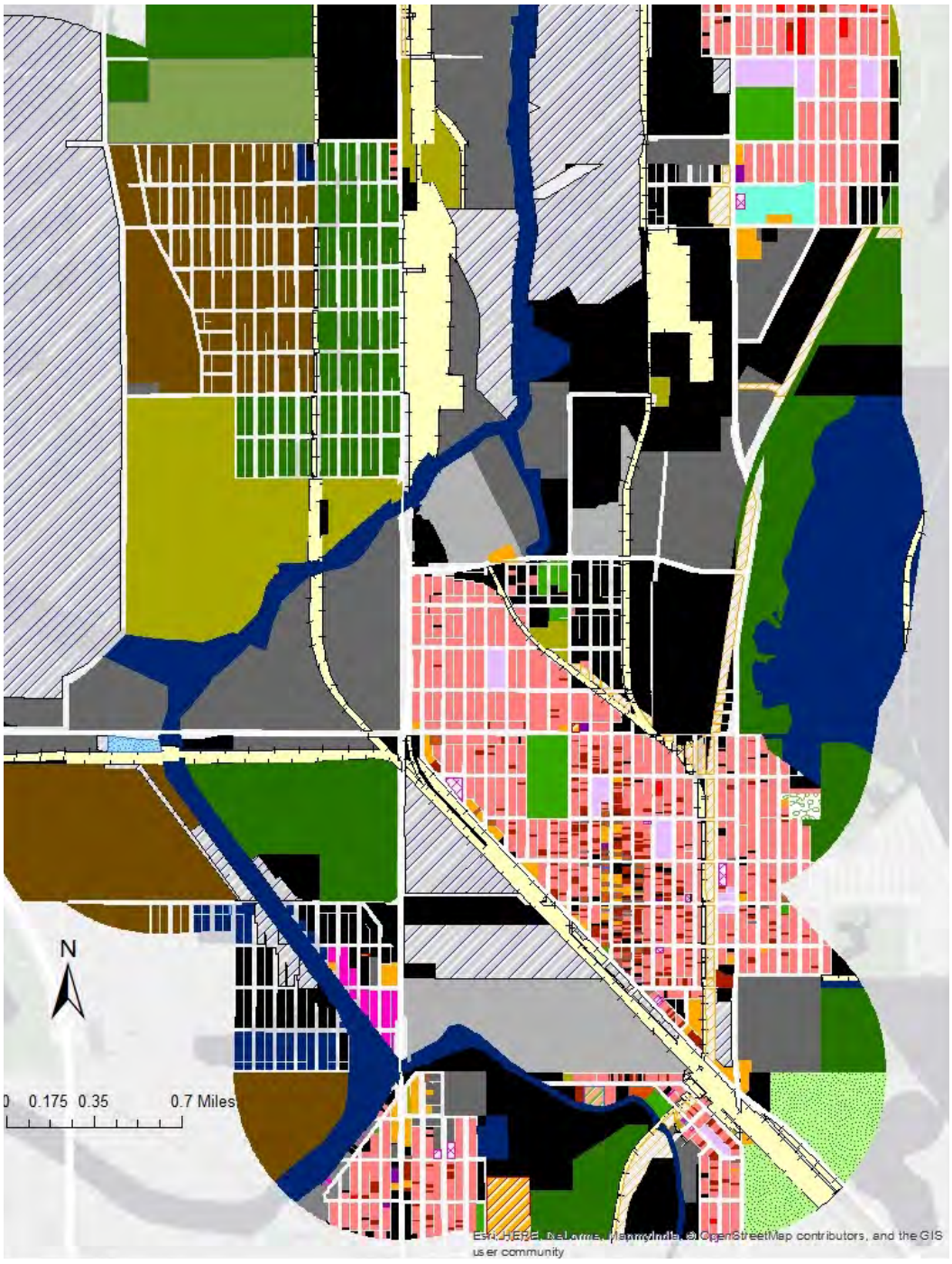


Table 14. Table representing top 5 zoning classes, by percentage of total study area land (2013)

Land Use Code (as per 2013)	Zoning Class	Square Miles	Acres	Percent of Study Area Land
1520	Other Linear Transportation	3.454676	2210.992325	22.43%
1111	Single Family Detached	1.256563	804.200627	8.16%
1420	General Industrial	1.107153	708.57778	7.19%
4140	Vacant Other	1.089279	697.138737	7.07%
3300	Open Space Conservation	1.050504	672.32248	6.82%

The table above shows the 5 largest land uses within the study area in 2013. When combined, they account for almost 52% of the total study area land.

According to CMAP's description of 2013 Land Use Inventory categories, '**1520 - Other Linear Transportation with Associated Facilities**' indicates transportation related activities separated from right-of-way parcels, including commuter rail stations and parking, as well as maintenance yards and freight terminals. This category also includes bus transportation, public and private, including passenger terminals and bus ports, garaging, and maintenance facilities; motor freight and miscellaneous transportation including trucking terminals, trucking equipment and maintenance facilities, taxicab transportation. This category also includes marine transportation including commercial docks and terminals.

The category '**1111 - Single Family Detached**' allows all single-family housing that have one housing unit per free-standing residential structure. It can include undeveloped residential properties when adjacent to a developed property with the same owner.

'**1420 - General Industrial < 100,000 sq. ft.**' includes smaller-scale manufacturing and warehousing operations.

The category '**4140 - Vacant Other**' includes land in an undeveloped state where classification is unknown or is classified as "Agriculture" by county assessor, where less than 25% of the parcel is farmed.

‘**3300 - Open Space Conservation**’ is an open space in a natural state, which includes public land, state-dedicated nature preserves, and privately-run conservation facilities.

Due to the reasons explained in the ‘data limitations’ sub-section, a direct comparison between the 1990 and 2013 land inventories shown above is not possible, however, we can highlight the following differences presented in Tables 13, 14, and 15, below:

By 2013, the study area had observed a notable increase in transportation facilities, terminals, and docks (1520), which grew to be the largest land use allocation by share, covering 22.43% of the total land area (see Table 14). On the other hand, vacant land share decreased from 17.72% in 1990 to 14.66% in 2013. Most of the 1990 vacant land that had not been developed for any human purposes--such as forested/grassland (4110) and wetland (4120)--were converted to urban uses by 2013, specifically for transportation, residential, institutional, commercial, and industrial purposes.

Most land area in 2013 was devoted to residential and industrial uses, but both saw a decrease from their 1990 levels, as depicted in Table 15. Residential land accounted for 10.77% of the area in 2013, a decline from 14.70% in 1990. Specifically, the land use category for ‘single-family detached units, duplexes, and townhouses’ (whose units do not share a common entryway) saw a decrease in share from approximately 1503 acres (13.33%) in 1990 (see Table 13) to 804 acres (8.16%) by 2013 (see Table 14).

Interestingly, industrial land held a 12.39% share in 2013--a level reflecting a significant decrease from the nearly 20 percent share it held in 1990. In contrast, the share of land devoted to open space doubled from 4.85% in 1990 to 9.82% in 2013. Open space, primarily conservation, accounted for 6.82% of the total area in 2013.

In comparing 1990 and 2013 land use allocation within the study area, we noted that on the aggregate level, the 2013 land distribution was focused more on transportation, open space, and institutional uses than did the 1990 distribution.

Table 15. Comparison between 1990 and 2013 land uses in the Calumet Industrial Corridor

Land Use*	1990	2013	
Transportation/Communication/Utilities/Waste	25.37%	40.97%	↑
Vacant/Under Construction	17.72%	14.66%	↓
Industrial	19.06%	12.39%	↓
Residential	14.70%	10.77%	↓
Open Space	4.85%	9.82%	↑
Water/Other	14.53%	7.49%	↓

Institutional	1.18%	2.02%	↑
Commercial	2.59%	1.88%	↓
Agriculture	0	0	
Total	100.00%	100.00%	
*Note: In this table, 'Land Use' represents aggregates of the primary land use code categories.			

Proximity of pollution-generating properties to residential land

Figures 52 and 53, below, map the location of 1990 and 2016/2017 TRI and Superfund sites, as well as their proximity to residential land classes; for a description of both the TRI/Superfund programs see pages 20-21 of the 'Methods' sub-section.

On each map, we have displayed all residentially-allocated land in a ¼ mile buffer around each site. In general, we observed that the number of TRI sites (i.e. facilities that reported toxic chemical releases to the EPA's Toxics Release Inventory program) has decreased over time, with 17 sites in 1990 versus 9 sites in both 2016 and 2017. Despite this positive trend, 7 facilities--almost half of the 1990 TRI list-- also appeared on either the 2016 or 2017 TRI list, suggesting long-term contamination, and repeated toxic exposures for both workers at these sites, and residents living in proximity. These 7 sites include Cargill, Atlas Tube, PVS Chemical, Sherwin-Williams, PPG, Ford Motor, and American Zinc. Additionally, most facilities that appeared on the TRI list in 2016 also appeared on the 2017 list, with the exception of Horsehead and Sherwin-Williams. For a full listing of sites across all 3 years, see Figure 54, on page 108.

The immediate area around a number of TRI sites in both years was/continues to be allocated to a substantial amount of single and multifamily residential housing, sitting on both sides of the river in the north and south sections of the study area. Most 1990 multi-family residential zoning (depicted in brown) was located within a ¼ mile of the former Nalco Chemical Company on the west side of the Calumet River between 90th and 93rd streets. Besides the Nalco site, sites 0, 13, and 15 on Figure 52 (DTE, Chicago Steel, and Ford Motor Company) all were immediately surrounded by single/duplex/townhouse residential land. As can be seen on Figure 53, apart from the Ford site (which is immediately surrounded by 'single family detached' residential land), no other 2017 TRI site was immediately surrounded by any residential land allocation.

Even more so than TRI sites, the most hazardous sites (whose contaminants require multi-year remediation efforts) can be identified through the Superfund program. As observed when looking at the below figures, no sites had yet been identified for long-term cleanup on the National Priority List (NPL) in 1990. However, in 2005, the 'Lake Calumet Cluster' site was proposed for addition, and in 2010, it was formally listed after it was determined to pose 'a real

or potential threat to human health and the environment'. As mentioned in the 'Methods' sub-section on page 20, the NPL contains the most serious uncontrolled or abandoned hazardous waste sites throughout the US that have been flagged for potential long-term cleanup, and it is intended primarily to guide EPA strategy in determining which sites warrant further investigation and EPA staff/resources. According to the EPA, the 'Lake Calumet Cluster' is an 87-acre site composed of land, waste storage and disposal facilities. Industry operations over the long-term have contaminated the soil and groundwater with volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides and heavy metals. Currently, the site's EPA-led groundwater remediation strategy is under development.

More recently, the Schroud Property was proposed for addition to the NPL in June 2019. From 1951 to 1977, this site was used to store and dump slag material--a by-product of metal smelting--from the former Republic/LVT Steel facility, located about a mile away. Soil at the 67-acre site has been heavily contaminated with lead, chromium and other inorganic compounds, as a result. In November 2019, the site was officially added to the NPL, and the City of Chicago placed barriers and warning signs around parts of the site to discourage access. Neither Schroud nor the Lake Calumet Cluster sites are immediately situated next to residential land.

Figure 52. Spatial distribution of 1990 Superfund and Toxics Release Inventory (TRI) sites within the study area. Residential land (as per Figure 41) is depicted with ¼ mile land use buffers

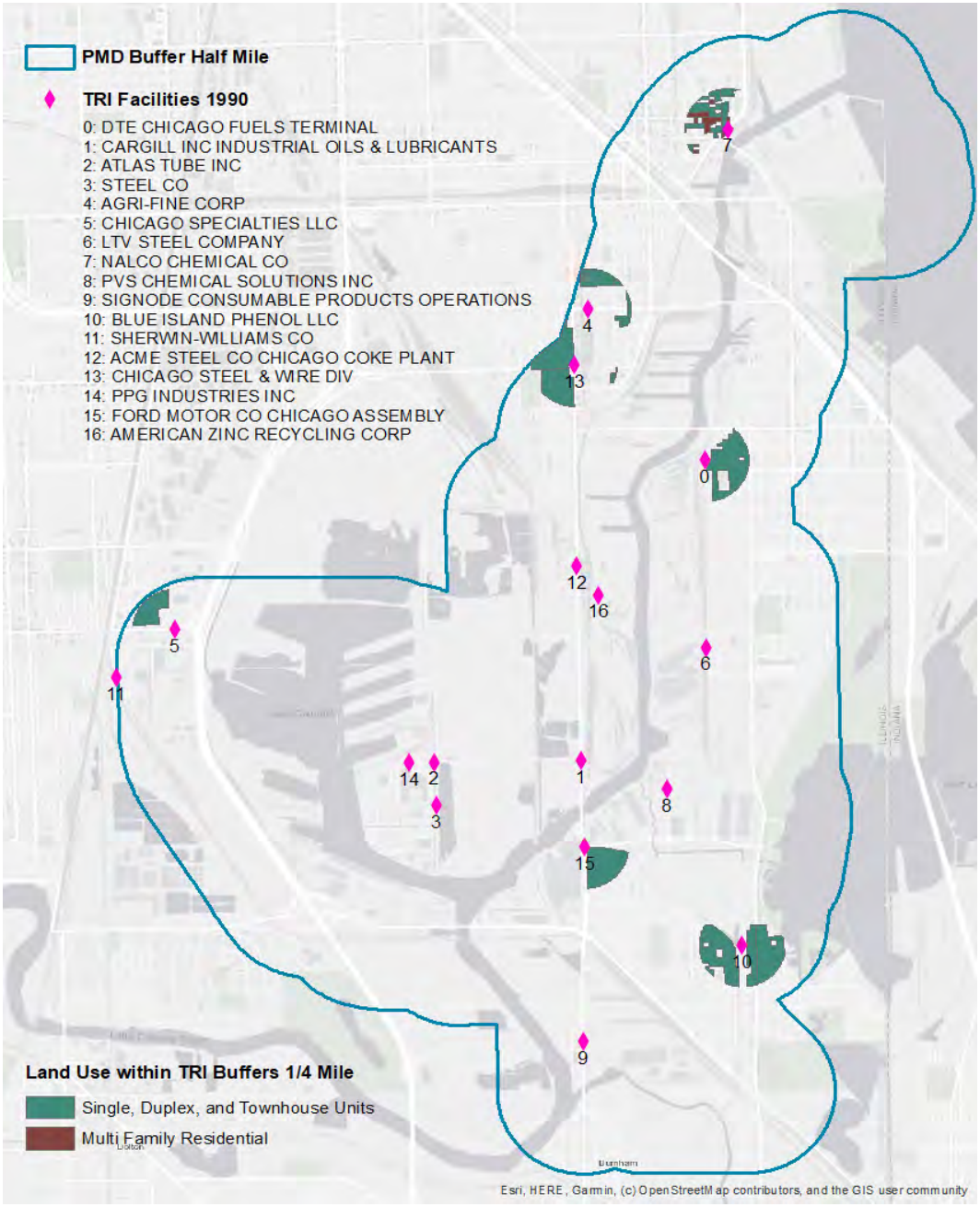


Figure 53. Spatial distribution of 2016/2017 Superfund and Toxics Release Inventory (TRI) sites within the study area. Residential land (as per Figure 47) is depicted with ¼ mile land use buffers

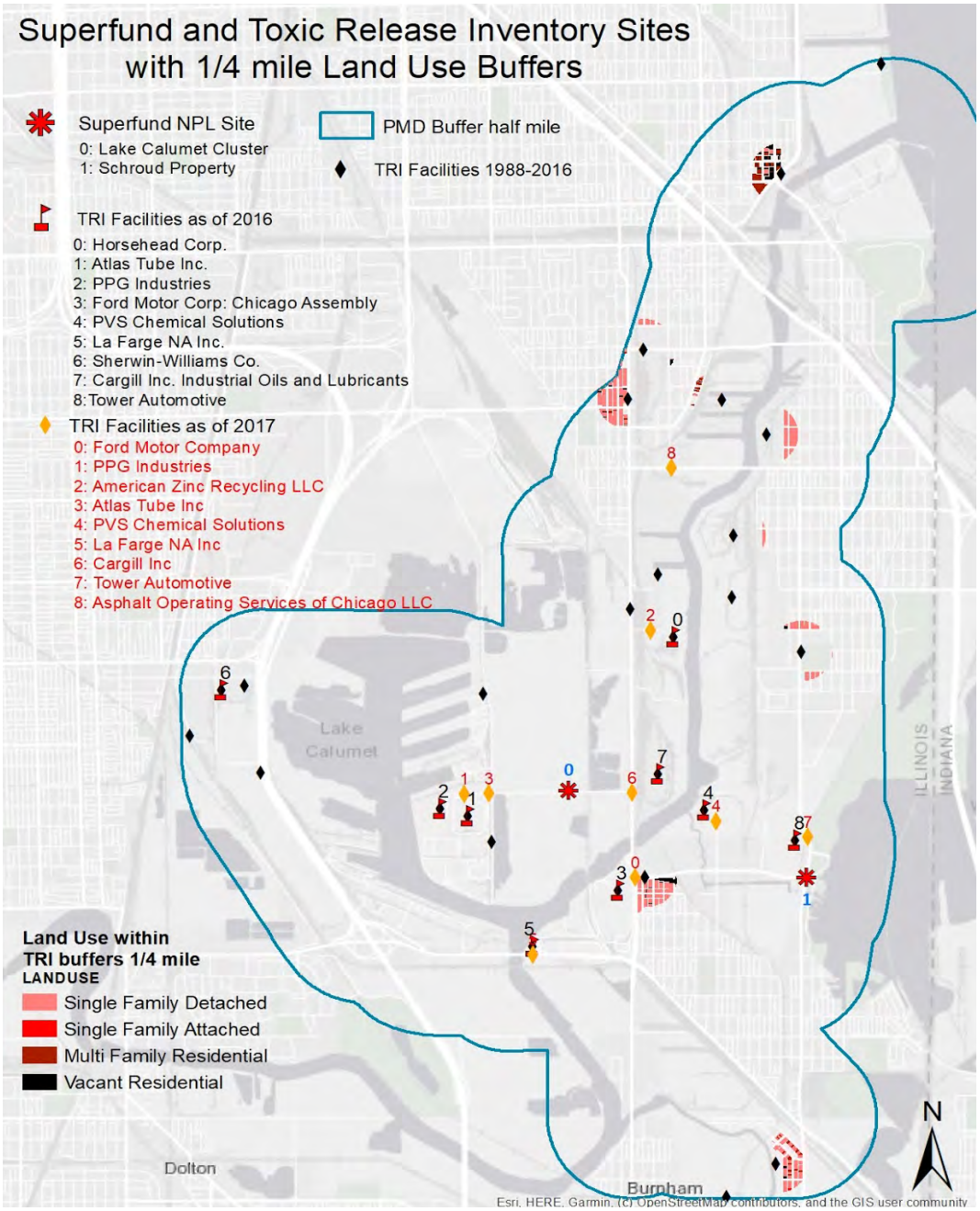
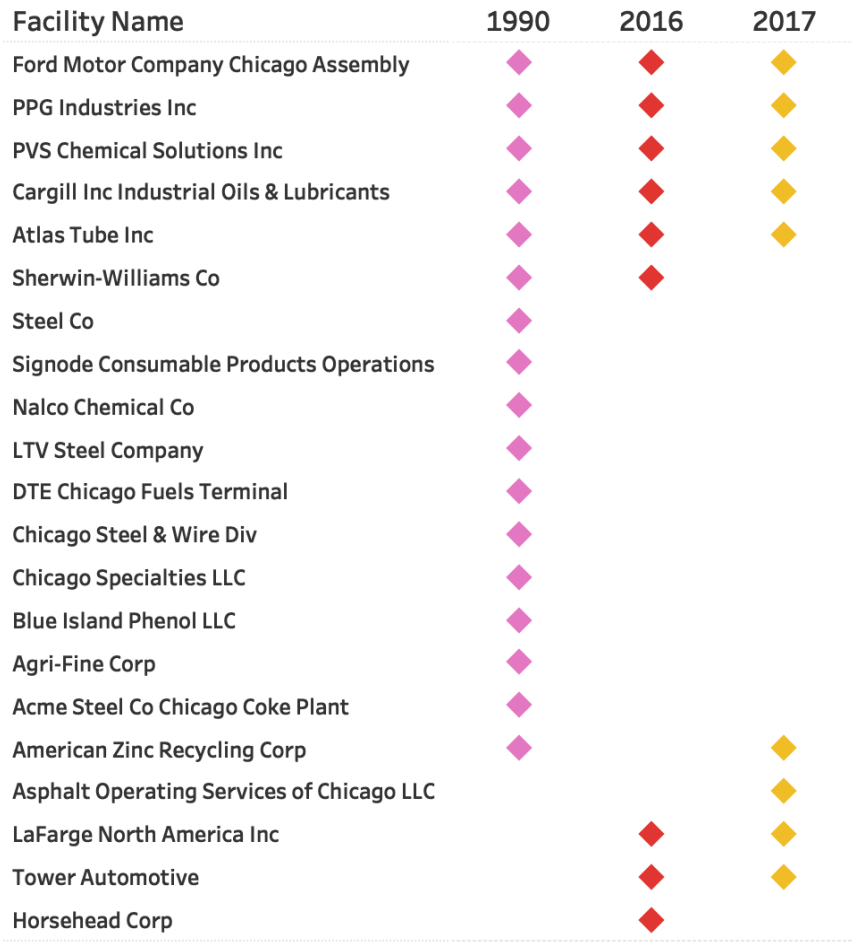


Figure 54. Toxics Release Inventory (TRI) sites within the study area, by year



Areas for Further Research

While our team would have liked to have conducted a more comprehensive examination of study area demographics, we were limited by both time and capacity constraints, and therefore, were limited to examining demographic characteristics for only two points in time: 1990 and 2017. Considering the duration between these years, we recommend that staff at the Department of Planning and Development gather data and produce visuals on the previously mentioned characteristics--overall population, race/ethnic composition, age, median household income, and educational attainment--for, at a minimum, years in between, such as 2000, and 2010. This multi-year examination would serve residents and Calumet-area stakeholders well,

aiding in a more comprehensive examination of changes in the study area over shorter time increments.

--

As was noted in the ‘Data Limitations’ portion of this sub-section, our team encountered significant roadblocks in our ability to understand company property histories, or to verify the accuracy of property records between different sources. Even with the use of exceptional proprietary software like CoStar, we were unable to get a full picture of the changeovers in company names, functions, and ownership over the duration of our analysis period. Given that many residents and stakeholders do not have access to proprietary software, we believe this poses a significant information barrier for the general public to understand the occupation and land allocation features of the study area. For this reason, we recommend that entities such as the Cook County Assessor’s Office work with real estate data collection firms like CoStar to ensure that property record information aligns in consistency, and, whenever possible, is made available to the public, especially when the properties in question have a direct impact on public health/safety, as they so often do in industrial corridors.

--

As was noted from our examination of land use allocation in the study area over time, we observed an increasing share of land within the corridor dedicated to transportation-related uses, such as for docks and shipping terminals. Because we used land use shapefiles available to us from the Chicago Metropolitan Agency for Planning, we were unable to look at land use allocation in more recent years. For this reason, we request that staff of the Department of Planning and Development analyze and make public any substantive changes in land use allocation beyond 2013. We are particularly interested in how the demand for transportation-related land uses may have impacted the demand for residential housing in the study area as a whole.

--

As noted from Figures 52 and 53, Ford Motor Company was listed as a Toxics Release Inventory site in 1990 as well as more recently, and is immediately surrounded by a significant swathe of residential land. For Ford as well as other companies with multi-year TRI listings (see Permitting Violations sub-section beginning on page 111 for further detail), we recommend inquiry into the possible connections between these companies’ long tenures/occupancy histories in the study area, and their lobbying contributions to local or state candidate election campaigns. Though the Research Team would have liked to include a comprehensive examination of occupancy histories (by way of property information found through the Recorder of Deeds) and lobbying contributions, due to the large number of companies within our study area, we were unable to carry this out, and recommend that entities such as the City of Chicago’s Office of Inspector General coordinate with staff at the Department of Planning and Development to carry out an exploration of these histories, as well as lobbying contributions, at least as far back as 1990. Sources like FollowtheMoney are a good starting point, and below, we have included a screenshot of FollowtheMoney’s available information on the Ford Motor Company’s lobbying contributions to State of Illinois campaigns in various years (1996-2012).

Figure 55. Select Ford Motor Company lobbying contributions to State of Illinois election campaigns

WOOD, CORINNE J GIESEKI	LOST-PRIMARY	LOST	REPUBLICAN	REPUBLICAN	IL	2002	STANDARD	GOVERNOR	OPEN	2	$1,000
FANTIN, ARLINE M	LOST-PRIMARY	LOST	DEMOCRATIC	DEMOCRATIC	IL	1998	STANDARD	HOUSE DISTRICT 029	INCUMBENT	1	$500
SHARP, WANDA J	LOST-PRIMARY	LOST	DEMOCRATIC	DEMOCRATIC	IL	2000	STANDARD	HOUSE DISTRICT 007	INCUMBENT	1	$250
BEDI, JONATHAN SINGH	LOST-PRIMARY	LOST	DEMOCRATIC	DEMOCRATIC	IL	2008	STANDARD	SENATE DISTRICT 005	CHALLENGER	1	$1,000
DILLARD, KIRK W	LOST-PRIMARY	LOST	REPUBLICAN	REPUBLICAN	IL	2010	STANDARD	GOVERNOR	OPEN	2	$1,000
NYBO, CHRISTOPHER	LOST-PRIMARY	LOST	REPUBLICAN	REPUBLICAN	IL	2012	STANDARD	SENATE DISTRICT 024	CHALLENGER	1	$1,000
CULTRA, SHANE	LOST-PRIMARY	LOST	REPUBLICAN	REPUBLICAN	IL	2012	STANDARD	SENATE DISTRICT 053	INCUMBENT	1	$250
PARKER, KATHLEEN K	LOST-GENERAL	LOST	REPUBLICAN	REPUBLICAN	IL	2002	STANDARD	SENATE DISTRICT 029	INCUMBENT	3	$1,250
CIARLO, FLORA L	LOST-GENERAL	LOST	REPUBLICAN	REPUBLICAN	IL	1996	STANDARD	HOUSE DISTRICT 080	INCUMBENT	1	$200
DEANGELIS, ALDO A	LOST-GENERAL	LOST	REPUBLICAN	REPUBLICAN	IL	1996	STANDARD	SENATE DISTRICT 040	INCUMBENT	2	$800
MURPHY, MAUREEN	LOST-GENERAL	LOST	REPUBLICAN	REPUBLICAN	IL	1996	STANDARD	HOUSE DISTRICT 036	INCUMBENT	1	$100
MYERS, JUDITH A	LOST-GENERAL	LOST	REPUBLICAN	REPUBLICAN	IL	2006	STANDARD	SENATE DISTRICT 052	OPEN	1	$250

Permitting Violations

Guiding Questions (Quantitative)

- How many companies in the corridor and surrounding area have outstanding or current permit violations, release records, or inspection violation records as collected through:
    - The City of Chicago Department of Buildings?
    - The US Environmental Protection Agency (EPA) Toxics Release Inventory Program?
    - The US Department of Labor's Occupational Health and Safety Administration (OSHA)?
- Based upon data as provided by the City of Chicago, EPA, and OSHA, what types of workplace and public health violations most frequently impact study area workers and/or residents?
- For companies in the study area that may have outstanding or past violations under the above programs, what data tools and resources--if any--exist to help the public distinguish between differing levels of severity and resident/worker exposure risk?
    - Based on these tools, are there certain chemicals that pose more or less of an environmental health risk to residents/workers in the study area?
    - Based on these tools, are there certain industries or industry sub-sectors that pose more or less of an environmental health risk to study area residents/workers?
- Based upon multi-year violation accrual data, what can we determine about the propensity of businesses in the area to produce adverse impacts on the environment, and on their own workforces?

Outline of Research Findings Components

- City of Chicago Department of Buildings Violations
    - Findings on permit violations by company/site
    - Breakdown of violations by study area industries, and industry sub-sectors
    - Table of most frequently cited violations
    - Chart displaying year-to-year violation accruals
- Environmental Protection Agency's Toxics Release Inventory (TRI) Program
    - Explanation of total on-site and off-site release reports by company/year
    - Narrative on off-site vs. on-site release volumes by company/year
    - Figure displaying Risk Screening Environmental Indicator (RSEI) Scores by site/year
    - Breakdown of RSEI Scores for the study area's 10 most frequently released chemicals
    - Findings on study area industry sub-sector RSEI Scores by year

    - Chart displaying Industry Median RSEI Scores for top on-site and off-site release industries within the study area
    - Figures displaying shares of on-site and off-site releases from study area industries
- Occupational Health and Safety Administration Inspections
    - Findings on agency violations (open or closed) by site and severity level
    - Figure displaying year-to-year violation accruals
    - Chart of violation record details, compiled from records of top company violators

Methods

City of Chicago Department of Buildings Violations

The City of Chicago provides public access to the Department of Buildings' electronic record system (see Table 16, row 2 for full source information), which contains data on building permits, inspections, and alleged violations cited by the Department. The City also details information on violations and the inspection process in the Municipal Code (see full source information in Table 16 row 3), which the research team consulted as a first step. According to the code, city buildings that typically require annual inspection include theaters, churches, schools, public assembly units, public places of amusement, and open air assembly units. Other types of buildings require inspections "as often as deemed necessary" by the fire commissioner or buildings commissioner. These include three-story buildings with a basement apartment or living space, three-story buildings that have commercial space on the first floor and residential space on the upper two floors, two-story buildings that are commercial, and any buildings with four or more stories that are not single-family residence. The Fire Department and Department of Buildings are also authorized to conduct any additional inspections as they deem necessary to maintain health and safety. Though we made several attempts to get in touch with staff at the Department of Buildings in order to further understand what criteria would prompt additional inspections, we were unsuccessful in gathering more clarity.

If a building violates the Building Code set forth in the City of Chicago Municipal Code, the building business is subject to fines between $500 and $1,000. Each day the violation continues constitutes a separate and distinct offense. Violations are always connected to an inspection and there can be multiple violation records associated with a single inspection record. Inspection categories include: Building/Structural, Public Health/Sanitary, Fire Hazard/Life Safety, Licensing, Environmental, and accessibility requirements pertaining to the ADA (Americans with Disabilities Act). Businesses can fail inspections for reasons ranging from structural defects found within the building to serious pest control problems on-site, obstruction of exit doors, and uncontrolled emission of atmospheric pollutants. The most common reasons for *new* businesses to fail permit inspection include an array of building/structural violations, public health/sanitary violations, and fire hazard/life safety violations. These violation categories

are also listed among the common reasons for *existing* businesses to fail an inspection, in addition to licensing issues, environmental violations, and ADA accessibility violations.

The research team discovered that as of April 1, 2019 there were 78 Building/Construction Inspectors employed by the City of Chicago. Two of these employees were Chief Inspectors and nine of these employees were Supervising Inspectors. This employee information comes from the City of Chicago Data Portal (see Table 16 row 4 for full source information).

The research team compiled data collected by the Department of Buildings for violations issued during building inspections between April 1, 1995 and May 3, 2019. To do this, we visited the Building Permit and Inspection Records Search page, which enables visitors to search records by street address. Here, we entered the building/facility address (as listed on the Southeast Chicago Business List) in the search box. If a record existed, a search for the associated address was returned containing information on building attributes, building permits, building code enforcement case activity, previously conducted inspections, and alleged code violations. The research team manually scrolled down to the tables labeled “Department of Building Inspections” and “Alleged Code Violations”. From there, we copied and pasted the tables into a Microsoft Excel spreadsheet and tabulated the data for further analysis. Tables and graphs were then created to illustrate each company’s compliance with the Municipal Code. In these visualizations (Figures 56-58 which can be seen on pages 123-127), the research team noted the total number of violations by each company, the percentage of violations for each industry represented on the CACHET list, the top 5 violations from 1995-2019, and the number of violations within each inspection year.

US Environmental Protection Agency (EPA) Toxics Release Inventory Releases

Given that our initial study area exploration included a scan of Superfund as well as Toxics Release Inventory (TRI) sites, we have included an overview of the TRI program in the ‘Methods’ sub-section of the ‘Industrial Occupation and Land Use’ section. Below, the research team has opted to include information on the Toxic Substances Control Act (TSCA), the EPA’s first legislative mandate to touch upon regulation of chemical substances that pose substantive health or environmental risks, as well as the most recently amended version of the TSCA, the Frank R. Lautenberg Chemical Safety for the 21st Century Act (see Table 16, rows 9 and 10 for full source information):

> Passed in 1986, the TSCA gave the US EPA the regulatory authority to require annual reporting, record-keeping, and restrictions on the manufacturing of certain chemicals by private entities and public. Though various aspects of the TSCA impact facilities in the study area, the most relevant portions of this legislation pertain to compliance monitoring; see Table 16, row 10 for the EPA’s guidance document on compliance monitoring for the TSCA. As noted in this guidance document, Section 8 outlines reporting requirements for chemical manufacturers, importers, and processors of

potentially toxic substances. Most notably, Sections 8c and 8d require that regulated operations 'maintain records of significant adverse reactions to human health and/or the environment', and that EPA may request these operations for up-to-date records, or health/safety impact studies. Part of these records must be submitted annually through the EPA's self-reporting Toxics Release Inventory (TRI).

The research team compiled annually reported TRI data for all 91 facilities listed on the Southeast Chicago Business List over 3 separate reporting years: 2007, 2012, and 2017. To access TRI data, the research team consulted TRI Explorer, first mentioned on page 21. For each facility and reporting year record that we found, we noted 1) the total number of chemicals the company was required to report information for on-site and off-site (regardless of whether a release of said chemical occurred), 2) the total on-site and total off-site release amounts in pounds (if any releases of chemicals did occur), 3) the name of the chemical with the largest on-site and off-site release amount, and finally, 4) the total share of the on-site and off-site release amounts that the "largest release chemical" accounted for.

As an example, we noted that in 2007, American Zinc Recycling Corporation reported information on 4 chemicals each, on-site and off-site. As previously mentioned, even if a company does not experience an on or off-site toxic chemical release in a given reporting year, if the facility exceeds the EPA's thresholds in its use, manufacturing, or processing of toxic chemicals, it is still required by law to report data to the EPA. In the case of American Zinc, the company released 9,269 pounds of the 4 on-site chemicals combined, and 492,448 pounds of the 4 off-site chemicals combined. Zinc compounds accounted for the largest share of chemicals released, both on and off-site. In the case of the on-site releases, zinc compounds made up 88.6 percent of the total release volume, and 89.4 percent of the total release volume off-site.

Once we obtained records for all 4 ZIP codes that are part of the study area (60617, 60633, 60628, and 60827), the research team compiled tables and graphs (pages 128-131 and pages 136-137 of the 'Research Findings' section) depicting: the total number of chemicals each company filed reports for on and off-site, each facility's total volume of releases in pounds both on and off-site, and the share of total on and off-site release volumes that each industry category contributed in each reporting year.

We also analyzed each facility in terms of its Risk Screening Environmental Indicators (RSEI score), and how this facility score compares to its median industry RSEI score. The RSEI is a model developed by the EPA to provide context for a facility's TRI profile. This model considers every TRI facility's release in terms of the size of the chemicals, the size and location of the exposed population, and the chemical's toxicity. High RSEI scores highlight releases that would potentially pose greater risk over a lifetime of exposure, and low RSEI scores indicate low potential concern from reported TRI releases.

This same model was adjusted by the EPA to account for broad industry categories, as per the North American Industry Classification System (NAICS) Code. These codes can be broken down by industry sector/group (which is the most broad categorization), followed by the industry subsector, and then primary NAICS Code, which is the most specific categorization level. The median industry RSEI scores are reported for Primary NAICS Codes. To obtain the median value, all RSEI scores for facilities under the same Primary NAICS Code are gathered and the median value is then calculated. Depending on individual facility behaviors and the number of facilities categorized under a Primary NAICS Code, the median industry RSEI score will vary from year to year.

An NAICS classification is usually completed for one physical location at a time. However, if administratively distinct operations are occuring at a single location, each operation can be treated as distinct. An establishment is linked to an industry code according to its primary business activity. Versions of the NAICS are released every five years with the most recent revision occurring in 2017. Revisions often address changes in the economy, including new industries, clarifications of old industries, and title changes. From the 2012 version to the 2017 version, there was an addition of eight new industry categories. Six of the 20 broad industry sectors underwent notable changes for the 2017 revision, but none of these changes applied to the industry sectors that our 11 facilities are classified under.

Figure 63 on page 132 displays the 2007, 2012, and 2017 RSEI scores for 10 facilities, while Figure 66 shows the Median Industry RSEI score for 11 facilities. Median scores for both 2012 and 2017 are reported and the facility that each industry pertains to is listed as well. We gathered data for both figures from the EPA's TRI Envirofacts page (see Table 16 row 8 for full source information). After downloading each record, we created a Microsoft Excel table including the Industry Sector name and median RSEI score in 2012 and 2017. From this data table, a bar graph was created. Then another simple Excel table was created to show which facilities were classified under which industry.

We gathered individual facility RSEI Scores from Envirofacts' EasyRSEI Dashboard. After downloading all records into Microsoft Excel, the research team created figures ranking TRI facilities, top 10 release chemicals, and industry sectors in terms of their respective RSEI Score. The resulting visualizations in the 'Research Findings' sub-section illustrate the change in potential risk over time and also enable comparison between potential exposure risk and the volume of chemicals released from each company.

Occupational Safety and Health Administration (OSHA) Violations

Shortly after the US Department of Labor's Occupational Safety and Health Administration (OSHA) was first created, the agency created its initial standards package in May of 1971. As noted in 'Reflections on OSHA's History' (see Table 16, row 11 for full source information), this standards package was charged with setting the nation's first workplace guidelines around

benchmarks of safety and health. While the agency took a few years to establish its structure of regional as well as area offices, perceptions around its efficacy improved dramatically after notable enforcement changes were made towards the late 1970s. In these early years, the organization also aimed to decentralize federal programs, opting for states to establish their own OSHA-approved health and safety programs.

As per the agency's online fact sheet (see Table 16, row 12 for full source information), OSHA state offices have always focused their inspection resources on the nation's most hazardous workplaces, giving inspection priority to workplaces in the following order: 1) imminent danger situations (those that present hazards resulting in death or serious physical harm), 2) workplaces where employers report severe injuries and illnesses as measured by fatalities during 8-hour spans and inpatient hospitalizations/amputations/losses of vision within 24-hour spans, 3) worker complaints, 4) referrals by local agencies, organizations, or the media, 5) targeted inspections for specific high-hazard industries, and finally, 6) checks for abatement of violations that were incurred during previous inspections. If OSHA inspectors find the workplace to be in violation of agency health and/or safety standards, they may issue citations and fines, which must be issued (along with a penalty, when applicable) within 6 months of the violation's occurrence. Such violations are typically categorized as: 1) willful, 2) serious, 3) other-than-serious, 4) *de minimis*, 5) failure to abate, or 6) repeated.

Between 1982 and 1984, states began to participate in the administration's Integrated Management Information Systems (IMIS), the central hub for data on various inspection cases, as well as penalty information. However, this information did not become available to the public until 1998, shortly after OSHA's internet presence began in the mid-90s.

In terms of current data availability through IMIS, the agency provides access to its complete records through the 'Establishment Search' database: a compilation of enforcement inspection data, updated weekly by the administration (see Table 16, row 13 for full source information). Beyond searching for data by the name of the establishment, users can look up records according to an industry NAICS code if searching for records post-2003, or the Standard Industrial Classification (SIC) code if searching prior to 2003. Using establishment name and ZIP code information, the research team looked up records for every establishment on the CACHET List over the period from June 15, 2009 to June 15, 2019.

Once a user makes an entry in OSHA's database search bar, records are returned that list any and all inspections and violations associated with the searched facility; as an example, when we searched 'Nidera' and ZIP code '60617', two entries are returned: one inspection entry for 'Nidera Us Lic', and another inspection entry for 'Nidera Chicago & Illinois River Marketing, Llc'. Neither record contained violation data.

Records contain information on a variety of data including the case status (closed or open); inspection type (the impetus for said inspection whether it be part of accident follow-up, a planned schedule, a formal complaint, etc.); inspection scope (whether the inspection was a

records-only search, partial, or complete); emphasis (safety or health related); and whether or not the facility was given advanced notice of the inspection. In the event that the inspected facility is cited for a violation, its record would contain additional information, including violation type (willful, serious, etc.); standard (the OSHA standard the establishment is in violation of); abatement date (the date by which the violation should be corrected); current penalty (the amount currently assessed for the violation) and failure to abate penalty (assessment generated when a violation is not abated by the specified period). Links to a full list of inspection and violation detail definitions can be found below in Table 16, rows 14 and 15.

The research team gathered records on all violations (open or closed) for facilities on the Southeast Chicago Business List over the ten-year span, noting the severity of each violation, the inspection year during which each violation was issued, any associated penalty amounts, and the OSHA standard that the facility was in violation of. This information resulted in the production of Figures 69 and 70, and Table 19 in the 'Research Findings' section.

Data Sources

Table 16. Table of data sources used in section analysis

Table Row	Data/Source	Description	Link	Year(s) Available/Covered	Date Retrieved
1	Southeast Chicago Business List; Chicago Center for Health and Environment	List of businesses within the Calumet Industrial Corridor, and along the Calumet River	N/A; full list available in Appendix, Table 39	Current as of June 2018	April 2019
2	Building violation records; City of Chicago Department of Buildings	Electronic records on building permits and inspection information	https://webapps1.chicago.gov/buildingrecords/home	1995-2019	June 2019

3	American Legal Publishing Corporation; Municipal Code of Chicago	Building Code and Excerpts from the Municipal Code of the City of Chicago	http://library.amlegal.com/nxt/gateway.dll/Illinois/chicagobuilding/buildingcodeandrelatedexcerptsofthemunic?f=templates$fn=default.htm$3.0$vid=amlegal:chicagobuilding_il$vid=amlegal:chicago_il	Current as of June 12, 2019	October 2019
4	City of Chicago Current Employee Dataset	List of current City employees, their titles, and salaries	https://data.cityofchicago.org/widgets/xzkq-xp2w	Updated annually, last updated April 1, 2019.	October 2019
5	TRI Explorer database; Environmental Protection Agency	Annually updated database containing TRI-reported information, searchable by: geography, industry/NAICS code, chemical name, and/or facility name	https://iaspub.epa.gov/triexplorer/tri_release.facility	Data available for 1988-2017 reporting years; analysis cites data from 2007, 2012, and 2017 reporting years	August 2019
6	2012 Toxics Release Inventory (TRI) Program National Analysis Overview; Environmental Protection Agency	Overview of national reporting practices and findings for administration of the TRI Program in 2012	https://www.epa.gov/sites/production/files/2014-01/documents/complete_2012_tri_na_overview_document.pdf	For reporting year 2012	August 2019

7	2007 TRI Public Data Release eReport; Environmental Protection Agency	Overview of national reporting practices and findings for administration of the TRI Program in 2007	https://www.epa.gov/sites/production/files/2018-12/documents/2007_pdr_complete_report.pdf	For reporting year 2007	August 2019
8	TRI Envirofacts EasyREI Dashboard; Environmental Protection Agency	A dashboard used to find and compare facility RSEI scores and median industry RSEI scores.	https://enviro.epa.gov/enviro/enviro/rsei.html?facid=60633FRDMT12600	Data available for 2008-2017. 2012 and 2017 data used	November 2019
9	Frank R. Lautenberg Chemical Safety for the 21st Century Act; Environmental Protection Agency	Overview of amendment to the Toxic Substances Control Act (TSCA)	https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/frank-r-lautenberg-chemical-safety-21st-century-act	June 2016	November 2019
10	Compliance Monitoring for the Toxic Substances Control Act; Environmental Protection Agency	Overview of TSCA program, as well as enforcement mechanisms for compliance under the EPA	https://www.epa.gov/sites/production/files/2014-01/documents/tsca-cms.pdf	2016	November 2019
11	Reflections on OSHA's History; United States Department of Labor	Research, interview, and collective insight-based report on OSHA's history (with emphasis on early origins in the 1970's)	https://www.osha.gov/history/OSHA_HISTORY_3360s.pdf	January 2009	September 2019

12	OSHA Fact Sheet; US Department of Labor	High-level informational fact sheet outlining OSHA inspection priorities, on-site inspection procedures, workers' rights, and the employer appeals process	https://www.osha.gov/OshDoc/data_General_Facts/factsheet-inspections.pdf	N/A	July 2019
13	Establishment search database; Occupational Health and Safety Administration (OSHA)	Searchable electronic records database cataloguing enforcement inspections and detailed violation information	https://www.osha.gov/pls/imis/establishment.html	Analysis cites data from 2009-2019; data available from 1972-ZIP2019	June 2019
14	Inspection Detail Definitions; Occupational Health and Safety Administration (OSHA)	List of definitions for interpreting OSHA inspection record information	https://www.osha.gov/oshstats/est1def.html	Current as of August 1, 2019	June 2019
15	Violation Detail Definitions; Occupational Health and Safety Administration (OSHA)	List of definitions for interpreting OSHA violation record information	https://www.osha.gov/oshstats/est1def.html	Current as of August 1, 2019	June 2019
16	Audit of Chicago Department of Public Health Air Pollution Enforcement; City of Chicago Office of Inspector General (OIG)	Findings from 2019 audit of CDPH air pollution enforcement procedures	https://igchicago.org/wp-content/uploads/2019/09/CDPH-Air-Pollution-Enforcement-Audit.pdf	Current as of September 16, 2019	February 2020

Data Limitations

City of Chicago Department of Buildings Violations

It should be noted that information on alleged Department of Buildings violations reflect the conditions found by the inspector at the time of the inspection, and may not reflect the current status of the violation (or the current condition of the property). Further, the absence of alleged violations does not mean a building or property is in compliance with the requirements of the municipal code.

US Environmental Protection Agency (EPA) Toxics Release Inventory Releases

The research team acknowledges that the TRI overview section of the databook may be strongly limited by 1) an absence of reported data on the part of facilities required to report under EPA reporting requirements, 2) a misattribution of data to a facility that may at one point have been in operation within the study area before switching addresses, and/or 3) inconsistencies between facility names, parent company names, recorded addresses, or years of operation between CoStar and EPA websites (TRI Explorer, TOXMAP, ECHO, and the FRS).

Regarding the first point, after tabulating data for each of the 3 reporting years and each possible address on the CACHET list, we found that less than 18 percent of the 91 total facilities on the Southeast Chicago Business List had reported any information to the EPA. It should be noted that our search for each facility on the list (even if its CACHET-listed address was not geographically part of the study area boundary) was done in order for the research team to understand how industries generally in Southeast Chicago respond to EPA reporting requirements.

Regarding points 2 and 3, please see the ‘Data Limitations’ portion of the ‘Industrial Occupation and Land Use’ sub-section for a detailed description and examples.

For these reasons, there is no guarantee that a facility that reported chemicals and release amounts in 2007 would have been listed in the TRI Explorer database under the same name and/or site address in the 2012 and 2017 reporting years. As a result, we encourage readers to exercise caution when comparing data across all three reporting years for the same company, as listed on the Southeast Chicago Business List.

We also noted through the course of our analyses that while toxicity can vary widely across different forms of chemicals, companies reporting to the Toxics Release Inventory are not required to report *which form* of chemical they release or transfer. To compensate, the RSEI Model (first mentioned on page 114) assumes each reporting company releases the most toxic

form, except for 1) polycyclic aromatic compounds, 2) chromium/chromium compounds, and 3) mercury/mercury compounds. To the extent that the RSEI assumption differs from what is released by each company, the research team would like to note that the RSEI score for a given facility, chemical, or industry classification may not represent the full extent of potential health risks from a chemical release.

Occupational Health and Safety Administration (OSHA) Violations

The research team compiled violations data from the OSHA 'Establishment Search' database for the ten year period from June 15th, 2009 to June 15th, 2019. As is the case for the Toxics Release Inventory (TRI) data analysis, this section was also limited by an absence of data, as well as ambiguity regarding alignment between names and addresses of facilities as listed on the CACHET list, versus within the 'Establishment Search' database. Similar to TRI Explorer, the OSHA Establishment Search database lists violations data organized by address; as a result, it is possible that some violations in our compilation may be attributed to a company that relocated, or eventually began identifying by a different name within the ten year period in question.

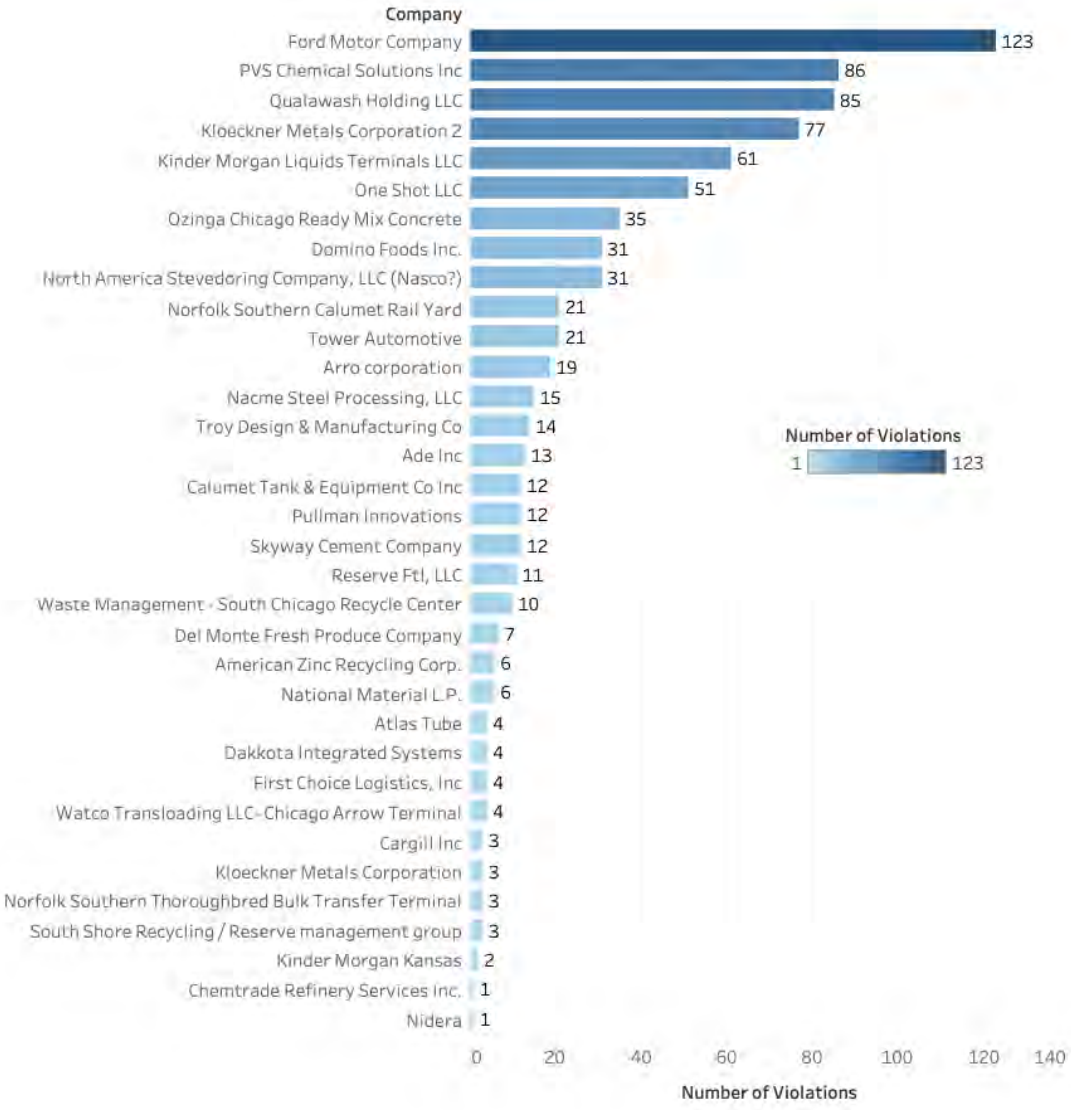
As an example, we found that the facility listed as 'Blackhawk Steel Corp.' on the CACHET list--located at 11828 S Stony Island Ave--was listed in the OSHA 'Establishment Search' database as 'Dockside Steel Processing, Llc'. Similarly, the facility listed as 'South Shore Recycling/Reserve management group' on the CACHET list--located at 11600 South Burley Avenue--was listed in the OSHA 'Establishment Search' database under two names: 'Reserve Marine Terminals', as well as 'South Shore Recycling'. Although we exercised strong attention to detail in our facility search, we note that we may have missed discrepancies in facility name or address between the CACHET list and 'Establishment Search' database that prevents our findings from including all relevant information.

Research Findings

City of Chicago Department of Buildings Violations

Of the 91 companies on the CACHET list, we found that only 34 have violation records as recorded by the city's Department of Buildings (See Figure 56, below). Over the 24 year period, we counted 791 total violations, with Ford Motor Company at the top of the list with 123 violations, followed by PVS Chemical Solutions Inc. with 86 violations, and Qualawash Holding LLC with 85. Chemtrade Refinery Services Inc. and Nidera both only registered one violation during the entire period in question.

Figure 56. Number of building violations by company



The industries in the Calumet Industrial Corridor fall into four main categories: Manufacturing, Wholesale, Transportation, and Services. We found that 65% of the violations during the ten year period in question originated in the Manufacturing industry, while 4.05% are contributions from the Services industry (See Figure 57, below).

Figure 57. Percentage of violations by industry category

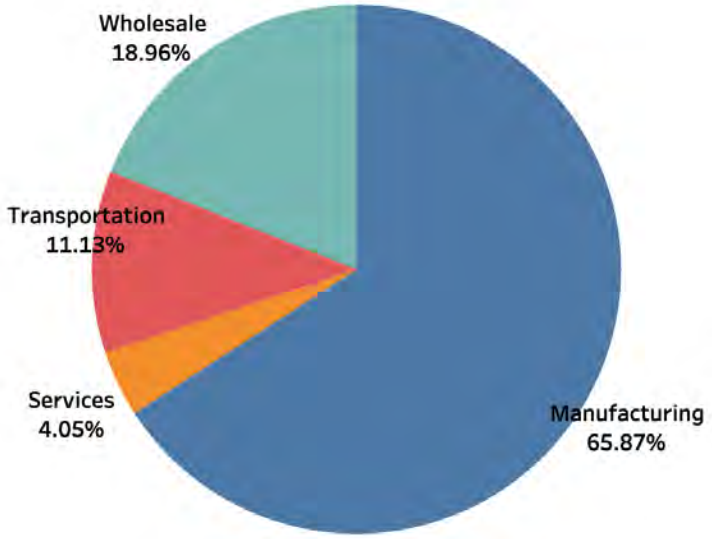


Table 17, below, shows the industry sub-sector breakdown of violations by number as well as percentage share. ‘Motor Vehicle Parts Manufacturing’ accounts for the largest share of violations in the Manufacturing category, while ‘Metals and Minerals Wholesale’ accounted for the largest share in the Wholesale category. They both are responsible for 280 violations, which makes up over one-third of all violations issued.

Table 17. City of Chicago Department of Buildings’ violations by industry group and sub-sector

Industry Group	Industry Sub-sector	Number of Violations	Percentage Share
Manufacturing	Motor Vehicle Parts Manufacturing	158	19.97%
	Basic Chemical Manufacturing	86	10.87%
	Miscellaneous Chemical Manufacturing	85	10.75%
	Paint, Coating, and Adhesive Manufacturing	51	6.45%
	Cement and Concrete Product Manufacturing	47	5.94%
	Food Manufacturing	46	5.82%
	Metal Products Manufacturing	31	3.92%
	Rubber and Plastic Product Manufacturing	13	1.64%
	Motor Vehicle Manufacturing	4	0.51%

	Total	**521**	**65.87%**
Wholesale	Metals and Minerals Wholesale	122	15.42%
	Grocery Wholesale	26	3.29%
	Chemical Wholesale	1	0.13%
	Machinery Wholesale; Construction and Hardware Materials Wholesale	1	0.13%
	Total	**150**	**18.96%**
Transportation	Road Transportation Services	61	7.71%
	Railroad Transport	21	2.65%
	Trucking	4	0.51%
	Pipeline Transportation	2	0.25%
	Total	**88**	**11.13%**
Services	Waste Management	13	1.64%
	Industrial Machinery Repair and Maintenance	12	1.52%
	Commercial Real Estate Leasing	4	0.51%
	Storage and Warehousing	3	0.38%
	Total	**32**	**4.05%**
	Grand Total	**791**	**100%**

Table 18, below, lists descriptions of the top five violations issued during building inspections. They illustrate the most common reasons study area businesses failed their inspections.

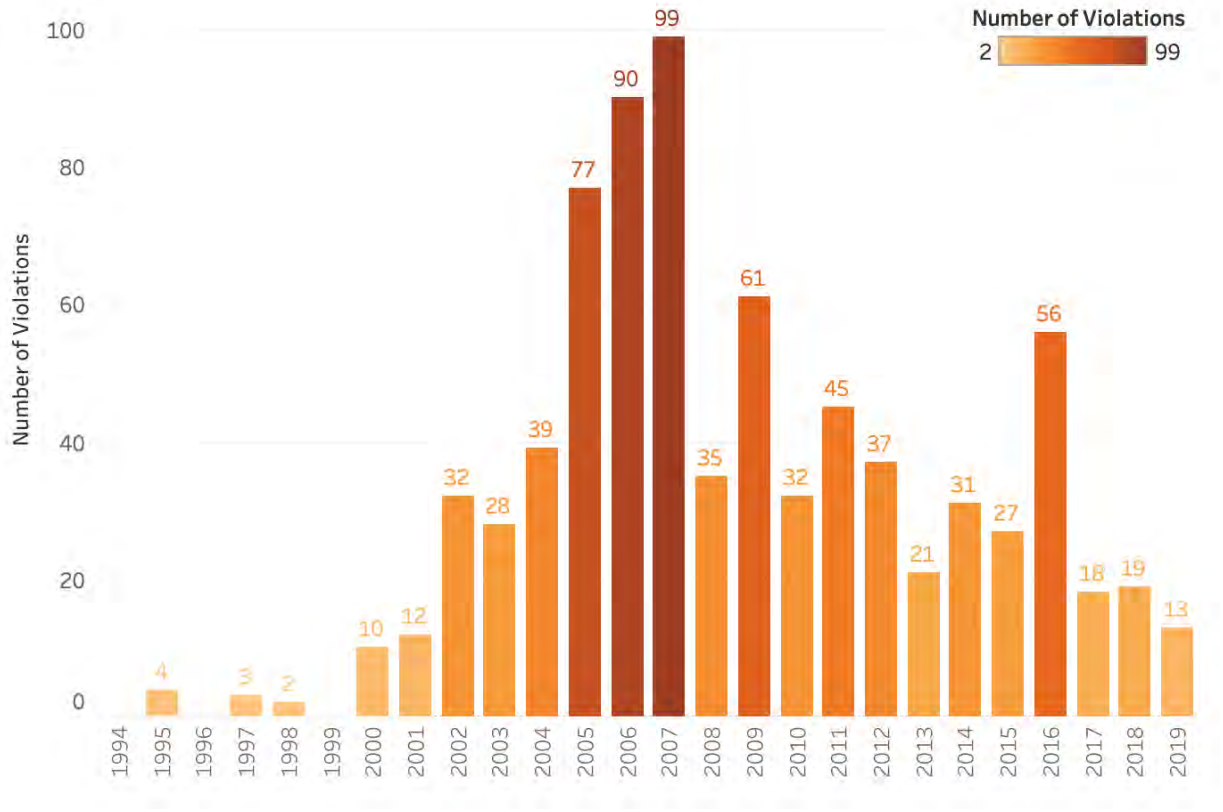
Table 18. Top 5 violations from 1995-2019

Violation	Building Code Citation	Number of Violations	Percentage Share
BR1001	The code violations listed below must be corrected within 15 days of receipt of this notice. The owner or the contractor who does the work must sign, date, and return this notice or a copy to indicate that the work is done to the Boiler Inspection Bureau.	102	12.90%
BR2080	Remove boiler hand hole and manhole plates before end of current year to provide access for internal inspection.	96	12.14%

FP2148	Provide for a performance test of your fire pump, which shall be witnessed by the Bureau of Fire Prevention. Said pump will be in compliance only when it produces its rated gallons per minute and pressure.	31	3.92%
FP1924	Repair or replace defective fire pump.	28	3.54%
VT1010	Arrange mechanical ventilation or warm air heating system final inspection when work completed.	19	2.40%

As can be seen in Figure 58, below, the City of Chicago Department of Buildings issued its highest number of violations between 2005 and 2009, with 99 violations having been issued in 2007. In recent years, the number of violations has decreased considerably, with only 19 violations issued in 2018, and 13 violations issued during building inspections from January to May 2019. Though we were unable to get in touch with the Department of Buildings' staff to gain clarity on this trend, it is our perception that a combination of limited inspection and enforcement staff, changes in procedures, and availability of public data are all contributing factors.

Figure 58. Number of violations by inspection year



US Environmental Protection Agency (EPA) Toxics Release Inventory Releases

According to the EPA, a release of a TRI chemical into the environment refers to a chemical that is emitted to the air, discharged to water, or disposed of in some type of land disposal unit. Facilities may also transfer wastes that contain TRI chemicals to an off-site location for treatment or disposal. Many factors can affect release trends including production rates, management practices, the composition of raw materials used, and the installation of control technologies. The following figures and tables help us illustrate comparisons over time by company, chemical, and industry.

Figures 59 and 60, below, show the total number of ‘on-site’ and ‘off-site’ chemicals each company was required to report (regardless of whether a release occurred) to the Environmental Protection Agency during the 2007, 2012, and 2017 reporting years. Over the 3 separate reporting years, Ford Motor Company reported the largest number of on-site

chemicals, with 17 chemicals in 2007, and 21 in both 2012 and 2017. PPG Industries reported the largest number of off-site chemicals in 2017.

Figure 59. Number of on-site chemicals reported by company and year

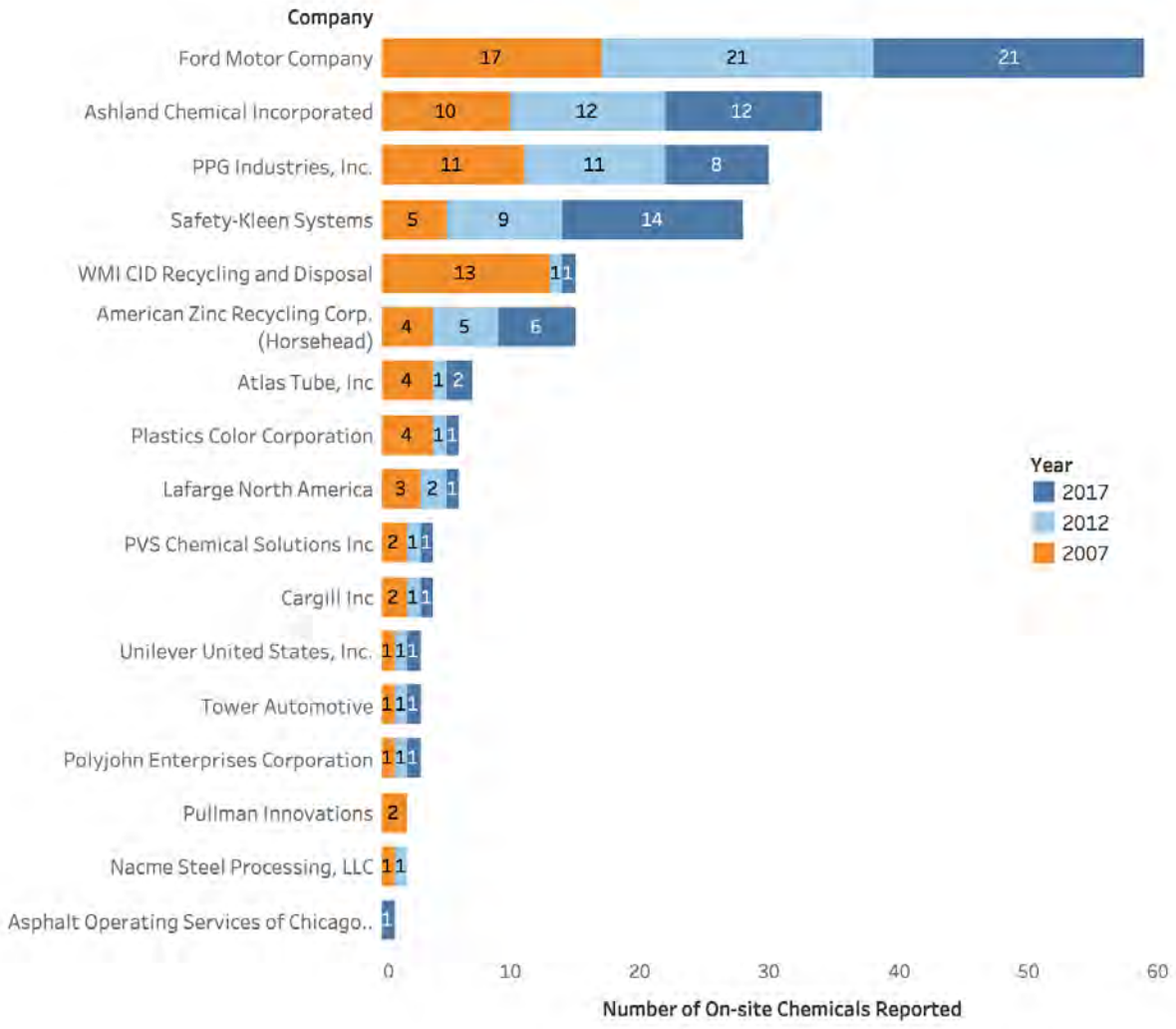
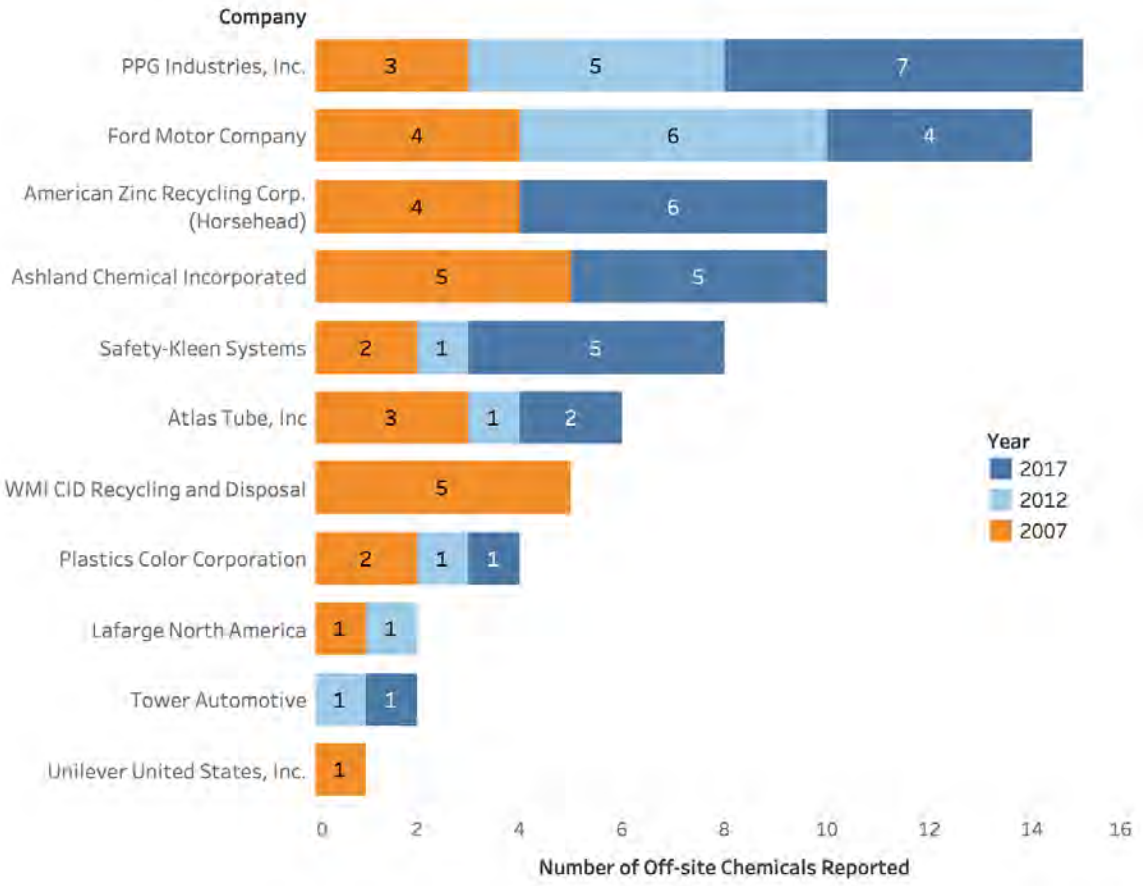


Figure 60. Number of off-site chemicals reported by company and year



Figures 61 and 62, below, show release volumes of TRI chemicals (in pounds), including ‘on-site’ disposal and ‘off-site’ transfers for disposal. In 2017, Ford Motor Company was at the top of this list, with 592,156 pounds of ‘on-site’ chemical releases, followed by Safety-Kleen Systems with 14,683 pounds, and WMI CID Recycling and Disposal with 12,433 pounds. On the other hand, American Zinc Recycling Corp was the largest ‘off-site’ releaser with 1,459,934 pounds in 2017, far exceeding any other facility for all 3 years combined.

Figure 61. Total on-site chemical releases (in pounds) by company and year

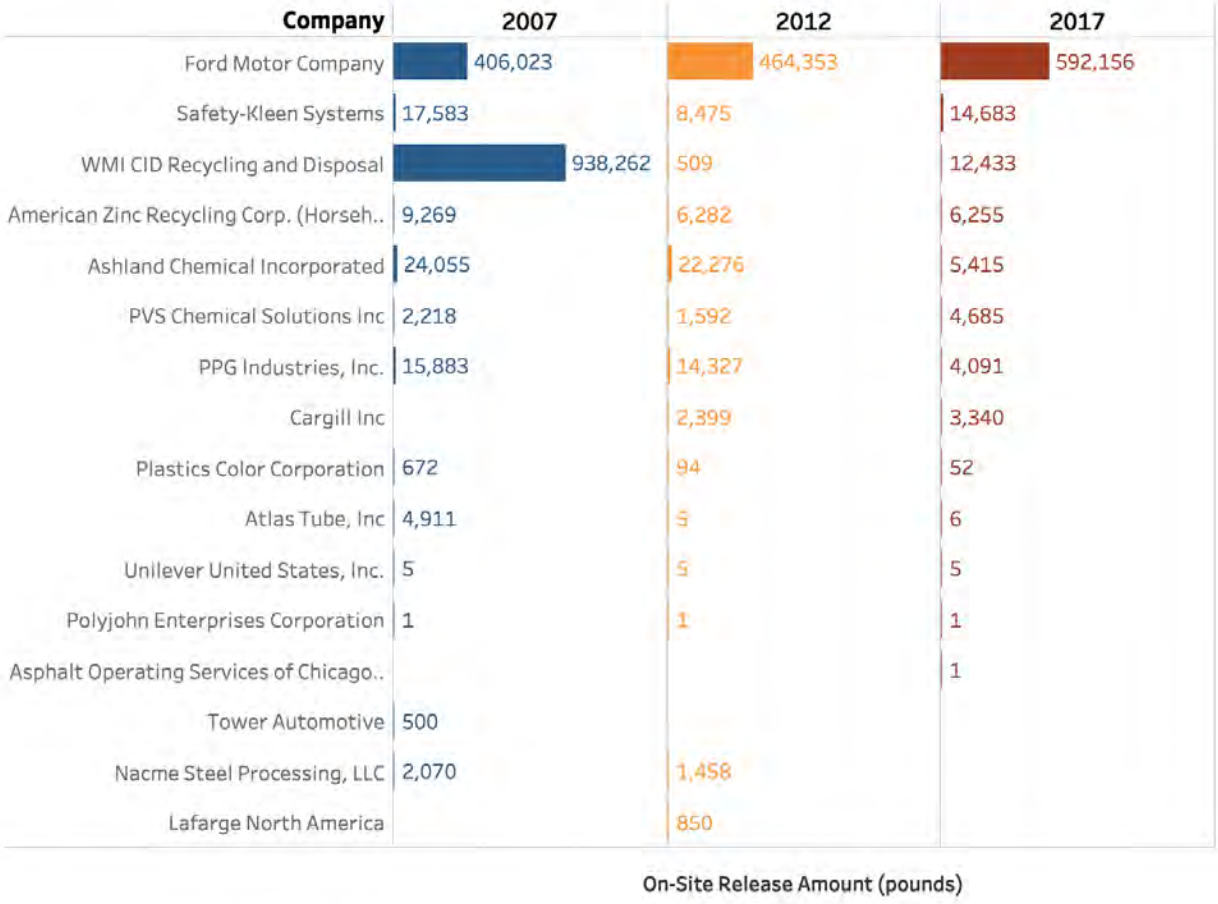
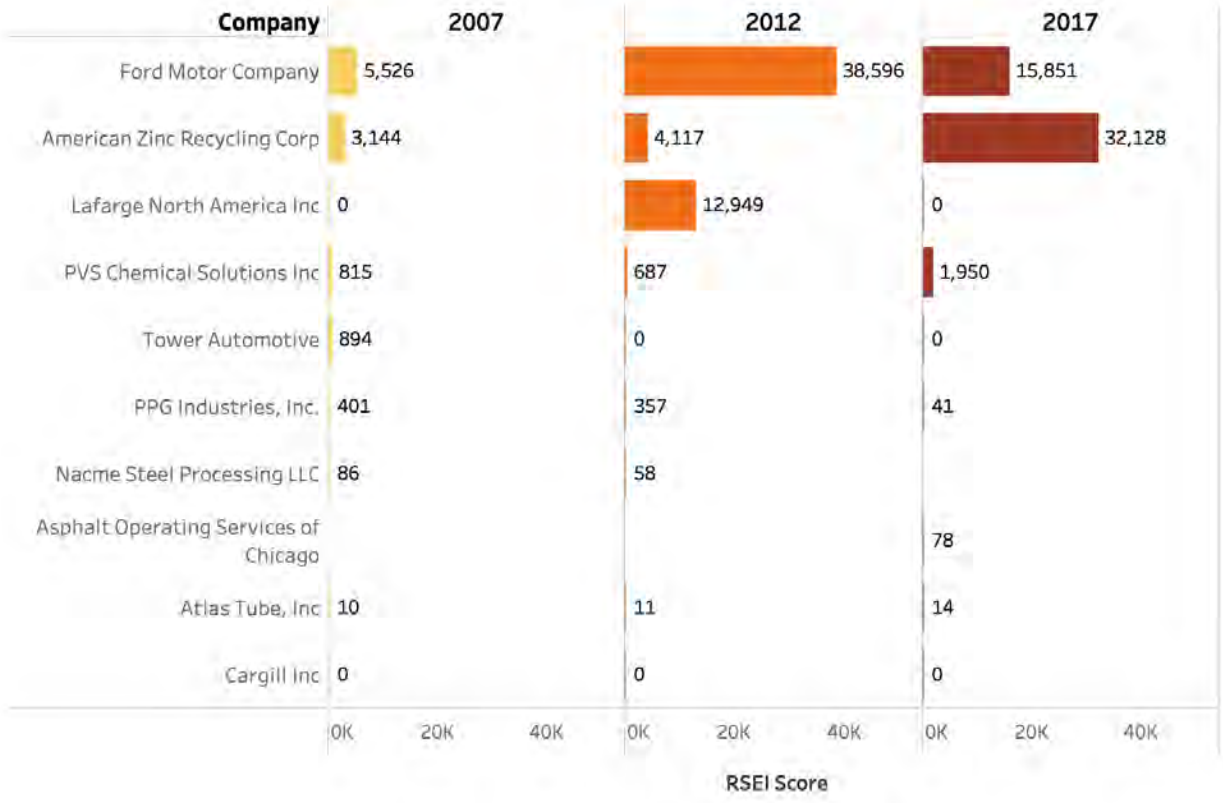


Figure 62. Total off-site chemical releases (in pounds) by company and year

As per the EPA's custom-created model, Risk Screening Environmental Indicators (RSEI) Scores add context to a facility's release information profile. These scores were developed based off of an algorithm that considers--in the event of a chemical's release--the size of the chemical(s), the size and location of the exposed population, and the chemical's toxicity. High RSEI scores indicate releases that would potentially pose greater risk over a lifetime of exposure, while a low RSEI score indicates low potential concern from reported releases. As can be seen in Figure 63, below, we found high RSEI scores associated with Ford Motor Company in 2007 and 2012. In 2017, however, American Zinc Recycling Corp's potential for risk was highest, almost twice that of Ford. Even though American Zinc didn't report the largest number of 'on-site' or 'off-site' chemicals in the figures 59 and 60, the company released 1,459,934 pounds of chemicals, becoming the largest 'off-site' chemical releaser with the highest RSEI score in 2017.

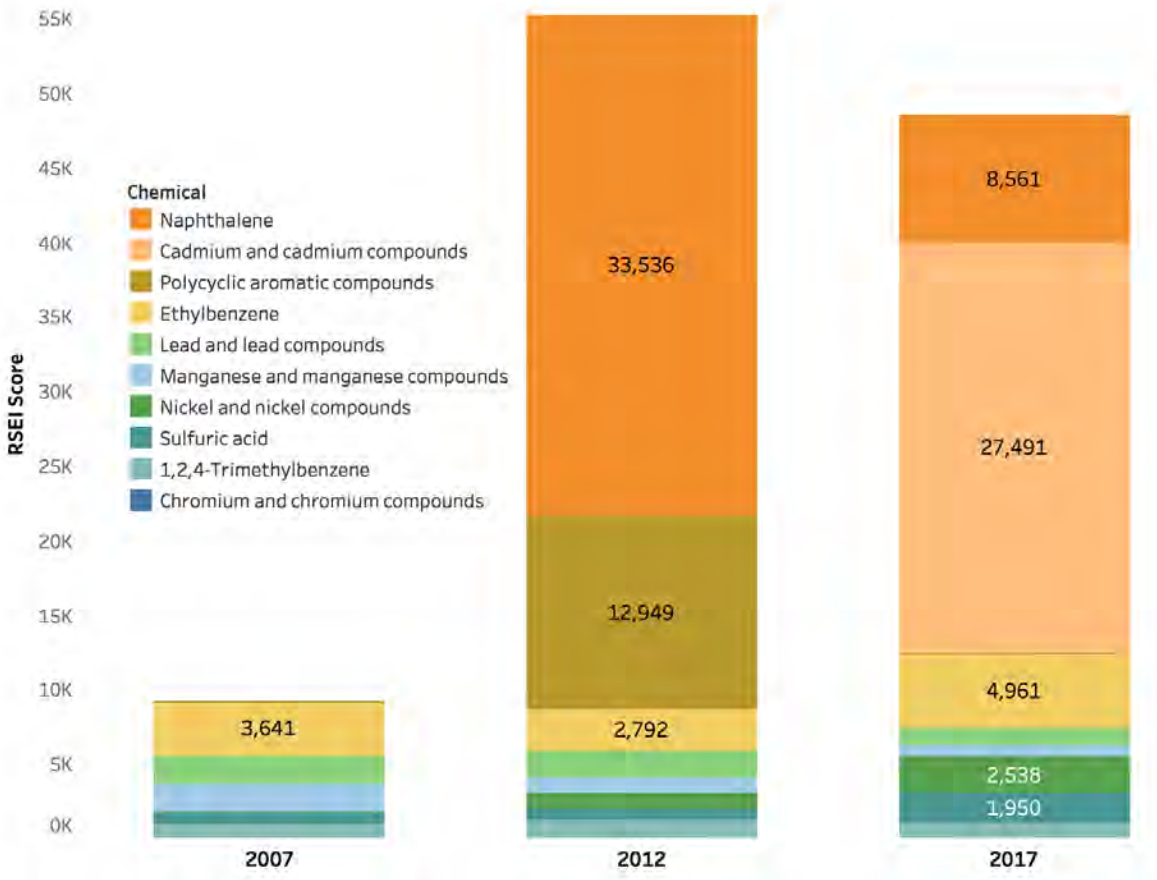
In 2012, even small chemical releases were associated with high RSEI scores when Lafarge North America Inc--the smallest on-site chemical releaser (850 pounds)-- scored the second largest in terms of potential for risk with an RSEI score of 12,949. The first was Ford Motor Company, with an RSEI score of 38,596.

Figure 63. RSEI score by company and year for TRI facilities in the study area



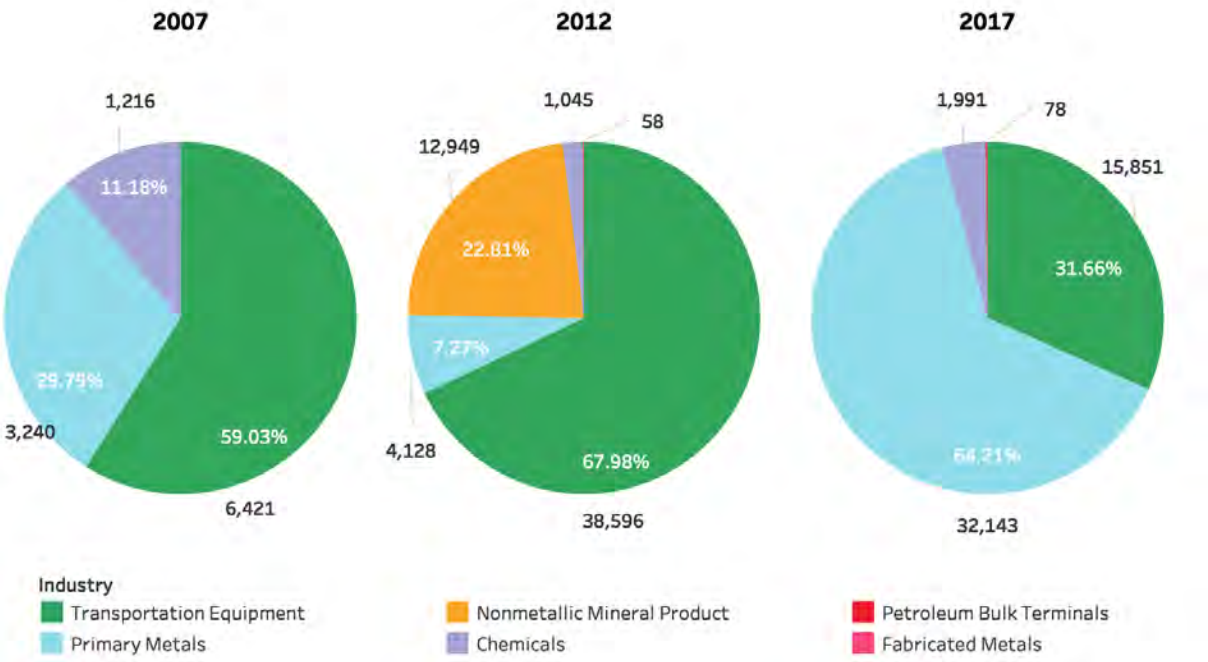
Figures 64 and 65, below rank the top chemicals and industry sectors by RSEI score, illustrating the change in potential risk over time. Over the 3 years in question, we noted the below 10 chemicals to have been the most frequently released by study area facilities on or off-site. Naphthalenel received the highest RSEI score in 2012, which later declined. By 2017, Cadmium and cadmium compounds' potential for risk was over 3 times higher than Naphthalenel.

Figure 64. RSEI score for top 10 chemicals by year



In terms of industry sub-sector (see Figure 65, below), ‘Transportation Equipment’ received the highest RSEI score in 2007 and 2012, which later decreased by more than half from 2012 to 2017. ‘Primary Metals’ received the highest score in 2017.

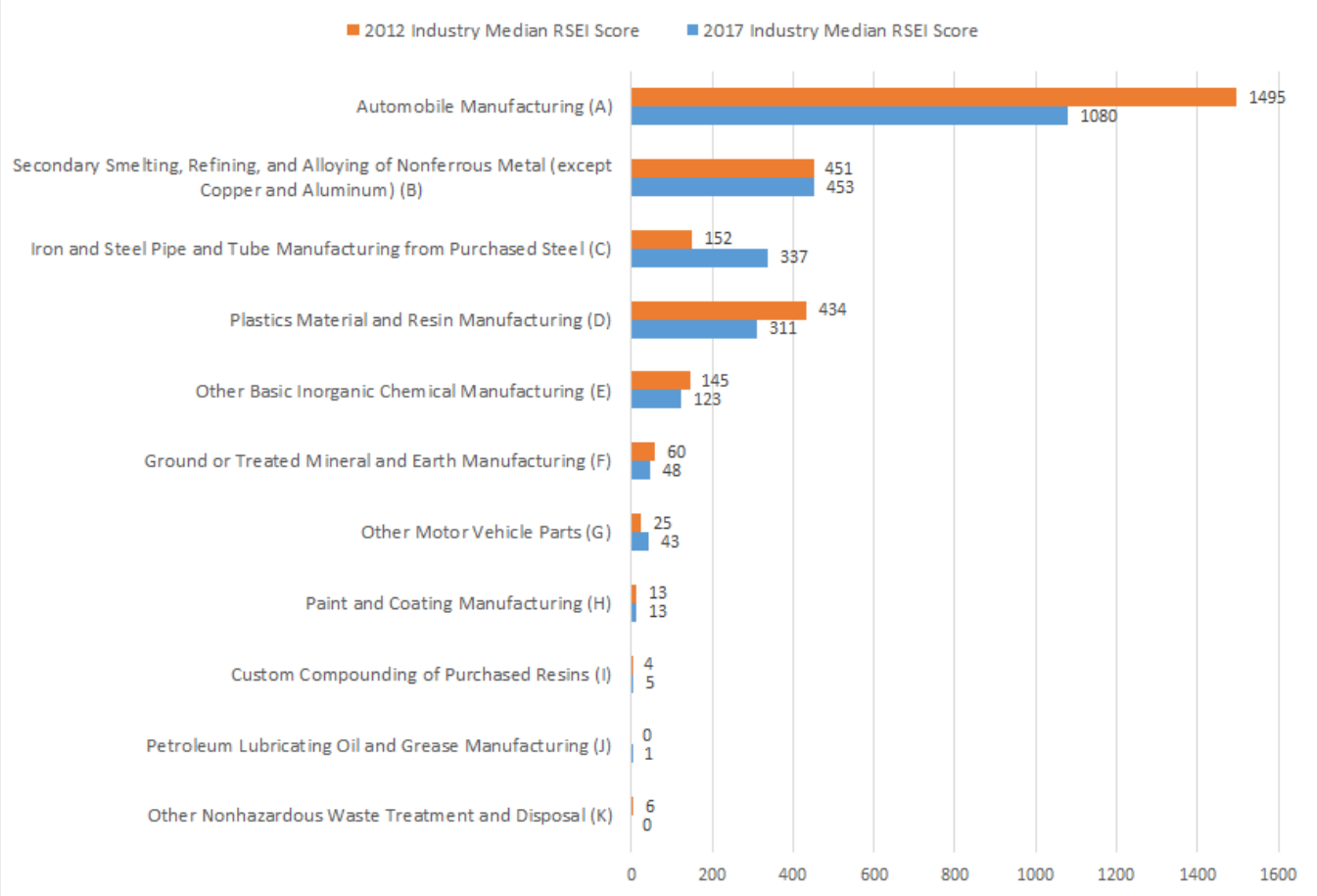
Figure 65. RSEI score by industry sector and year; note, to be viewed in tandem with the table directly below, listing facilities by industry



Industry Sector	Company	
Chemicals	Cargill Inc	
	PPG Industries, Inc.	
	PVS Chemical Solutions Inc	
Fabricated Metals	Nacme Steel Processing LLC	
Nonmetallic Mineral Product	Lafarge North America Inc	
	Ozinga Chicago Ready Mix Concrete	
Petroleum Bulk Terminals	Asphalt Operating Services of Chicago	
Primary Metals	American Zinc Recycling Corp	
	Atlas Tube, Inc	
	Nacme Steel Processing LLC	
Transportation Equipment	Ford Motor Company	
	Tower Automotive	

Figure 66, below shows the Industry Median RSEI scores for the NAICS Codes represented by the top on-site and off-site chemical release facilities. Background information on NAICS Codes can be found in the 'Methods' section on page 13. Industry sectors, represented in the below pie charts, are the most broad categorizations for an industry, whereas primary NAICS Codes are the most specific. The figure below shows the median RSEI score for the relevant NAICS Codes in 2012 and 2017. In most cases, the median RSEI score decreased from 2012 to 2017 or stayed relatively the same. Ford Motor Company, the highest on-site releaser, belongs to the 'Automobile Manufacturing' NAICS Industry which was the industry with the highest median score. American Zinc Recycling Corp (Horsehead), the largest off-site releaser, belongs to the 'Secondary Smelting, Refining, and Alloying on Nonferrous Metals' NAICS Industry which has a Median Industry RSEI score in line with American Zinc's.

Figure 66. Primary NAICS industry median RSEI scores in 2012 and 2017; note, letters in parentheses on the left-hand axis correspond to the table directly below, listing facilities by industry



Company	Corresponding Industry
Ford Motor Company	A
American Zinc Recycling Corp (Horsehead)	B
Atlas Tube	C
Ashland Chemical Incorporated	D
PVS Chemical Solutions	E
Lafarge North America	F
Tower Automotive	G
PPG Industries, Inc.	H
Plastics Color Corporation	I
Safety-Kleen Systems	J
WMI CID Recyling & Disposal	K

The manufacturing sector accounted for almost 62% of on-site releases and 99% of off-site releases, as can be seen in Figure 67, below.

Figure 67. Percentage of on-site releases by industry category

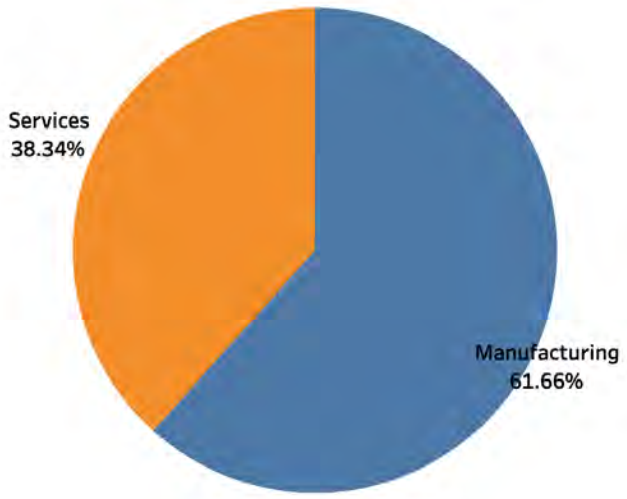
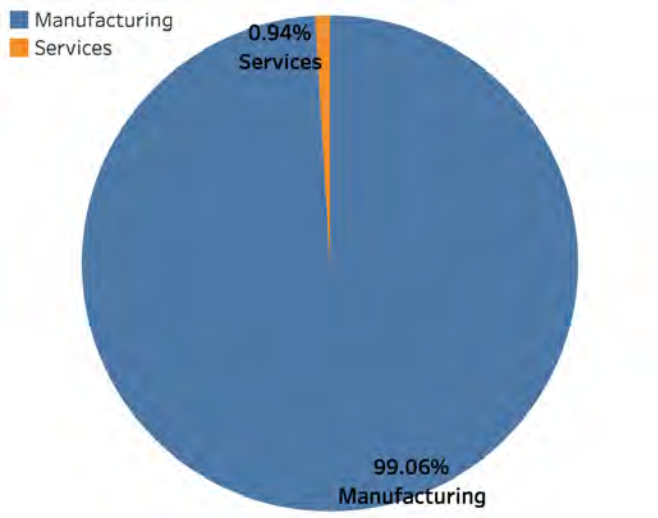


Figure 68. Percentage of off-site releases by industry category



Occupational Health and Safety Administration (OSHA) Violations

The operations of many companies in the study area not only endanger environmental health but also negatively affect human safety, particularly for workers employed in these heavy industry jobs. The research team's analysis of OSHA violations data over the past ten years confirms the well-known fact that the working conditions of many businesses in the Calumet Industrial Corridor continue to jeopardize the health and safety of workers.

Out of the 91 companies researched for this report, 17 had documented OSHA violations in the past ten years. The 17 companies combined recorded 71 total initial violations of OSHA rules. OSHA inspectors typically assign one of three categories for each violation, depending on the degree of severity: 'serious' (when a workplace hazard can cause life threatening illness, accidents, serious physical harm or death), 'other' (when a minor hazard is noted on the site) or 'repeat offense' (for a company that has repeatedly been cited for the same noncompliance). Of the 71 recorded violations, roughly 70 percent were classified as 'severe' by OSHA inspectors.

The breakdown of violations by company is shown below in Figure 69. When tabulating the change in the number of violations over time (displayed in Figure 70, also below), we observed a peak in violations in 2013. So far this year--the ending date for this data compilation having been June 15th, 2019--the number of violations in the study area is lower than in many of the previous years. However, the total value as of December 2019 may be on track to mirror the number of violations we observed for ~2015 - 2017.

Figure 69. OSHA violations by category for Calumet Industrial Corridor businesses

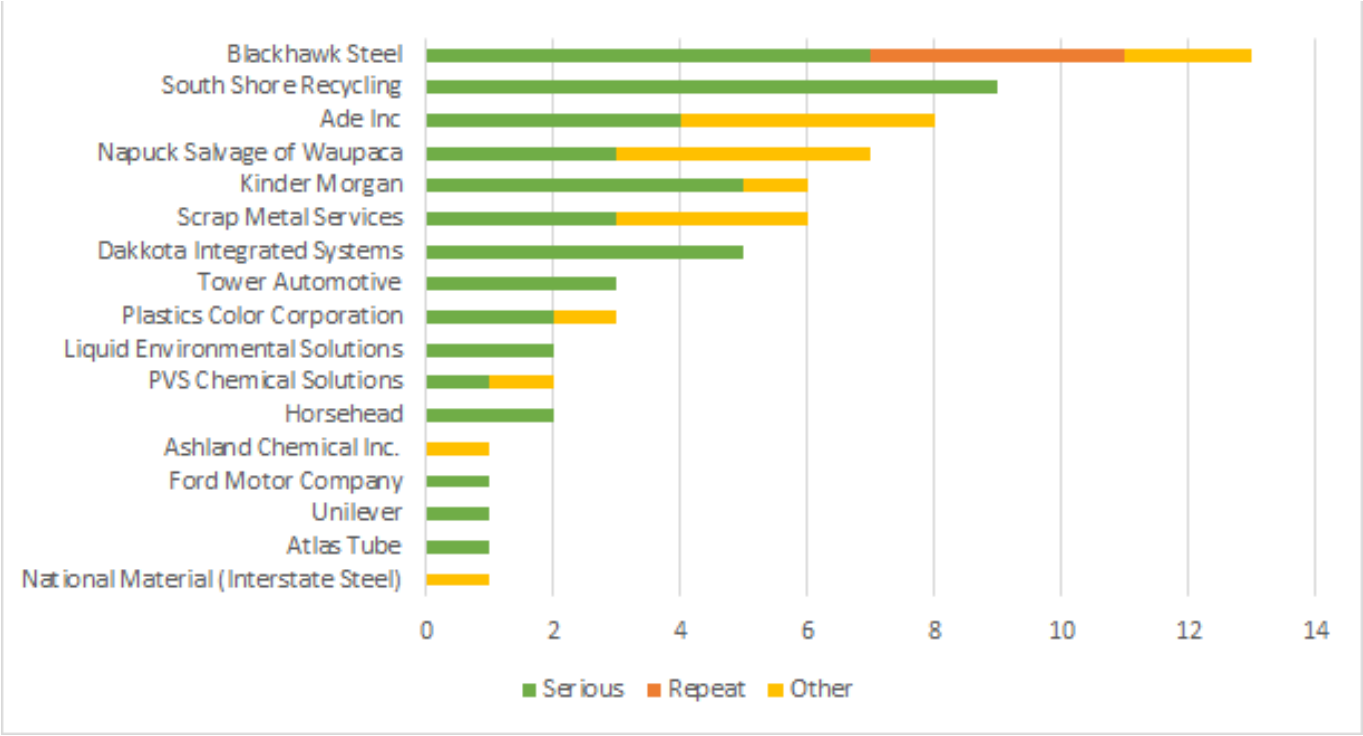
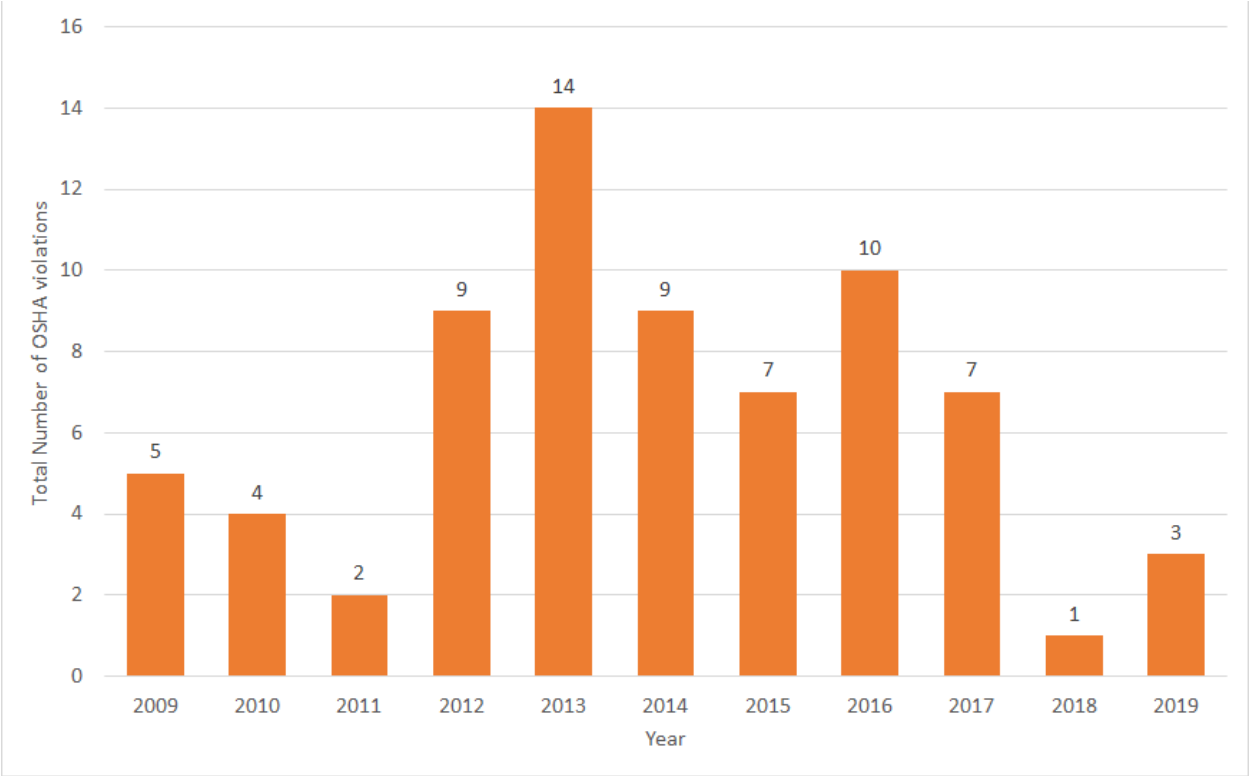


Figure 70. Total number of OSHA violations by year



OSHA inspectors documented a wide array of violations on the part of companies in the study area and surrounding area. These violations included some of minor severity, but still many that had the ability to substantially endanger human and environmental health in the long-term. Some of the more concerning violations we noted included: dangerous lead exposure, toxic cadmium fumes, failure to identify respiratory hazards (such as chemical fumes) and failure to communicate proper chemical hazard training or safety to workers. In order to convey a high-level understanding of the types of violations OSHA inspectors typically pursue penalty action for, the research team compiled select violation descriptions in Table 19, below, for penalties incurred by the top 5 company violators as measured by their aggregate number of violations over the ten year period.

Table 19. Select OSHA violation descriptions for top 5 study area facility violators, 2009-2019

CACHET-listed Facility Name	OSHA-listed Facility Name	Violation Detail	Inspection Year	Initial Penalty Amount	Record Link
Blackhawk Steel	Dockside Steel Processing, Llc	An evaluation of each powered industrial truck operator's performance shall be conducted at least once every three years.	2019	$0	https://www.osha.gov/pls/imis/establishment.violation_detail?id=1388651.015&citation_id=01001
Blackhawk Steel	Dockside Steel Processing, Llc	The point of operation of machines whose operation exposes an employee to injury, shall be guarded. The guarding device shall be in conformity with any appropriate standards therefor, or, in the absence of applicable specific standards, shall be so designed and constructed as to prevent the operator from having any part of his body in the danger zone during the operating cycle.	2013	$4,900	https://www.osha.gov/pls/imis/establishment.violation_detail?id=891698.015&citation_id=01002

Blackhawk Steel	Dockside Steel Processing, Llc	An evaluation of each powered industrial truck operator's performance shall be conducted at least once every three years.	2013	$4,200	https://www.osha.gov/pls/imis/establishment.violation_detail?id=891698.015&citation_id=02001
Blackhawk Steel	Dockside Steel Processing, Llc	The employer shall assure that portable fire extinguishers are maintained in a fully charged and operable condition and kept in their designated places at all times except during use.	2016	$2,310	https://www.osha.gov/pls/imis/establishment.violation_detail?id=1116738.015&citation_id=01002

South Shore Recycling/Reserve management group	Reserve Marine Terminals	Used containers. No welding, cutting, or other hot work shall be performed on used drums, barrels, tanks or other containers until they have been cleaned so thoroughly as to make absolutely certain that there are no flammable materials present or any substances such as greases, tars, acids, or other materials which when subjected to heat, might produce flammable or toxic vapors. Any pipe lines or connections to the drum or vessel shall be disconnected or blanked.	2016	$12,471	https://www.osha.gov/pls/imis/establishment.violation_detail?id=1162449.015&citation_id=01001

South Shore Recycling/Reserve management group	Reserve Marine Terminals	Cadmium: Eight-hour TWA exposures shall be determined for each employee on the basis of one or more personal breathing zone air samples reflecting full shift exposure on each shift, for each job classification, in each work area. Where several employees perform the same job tasks, in the same job classification, on the same shift, in the same work area, and the length, duration, and level of cadmium exposures are similar, an employer may sample a representative fraction of the employees instead of all employees in order to meet this requirement. In representative sampling, the employer shall sample the employee(s) expected to have the highest cadmium exposures.	2013	$2,800	https://www.osha.gov/pls/imis/establishment.violation_detail?id=904507.015&citation_id=01007A

South Shore Recycling/Reserve management group	Reserve Marine Terminals	Lead: With the exception of monitoring under paragraph (d)(3), the employer shall collect full shift (for at least 7 continuous hours) personal samples including at least one sample for each shift for each job classification in each work area.	2013	$2,800	https://www.osha.gov/pls/imis/establishment.violation_detail?id=904507.015&citation_id=01004A
South Shore Recycling/Reserve management group	Reserve Marine Terminals	General. The employer shall provide a medical evaluation to determine the employee's ability to use a respirator, before the employee is fit tested or required to use the respirator in the workplace. The employer may discontinue an employee's medical evaluations when the employee is no longer required to use a respirator.	2013	$2,800	https://www.osha.gov/pls/imis/establishment.violation_detail?id=904507.015&citation_id=01001A

Ade Inc	Ade Inc	"Procedures." The employer shall maintain a written copy of the procedures outlined in paragraph (b)(2) and shall make it available for inspection by employees and by the Assistant Secretary of Labor and his or her authorized representatives.	2012	$0	https://www.osha.gov/pls/imis/establishment.violation_detail?id=242710.015&citation_id=01003
Ade Inc	Ade Inc	Machine guarding. Abrasive wheels shall be used only on machines provided with safety guards as defined in the following paragraphs of this section	2015	$1,200	https://www.osha.gov/pls/imis/establishment.violation_detail?id=1043239.015&citation_id=01003A

Ade Inc	Ade Inc	Employers shall develop, implement, and maintain at each workplace, a written hazard communication program which at least describes how the criteria specified in paragraphs (f), (g), and (h) of this section for labels and other forms of warning, safety data sheets, and employee information and training will be met, and which also includes the following:	2015	$1,200	https://www.osha.gov/pls/imis/establishment.violation_detail?id=1043239.015&citation_id=01004
Kinder Morgan Liquids Terminals LLC	Kinder Morgan Liquids Terminals Llc	Verification of isolation. Prior to starting work on machines or equipment that have been locked out or tagged out, the authorized employee shall verify that isolation and deenergization of the machine or equipment have been accomplished.	2012	$7,000	https://www.osha.gov/pls/imis/establishment.violation_detail?id=604418.015&citation_id=01002

Kinder Morgan Liquids Terminals LLC	Kinder Morgan Liquids Terminals Llc	Initial determination. Each employer who has a workplace or work operation covered by this standard shall determine if any employee may be exposed to lead at or above the action level.	2012	$6,000	https://www.osha.gov/pls/imis/establishment.violation_detail?id=640698.015&citation_id=01001
Kinder Morgan Liquids Terminals LLC	Kinder Morgan Liquids Terminals Llc	Each employer who has a workplace in which there is a potential exposure to airborne lead at any level shall inform employees of the content of Appendices A and B of this regulation.	2012	$6,000	https://www.osha.gov/pls/imis/establishment.violation_detail?id=640698.015&citation_id=01003
Napuck Salvage of Waupaca, LLC	Napuck Salvage of Waupaca, Llc	Rungs and steps of portable metal ladders are corrugated, knurled, dimpled, coated with skid-resistant material, or otherwise treated to minimize the possibility of slipping;	2013	$4,900	https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.23

Areas for Further Research

In 2019, the City of Chicago Office of Inspector General (OIG) released a report (see Table 16, row 16 for full source information) summarizing findings from an audit of Chicago Department of Public Health (CDPH) processes related to air pollution prevention, including permitting, inspection, and data provided to the public. This examination also assessed how well CDPH monitored facilities that pollute the air. Ultimately, the examination revealed substantial gaps in CDPH's air pollution permit and inspection program, suggesting that facilities within the city limits emit more pollution than allowed by law, thus harming human health and the environment.

Specifically, OIG concluded that CDPH: A) did not meet its internal air-quality inspection frequency goals. From 2015 to 2017, CDPH met its inspection frequency goal for only 17% of the facilities it intended to visit annually. Also, 19% of the facilities that should have been inspected annually received no inspection at all over the 3-year period. B) did not consistently categorize facilities based on their potential to emit pollution. As of October 2018, 26% of the facilities, with active air pollution control permits issued prior to 2015, were not categorized. Without a category assignment, CDPH may not be charging the correct Certification of Operation fee because it doesn't know how much pollution a facility may be emitting. C) did not ensure that facilities maintain a valid Certificate of Operation. The Certificate of Operation requires a facility to annually self-certify it is operating safely and in compliance. It was created by the City Council to compensate for the City's inability to inspect every facility annually. Between 2012 and 2017, only 39% of the facilities fully complied with the certificate. D) resolved most of its air-quality complaints within 24 hours. CDPH responds to a variety of air-quality complaints regarding emissions, odors, and fugitive dust. Complaint calls are routed from 311 to CDPH, which are then assigned to an inspector. In 2017, CDPH resolved 81% of air-quality complaints within 24 hours, but a "resolved complaint" means that an inspector went to the site and performed an inspection and did not necessarily mean any enforcement action was taken. In many cases, complaints are difficult to resolve because odors or dust may be noticeable for a shorter period of time, consequently, when the inspector arrives on site, they may not be able to observe or measure the alleged violation. E) does not maintain complete and accurate records on the City's Data Portal.

Recommendations were made to CDPH and in response to the audit, CDPH stated that it has already begun implementing corrective actions. We recommend that the Department of Planning and Development work in close coordination with CDPH to monitor these corrective actions, ensuring that a broad city approach to health/safety inspections in general (not just limited to air pollution) is taken. In particular, we strongly suggest that these two entities work with staff at the Department of Buildings to issue transparent and frequent communications to the public regarding its historic and future inspection frequencies, as well as the budget line items over the past 20 years that have gone towards maintaining regular inspection frequencies. We recommend particular attention be paid to the facilities that we found were listed at least

twice on the TRI as top toxic polluters/those with high RSEI scores: Ford Motor Company, PPG Industries, PVS Chemical Solutions, Cargill, Atlas Tube, Sherwin-Williams, American Zinc, LaFarge, and Tower Automotive.

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Due to time and resource constraints, we were unable to analyze OSHA violation records for other industrial corridors, particularly those in environmental justice communities. Therefore, it was difficult for the research team to draw firm conclusions regarding whether our findings would be considered normal, as compared to other corridors in the city. For this reason, we request that staff of the Department of Planning and Development work in coordination with the City of Chicago's Office of Inspector General, and staff of the Occupational Safety and Health Administration to 1) compile data on budget allocations towards staff inspections, particularly in EJ communities, 2) replicate our analyses for, at a minimum, 5 other industrial corridors within the City of Chicago that have a similarly high percentage of land dedicated to their PMDs, and 3) make OSHA violation records more easily searchable and downloadable for the purposes of overall aggregation and analysis over time. Regarding suggestion number 2, we request particular attention be paid to the existence of repeat violators; as noted in the 'Research Findings' section, we noted a near complete absence of repeat violators among the companies on the CACHET list. Due to the length of our analysis period, we suspect that this is due to a lack of appropriate record-keeping or inspection frequencies, rather than an actual reduction in the number of violations on the part of companies.

Health Outcomes and Services

Guiding Questions (Quantitative)

- To what extent do commonly-used metrics of public health capture the adverse impacts of corridor and surrounding area land use? How are these impacts distributed across residents, as well as workers who might live elsewhere, but experience repeated exposure at their workplaces located within the corridor/surrounding area?
    - What impacts are evident when examining these metrics currently?
        - Within the residential study area, does there appear to be a statistically significant relationship between living in proximity to large industrial corridors, and experiencing negative environmental health outcomes?
        - Does a statistically significant relationship exist for residents of the Calumet Industrial Corridor/surrounding area, specifically?
        - Does a statistically significant relationship exist for people who work within the Calumet Industrial Corridor/surrounding area?
        - How might trends differ, if at all, between corridor residents and workers?
- What is the spatial distribution of health services in the corridor and surrounding area?
    - Of the portions of land that are in close proximity to health services, what is the total percentage of that land that is zoned for residential activity?
        - What is the percentage of that land that is occupied by residential activity?
    - What is the accessibility of health services in the corridor and surrounding area, as it pertains to density of medical services?

Outline of Research Findings Components

- Residential Population Health Outcomes and Services
    - Findings on chronic disease and health index prevalence rates
        - Spatial visualization of prevalence rates
        - Summary statistics for study area, comparison areas, and the City of Chicago
        - Significance testing results and narrative
    - Explanation of spatial clustering testing and results
        - Getis-Ord test output
        - Hot Spot Analysis visualization
    - Overview of the spatial distribution of study area health services

        - Spatial visualization by year, mapped to residential land areas
        - Findings on residential land proximity, by unique health asset
    - Narrative and spatial visualization on the presence of medically underserved populations within the study area

- Worker Population Health Outcomes and Services
    - Findings on chronic diseases in top “worker home” locations
        - Spatial visualization of select chronic disease rates by census tract
    - Overview of the presence of medically underserved populations within the study area

Methods

Given the working group’s interest in the environmental health and safety of both workers as well as residents within the study area, the research team treated these two populations separately in the methods and analyses we chose to conduct; below, the ‘Residential Health’ methods sub-section spans pages 151-158, while the ‘Worker Health’ methods sub-section spans pages 158-161. It should be noted, however, that there is *some* overlap between these populations. Specifically, we found that in 2017 (the most recent year for which we could obtain estimates), that roughly 8 percent (1,003 people) of all labor force participants within the study area also lived within this boundary. For detail on how this overlap affected the analyses we chose to conduct, see page 159.

Residential Health

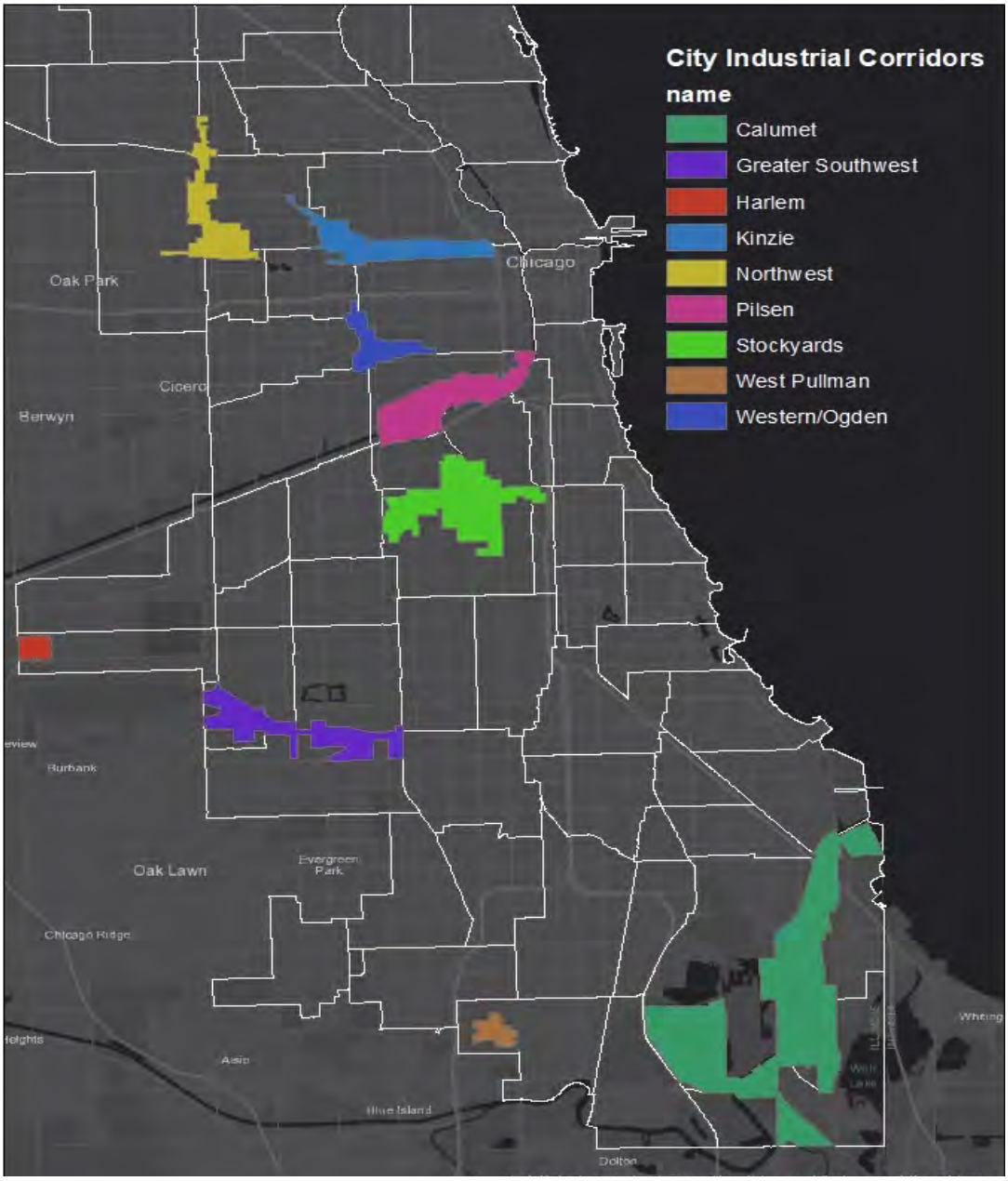
Data compilation and visualization of prevalence rates

In order to understand the residential health landscape within the corridor and surrounding area, the research team began by assembling data on chronic health conditions available to us, in part, through PolicyMap--a proprietary data collection and visualization platform for which MPC has its own organizational licenses. Within PolicyMap, users have access to a large variety of data across varying time periods, geographies, and topics, including education, housing, and the economy. After examining the data available as part of the ‘Health Status’ portfolio, we downloaded BRFSS census tract level data on the prevalence of Asthma, Chronic Obstructive Pulmonary Disease (COPD), and Coronary Heart Disease among adults for every census tract in Cook County (see Table 20, rows 1-3 for original source information).

The research team then imported shapefiles of the geographic boundary of Cook County into ArcMap, as well as boundaries of all census tracts within the state of Illinois (see Table 20, rows 4 and 5 for full source information) into a clean map interface. In order to perform a spatial join of the PolicyMap data to the appropriate census tracts within Cook County, we first clipped the Illinois census tract shapefile to the Cook County shapefile border file. This way, only the tracts in Cook County would be part of our data visualization and spatial analysis tests, described in detail later in this section. The research team then added the shapefile we had previously used containing all city of Chicago industrial corridors to the map interface.

According to the Calumet River Communities Planning Framework (see Table 20, row 11 for full source information), the planned manufacturing district (PMD) takes up 73 percent of the land acreage of the Calumet Industrial Corridor. Given the huge variety of zoning mixes in industrial corridors across the city, the research team determined that, methodologically, it would only be appropriate to compare adult residential health within the Calumet to corridors in the city that have a similar or higher amount of land zoned for the PMD. Figure 71, below, displays the boundaries of the 9 industrial corridors (including the Calumet) within the city that have 73 percent or more of their land area zoned for the PMD; these 9 corridors served as the basis for our comparisons.

Figure 71. City industrial corridors that have 73 percent or more of land area devoted to the Planned Manufacturing District (PMD)



After making this decision, the research team deleted all other industrial corridors except the nine above from the city corridor shapefile. We then proceeded to create ½ mile buffers around each of the 9 corridors using ArcMap's buffer geoprocessing tool, and then reprojected the

resulting shapefile, converting the projected coordinate system from ‘WGS1984’ (the default for city shapefiles) to ‘NAD_1983_2011_StatePlane_Illinois_East_FIPS_1201_Ft_US’.

After spatially joining each chronic health data spreadsheet to the larger Cook County census tract shapefile, we clipped this file to the 9-corridor layer, and changed the symbology of each shapefile to visualize the health rate data as the primary display variable on a color gradient map. In terms of data distribution options, the research team used ArcMap’s ‘natural breaks’ selection for value distribution. The resulting color gradient maps for asthma, COPD, and coronary heart disease (Figures 74-76) can be found in the Research Findings section, on pages 172-176.

Along with the prevalence of asthma, COPD, and coronary heart disease, the research team also examined 3 health indices from the EPA’s National Air Toxics Assessment (NATA) database. NATA is a screening tool for state, local and tribal air quality monitoring agencies. NATA calculates toxics concentrations and risks at the census tract level.

Among the available options, we downloaded census tract data for the state of Illinois on ‘Cancer Risk’, ‘Non-Cancer Respiratory Illness Hazards’, and ‘Neurological Illness Hazards’ (see Table 20, rows 8-10), and, using the same ArcGIS methods as previously described for asthma, COPD, and coronary heart disease, we visualized these indices for the same 9 corridors of interest. The resulting maps (Figures 77-79) can be seen on pages 178-182.

Below, we display the language developed by NATA regarding each variable index:

> “In NATA, individual lifetime cancer risk associated with exposure to a single air pollutant was estimated by multiplying an average estimated long-term exposure concentration by the corresponding **URE** for that pollutant. Thus, the equation below estimates the probability of an individual developing cancer over a lifetime from the exposure being analyzed due to a given inhalation exposure, over and above that due to any other factors.”
>
> Risk = **EC** × **URE**
>
> **Risk** = estimated incremental lifetime cancer risk for an individual due to exposure to a specific air toxic, unitless (expressed as a probability)
>
> **EC** = estimate of long-term inhalation exposure concentration for a specific air toxic, in units of µg/m3
>
> **URE** = the corresponding inhalation unit risk estimate for that air toxic, in units of 1/(µg/m3) ”

> “The following equation estimates the non-cancer hazard due to a given inhalation exposure:
>
> **HQ= EC/RfC**
>
> **HQ** = the hazard quotient for an individual air toxic, unitless
>
> **EC** = estimate of long-term inhalation exposure concentration for a specific air toxic, in units of mg/m3
>
> **RfC** = the corresponding reference concentration for that air toxic, in units of mg/m3”

“With this being a unitless index quotient, the result is a value that is either below or equal to 1, or higher. A value below 1 indicates that there is no likelihood that there is a risk of adverse effects. This method of quantifying risk is used to assess the non-cancer respiratory illness hazards, and the neurological illness hazards.”

Significance testing of prevalence rate distribution

After all health data maps were created, the research team conducted statistical analyses to test whether the rates of these various health data variables within the corridor and surrounding half mile buffer were measurably different from their rates in non-corridor census tracts. In order to test these differences, we employed t-testing. Within the parameters of our significance test, we sought to determine whether a statistically significant difference exists between the rates of each chronic condition/health index value as observed inside and outside of the study area, specifically through the comparison of study area census tracts to an “average” city tract, as well as to the “average” tract in the other 8 industrial corridors (and their ½ mile buffers) that have a similarly high mix of heavy industries.

To perform the t-testing, the research team exported from ESRI ArcMap the attribute table of each chronic condition/health index value into Microsoft Excel. There, we tabulated the rates of each health variable in order to prepare for the testing. Using the ‘Data Analysis ToolPAK’ add-on, we selected the ‘t-Test: Two-Sample Assuming Equal Variances’ option.

As inputs, we selected the column with the study area census tracts for ‘Variable 1 Range’, and for ‘Variable 2 Range’, we chose the column with the comparison group; because we employed two different ‘rounds’ of significance testing, our comparison group for half of the tests was the group of tracts in the City of Chicago, while the other comparison group was the tracts in the 8 other industrial corridor/buffer areas. For each health variable, a t-Statistic value ‘*t*’ and p-value ‘p’ was computed. The *t*-Test results for each significance test can be found in Tables 21-32 on pages 173-183. Given that we chose to use testing at the 95% confidence threshold, a p-value less than or equal to 0.05 indicates a statistically significant difference exists between the rates of each chronic condition/health index value as observed inside and outside of the study area.

Spatial clustering analysis of prevalence rate distribution

In addition, we used ArcGIS spatial clustering analysis tools to determine whether statistically significant “clusters” of high or low chronic disease rates exist in or around the study area, as well as our other 8 comparison corridors. We did so through the use of Getis-Ord General G, and Optimized Hot Spot Analysis tests, both part of ArcMap’s ‘Analyzing Patterns’ toolbox.

The Getis-Ord General G tool analyzes a specified data variable in a geography (in this case, each census tract), relative to the context of neighboring census tracts to determine if there is significant spatial clustering. The Optimized Hot Spot tool then takes the output of the Getis-Ord General G test to create a visual representation of any clusters that are identified; this output is known as a hot-spot or cold-spot map. In our analyses, the research team tested for spatial clustering of each aforementioned health data variable except for adult coronary heart disease.

Within these two tools, the research team had to make a variety of decisions regarding the optimal way for clustering analyses to be run, as well as interpreted. Within the Getis-Ord General G tool, tests were run after we modified the ‘Conceptualization_of_Spatial_Relationships’ field to use a Fixed_Distance_Band. The Incremental Spatial Autocorrelation Tool was used to determine the correct distance needed for the Fixed_Distance_Band. This distance was determined to be 18,758.85 feet. Tests were run with and without row standardization for the city of Chicago COPD and Asthma data and Cook County Cancer Risk and Respiratory Hazard risk data. The results with row standardization were inconclusive but the results without row standardization yielded usable data.

After the spatial clustering statistics were developed, we used the Optimized Hot Spot tool to visually identify significant spatial clusters of high and low prevalence rates. The Optimized Hot Spot tool was used to develop visual representations of Getis-Ord clustering for COPD, Coronary Heart Disease, Asthma, Cancer Risk, and Respiratory Hazard Risk data; see the resulting visuals (Figures 80-85) on pages 185-191.

Spatial distribution of health services

The research team mapped the spatial distribution of health services available to Calumet residents and workers in 2009, 2012, 2015, and 2018, using health services asset data from MAPSCorps, a youth empowerment non-profit organization that trains young people in community data science and asset-mapping. This data is an asset-based compilation containing businesses and organizations at the address-level for various communities on Chicago’s South and West Sides.

We uploaded this dataset, along with the study area shapefile and the 2013 CMAP land allocation shapefile into ArcMap, and made preparations to geocode these addresses. The research team was able to successfully geocode all health assets on the list for all four years,

and changed the symbology of the resulting shapefile to display each unique health service in a different color (i.e. alternative medicine clinics displayed in white, chiropractors in blue, dentistry in yellow, etc).

After changing the symbology, the research team performed a buffer function to give each health asset its own ¼ mile buffer, and performed a clip so that the 2013 land use information would only display within those areas around each asset. We then selected attributes to only display parcels within residential zoning classes (i.e. 'Single Family Detached', 'Single Family Attached', 'Multi-Family Residential', 'Urban Mix with Residential', and 'Vacant Residential'), and made preparations to calculate the residential land area in each ¼ mile area. To do this, we created a new field 'Area_Buffer' in the shapefile attribute table, and used the 'Calculate Geometry' function.

Using ArcMap's 'Intersect' tool, we performed a geometric intersection between the ¼ mile buffer layer and the clipped land use buffer displaying only residentially zoned parcels. In the resulting attribute table, the research team calculated the area of parcels by creating a new field 'Area_Parcel' and using the 'Calculate Geometry' function. We then summarized the data by each unique health asset ID, using the 'Summarize' function. This function created a new output table containing one record for each unique health asset. From here, we calculated the percentage of residential land that is located within a ¼ mile of each health asset. To do this, we divided the 'Area_Parcel' field by the 'Area_Buffer' field calculated above, and then multiplied this fraction by 100 to yield final percentages. The resulting maps and visuals (Figures 86-90) can be seen on pages 192-199.

From here, we used data from the Health Resources and Services Administration (HRSA) to get a sense of health services access in both the study area and the home location census tracts of those working in the study area; see Table 20, row 14 for full source information. Each year, State Primary Care Offices (PCOs) submit an application to the HRSA using the Shortage Designation Management System (SDMS). Then, the HRSA classifies areas and populations as being "Medically Underserved" or not, depending on their access to health services.

The HRSA classifies an area or a population as being 'medically underserved' based on their Index of Medical Underservice (IMU). This index has a 0 to 100 scale, with 0 indicating areas that are completely underserved, while on the other extreme, 100 indicating best served areas, in terms of access. An area or population's IMU is determined by the sum of the following four weighted indicator values: the population to health care provider ratio, the percent of the population below the federal poverty level, the percent of the population over age 65, and the infant mortality rate. An index of 62 or less qualifies an area or population as being medically underserved.

Some areas or populations may not meet the MUA/MUP designation criteria based on their IMU. It is possible to request a Medically Underserved designation for other populations and areas. In order to do so, the conditions that prevent health care access or explain the lack of health care services must be documented with supporting data. A written recommendation from

the state governor or another Chief Executive Officer and a local health official then must be submitted. The governor or chief executive officer of the state must recommend the designation and then a Primary Care Office can request the designation.

Once again using MPC's PolicyMap license, the research team downloaded census-tract level data on MUA/MUP designations for the entirety of both Illinois and Indiana. The Indiana data was needed in order to analyze the top 25 'home location' census tracts of study area workers; for an explanation of the relevance of these 25 'home location' tracts, please see page 159. We combined and cleaned the Indiana and Illinois datasets in Microsoft Excel to make one dataset, and then uploaded this data to ArcMap along with the study area shapefile, the shapefile containing the top 25 home location census tracts, and a shapefile of all Illinois census tracts (see source information in Table 20 row 4). The top 25 home location tracts came from OnTheMap, first mentioned on page 15, within the 'Industrial Occupation and Land Use Methods' sub-section; the description on how we obtained the data for this section's analyses can be found below under the 'Worker Health' sub-heading.

The research team clipped the Illinois census tract shapefile in order to only display the census tracts in the study area, and we then performed a spatial join between the clipped shapefile and the MUA/MUP dataset. To display the different designations, we adjusted the symbology of the clipped layer, choosing 'Categories with Unique Values' and adding 'All Values' under the MUA/MUP field. After applying this change, our final exported map (Figure 91 on page 201) displayed a different color for each MUA/MUP designation. We followed this same process for displaying the designations for the top 25 home location census tracts, but did not have to clip this data, as the top 25 census tracts shapefile contains only those relevant 25 tracts. This resulting map, Figure 94, can be found on page 206.

We also gathered data from PolicyMap on the percent of adults reporting to have a primary care doctor or health care provider in the top 25 home location census tracts of study area workers. This data comes from the Center for Disease Control's (CDC's) Behavioral Risk Factor Surveillance System (BRFSS), first mentioned on page 151. The BRFSS conducts annual telephone surveys to gather state data on residents' health-related risk behaviors, chronic health conditions, and their use of preventive services. We used the same process as described above for visualizing this data, using PolicyMap and the top 25 census tract shapefile in ArcMap. For the final map display, however (Figure 95, on page 207), we used a 'Graduated Symbology' with 'Natural Breaks' for the visualization options.

Worker Health

<u>Spatial distribution of workers' home locations</u>

The research team used the OnTheMap application to gather information about where workers in the study area lived. First, the shapefile of the study area was imported into OnTheMap. Once

the study area was selected and confirmed, analysis settings were chosen. To find the census tracts where workers in the study area lived, “Work” was selected for the Home/Work Area, “Destination” was selected for the Analysis Type, “Census Tracts” was selected for the Destination Type, and the most recent year of data was selected - 2017. Finally for Job Type, “All Jobs” was selected. For the dataset used by OnTheMap, a person-job link is created if a person works at the same place for both the first quarter of the relevant year (January - April) and the second quarter of the year (April - June).

OnTheMap displays the top 10 results by default, but we chose to first analyze the top 100 census tracts. In order to display the data in ArcGIS, we selected the option to ‘Export Geography’, and selected “Shapefile” for the export type from the ‘Results’ tab. We then imported the study area shapefile, the 100 top census tracts shapefile, and a basemap to a clean ArcMap interface. For the final map visualizations, we changed the top 100 tracts shapefile symbology to a graduated color quantity, and used five ‘natural breaks’. Our final visualizations can be seen in Figures 72 and 73, showing the top 100 and top five census tracts for home locations of workers in the study area, respectively. We used the same process as described above for displaying the top 5 tract home locations from the OntheMap source data.

Through this visualization process, we learned that the most popular home locations of workers in the study area actually fall within the study area boundary itself, or in very close proximity to it. We also found that many of the top 100 home location census tracts of workers only had 25-35 people living in them. Because of this, we determined it would be difficult to predict health outcomes of the workers living in these census tracts, because they make up such a small proportion of the total people living in those tracts. In order to better understand worker health, the research team decided to conduct further analyses *only on the top 25 home location census tracts of workers*. The top 25 census tracts are in both Illinois and Indiana, most located close to the Illinois/Indiana border. Further analysis on these 25 tracts can be found within the ‘Research Findings’ sub-section starting on page 202.

Figure 72. Top 100 census tract home locations of study area workers

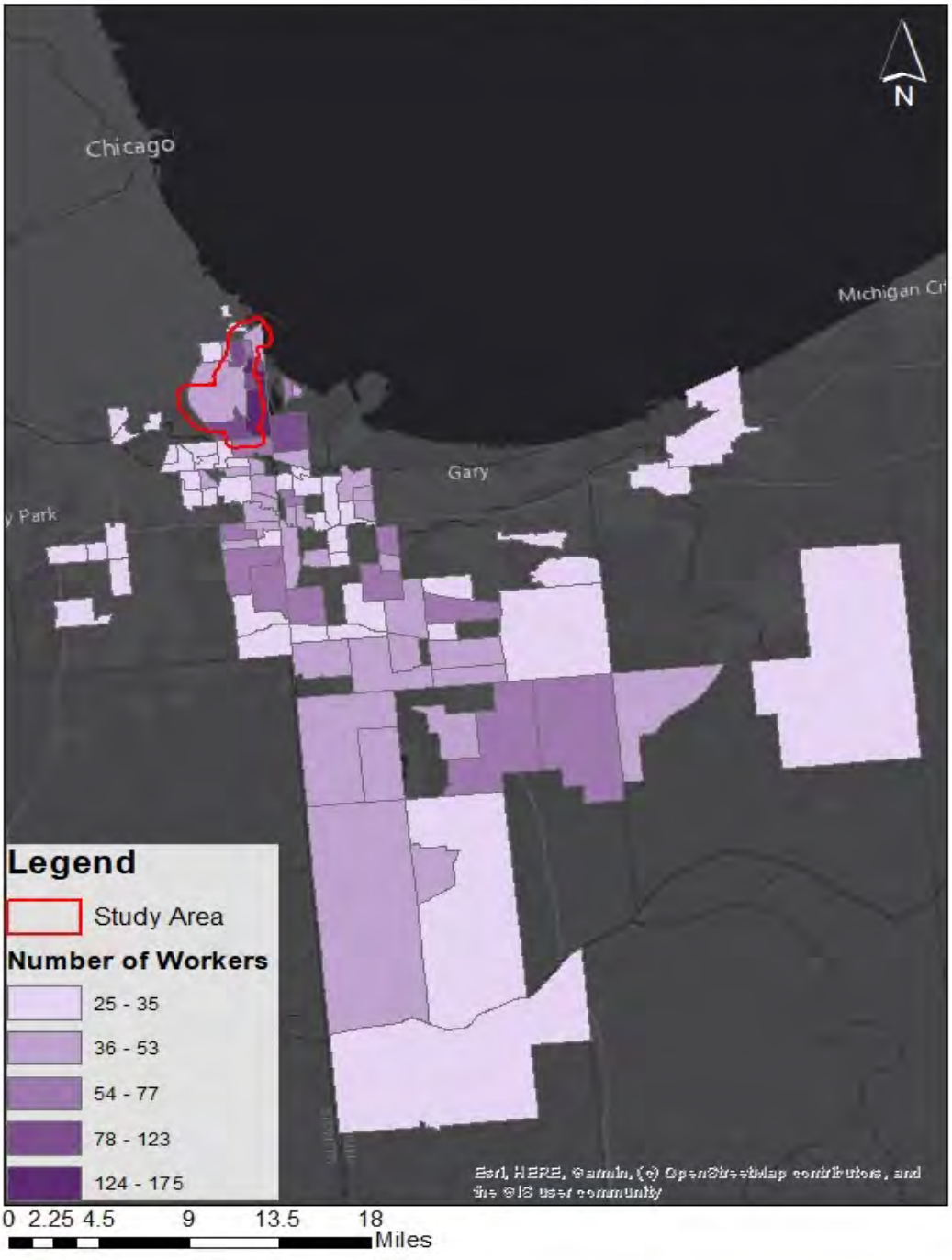
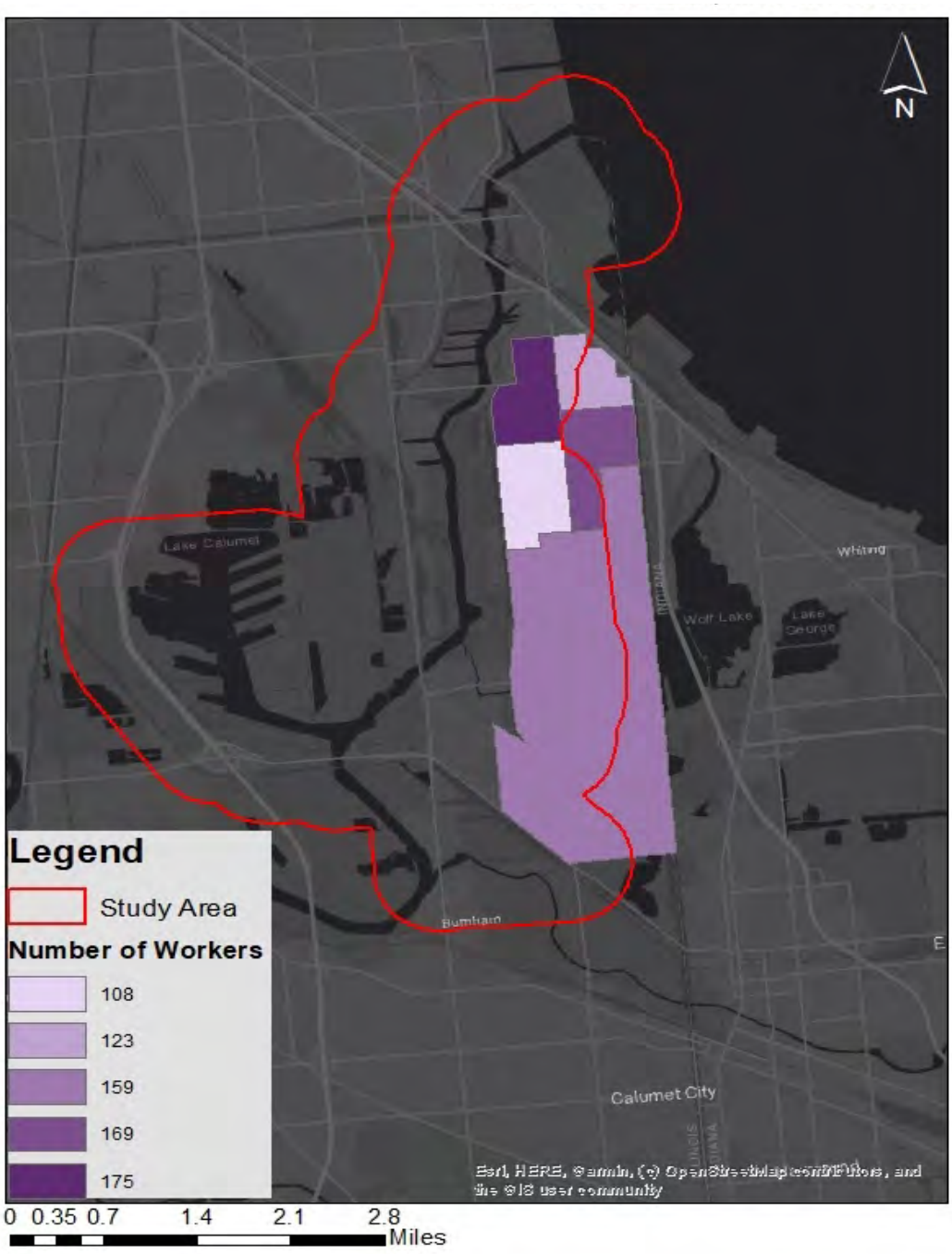


Figure 73. Top 5 census tract home locations of study area workers



Data Sources

Table 20. Table of data sources used in section analysis

Table Row	Data/Source	Description	Link	Year(s) Available	Date Retrieved
1	Rates of Adult Asthma; Centers for Disease Control and Prevention	Collected through the Behavioral Risk Factor Surveillance System	https://www.cdc.gov/brfss/annual_data/annual_2013.html	2013	July 2019
2	Rates of Adult Chronic Obstructive Pulmonary Disease; Centers for Control and Prevention	Collected through the Behavioral Risk Factor Surveillance System	https://www.cdc.gov/brfss/annual_data/annual_2013.html	2013	July 2019
3	Rates of Adult Coronary Heart Disease; Centers for Disease Control and Prevention	Collected through the 500 Cities Coronary Heart Disease survey, administered across America's 497 largest cities	https://nccd.cdc.gov/500_Cities/rdPage.aspx?rdReport=DPH_500_Cities.InteractiveMap&islStates=59&islCategories=HLTHOUT&islMeasures=CHD	2013	July 2019

4	Shapefile of Illinois Census Tracts; U.S. Census Bureau MAF/TIGER database (Master Address File/ Topologically Integrated Geographic Encoding and Referencing)	Spatial data file of census tract boundaries in the state of Illinois, as compiled by the U.S. Census Bureau. Shapefiles can be imported into ESRI ArcGIS software for manipulation and analysis purposes.	https://catalog.data.gov/dataset/tiger-line-shapefile-2013-state-illinois-current-census-tract-state-based	2013	May 2019
5	Shapefile of Cook County geographic boundary; Cook Central database (maintained by Cook County government)	Spatial data file displaying the boundary of Cook County, Illinois. Maintained by Cook Central, the Cook County government database, and created based off of the Public Land Survey System (PLSS)	https://hub-cookcountyil.opendata.arcgis.com/datasets/ea127f9e96b7467789272206 9c984198_1	2017	May 2019

6	Shapefile of city of Chicago boundary; Chicago Data Portal	Spatial data file of Chicago municipal boundary, as provided by the City of Chicago	https://data.cityofchicago.org/Facilities-Geographic-Boundaries/Boundaries-City/ewy2-6yfk	Created May 2015; updated June 2017	May 2019
7	Shapefile of city of Chicago industrial corridors; Chicago Data Portal	Spatial data file of Chicago industrial corridor boundaries, as provided by the City of Chicago	https://data.cityofchicago.org/Community-Economic-Development/Boundaries-Industrial-Corridors/vdsr-p25b	Created December 2010; updated August 2011	May 2019
8	Cancer Risk; Environmental Protection Agency's National Air Toxics Assessment (NATA)	Expressed as a probability resulting from the multiplication of estimated long term inhalation, and the inhalation unit risk of each pollutant.		2014	July 2019
9	Respiratory Hazard Index; Environmental Protection Agency's National Air Toxics Assessment (NATA)	The index is based off a quotient that is derived from the division of the long term exposure by the reference concentration. A value of <1 indicates that exposure is unlikely to		2014	July 2019

		result in adverse effects.			
10	Neurological Hazard Index; Environmental Protection Agency's National Air Toxics Assessment (NATA)	Same equation as the Respiratory Hazard Index (see row above), only with pollutants linked to neurological conditions. A value of <1 indicates that exposure is unlikely to result in adverse effects.		2014	July2019
11	Calumet River Communities Planning Framework; UIC Great Cities Institute's Great Cities, Great Rivers initiative	Great Cities Institute report articulating community concerns and desires for the transformation of South Chicago, East Side, and South Deering as it pertains to environmental and economic issues along the Calumet River	https://greatcities.uic.edu/wp-content/uploads/2019/05/CalumetRiverCommunitiesPlan_Web.pdf	Released February 2019	August 2019

12	Health services asset data; MAPSCorps	Annually updated community assets data containing businesses and organizations at the address-level for Chicago's South and West Sides	Available by request	2009, 2012, 2015, 2018	June 2019
13	PolicyMap	Online Mapping tool for data on various US demographics . Data sources from from various departments, centers, and other government entities.	https://www.policymap.com/	2013, 2016, and 2019 data used	October 2019
14	Medically Underserved Area/Population (MUA/P) Information; HRSA	Information on the process for designating areas or populations as Medically underserved; headed by HRSA.	https://bhw.hrsa.gov/shortage-designation/muap-process	Last reviewed June 2019	October 2019

15	Longitudinal Employer-Household Dynamics; US Census Bureau	Program that combines federal, state, and Census Bureau data to show statistics about longitudinally linked employment data.	https://lehd.ces.census.gov/#	2002 - 2017 available; 2017 used	October 2019
16	LEHD Origin-Destination Employment Statistics (LODES) Documentation; US Census Bureau	Information on file organization, naming, and structure of the data used in OnTheMap.	https://lehd.ces.census.gov/data/lodes/LODES7/LODESTechDoc7.4.pdf	Updated August 26, 2019	October 2019

Data Limitations

Residential Health

Data compilation and visualization of prevalence rates

In our analysis of chronic health data, the research team encountered challenges with regards to both the comprehensiveness of data available for the geographies we required, as well as limits on the ways we were able to process the data available to us. For example, as calculated by the Centers for Disease Control and Prevention, coronary heart disease rates are not calculated in census tracts outside of major metropolitan areas. This means that portions of Cook County that border Chicago (that are located within the half mile buffer surrounding the corridor) are absent from the data. While these areas of land are not substantive in terms of overall acreage, the absence of this data does skew the way the distribution of coronary heart disease values “appears” in our study area. Additionally, there are a few census tracts within the Chicago border that lacked Asthma and COPD data entirely.

We also encountered software limitations as we visualized this data in ArcGIS. As mentioned in the ‘Methods’ section, the Chicago border shapefile (retrieved from the City of Chicago Data Portal, and modified by our team on 7/24/2019) had to be amended because it did not match up in close enough conformance with the “clipped” shapefile containing only the census tracts that are actually located in the city of Chicago proper. While we amended the Chicago border so that both shapefile boundaries would align as closely as possible, there is still the possibility that small parts of census tracts outside the city of Chicago are included inside the ArcGIS map interface’s City of Chicago border. This can lead the software to accidentally count suburban data in calculations for city of Chicago statistics on COPD, asthma or coronary heart disease. This unintended inclusion of suburban data may result in a slight skewing of our data findings. While this is unlikely to have occurred due to manual editing of the Chicago border, this possibility is acknowledged.

Additionally, the measurements for NATA Cancer Risk and the Non-Cancer Hazard Indices are the result of the equations shown in the ‘Methods’ section (on pages 154-155), as applied to all of the necessary pollutants relevant to each category. For example, to derive the overall Cancer Risk in a particular census tract, the results of the individual pollutant equations are summed together. Below, see language directly from the NATA data dictionary on the 3 indices of interest:

> “In NATA, we assume that exposures to multiple carcinogens can be added together to estimate risks. This approach has drawbacks: Effects from multiple chemicals may be greater or less than additive, and statistical limitations exist. But this straightforward calculation is widely used to estimate cumulative risks, especially in screening assessments like NATA.”

This addition is also done for the Non-Cancer Index measurements.

Additionally, the Hazard Quotients (HQ) for the Non-Cancer Indices do not clearly define any level of risk. The EPA is very clear in assuring that any values over the value of 1 do not necessarily indicate there are risks for adverse effects. Again, see below for language directly from NATA:

> “As with the HQ, an HI value less than or equal to 1 indicates that the exposure is not likely to result in adverse noncancer effects. An HI value greater than 1, however, does not necessarily suggest a likelihood of adverse health effects and cannot be interpreted as a statistical probability of adverse effects occurring.”

<u>Significance testing of prevalence rate distribution</u>

The census tracts within and around the Calumet Industrial Corridor are mostly contained within the limits of the City of Chicago. Given that the City of Chicago was one of the comparison

areas in our t-testing design, it is possible that the difference in the average rate of chronic diseases between our study area and the rest of Chicago (Chicago minus our study area) might be larger than the difference between the study area and the city as a whole. This means that the impact of the prevalence rates of chronic diseases within the study area might be more salient than how they are presented in our final t-testing results.

Spatial clustering analysis of prevalence rate distribution

There were many data limitations our team encountered when we chose to employ spatial clustering analysis methods. For one thing, the census tracts around the Calumet Industrial Corridor are very large when compared to the average city of Chicago tract, and the study area in particular has few neighboring census tracts since many of the Calumet Industrial Corridor tracts are located on or very close to the official city border. When running spatial cluster testing, ArcGIS recommends that each census tract that is part of a chosen study area should have roughly eight tangential neighbors (i.e. at least eight census tracts that share a common edge) for the most accurate results. Some census tracts within the study area have under eight tangential neighbors, which has the most direct impact on the output of the 'Incremental Spatial Autocorrelation' test (first mentioned on page 156), which is needed as an input for the Optimized Hot Spot test.

Another data limitation we faced was the availability of coronary heart disease data, first mentioned on page 151. Due to the large amounts of unreported data in the city of Chicago for this variable as compared to Asthma or COPD, we chose not to perform spatial clustering tests on this indicator.

Finally, we were unable to perform spatial clustering on the NATA Neurological Hazard Index data, due to a lack of a "valid peak" when running the Incremental Spatial Autocorrelation test--which is used to find the distance needed for the Fixed_Distance_Band input. Because we were unable to input a value for the Fixed Distance Band parameter, the analysis could not be carried out.

Worker Health

Spatial distribution of workers' home locations

The research team encountered several technical limitations when we tried to access OnTheMap's full dataset on worker home locations, which limited our ability to download the various demographic cross-tabulations tables we had been hoping to include in our spatial visualizations. After downloading the exported geography of all worker home locations (for all workers in the study area) with the 'Show All Results' option chosen, the research team discovered that only the top 100 census tracts were included in the shapefile. Displaying 100

census tracts was the next-highest option below displaying all of them. This limited the number of home location tracts we could display and potentially analyze.

We also want to acknowledge the accuracy limitations of the LEHD data collection process overall. During the collection process for home-work location data, very little quality assurance is done to ensure that companies with multiple operational arms--such as many in our study area--are reporting worker home locations for each of their individual facility sites. For example, if a company, XYZ, has two work locations in both Chicago and Indianapolis, a general workplace selection of “XYZ” on OnTheMap may map to the Chicago location, though the true place of work for a worker could be the Indianapolis location. Given the inherent time involved in self-reported data collection processes, employers would not have strong incentives to choose the correct working location of every individual employee. Thus, this data may inaccurately portray where a person actually works if they are working at a facility that has several operational arms with unique addresses.

We believe this may have been the case for some of the multi-location facilities in our study area; when we visualized the worker home locations for the top 100 census tracts selection, we noted that there were many census tracts displayed as being home to a person who works in the study area, despite the fact that these tracts were located around 150 miles away from the study area itself. We find it unlikely that this is accurate and believe the data may contain more work-location errors as the distance from the study area increases.

Spatial distribution of health services

The ‘Medically Underserved’ status data seen in Figures 91 and 94 on pages 201 and 206 comes from 2019. The data on the percent of adults reporting a health care provider in Figure 95 on page 207 comes from 2013. Therefore, the groups being compared for these variables will not perfectly align.

Research Findings

Residential Health

Visualization of prevalence rates/significance testing of prevalence rate distribution

High prevalence of adult chronic health problems may be reflective of unusually high environmental hazards in the Calumet Industrial Corridor. High levels of air pollution and particulate matter are associated with increased morbidity from chronic diseases such as cancer and asthma. As detailed in the ‘Methods’ section on page 151, the research team mapped rates of asthma, coronary heart disease, chronic obstructive pulmonary disease, and select indices

from the National Air Toxics Assessment (NATA) across the study area, as well as 8 other comparison areas within the city of Chicago. Below, Figures 74, 75 and 76 illustrate the rates of COPD, asthma, and coronary heart disease at the census tract level in all of these areas, while Figures 77, 78, and 79 illustrate the National Air Toxics Assessment's index rates of cancer risk, respiratory hazards, and neurological hazards within these areas.

Below each map, viewers can see tables displaying our significance testing results, summary statistics for the distribution of values across the study area alone, the city of Chicago, and all 9 total areas of study (the Calumet study area along with the 8 other "comparison areas", as well as narrative presenting our high level findings.

Figure 74. COPD rates within a half-mile radius of the Calumet Industrial Corridor and 8 comparison areas

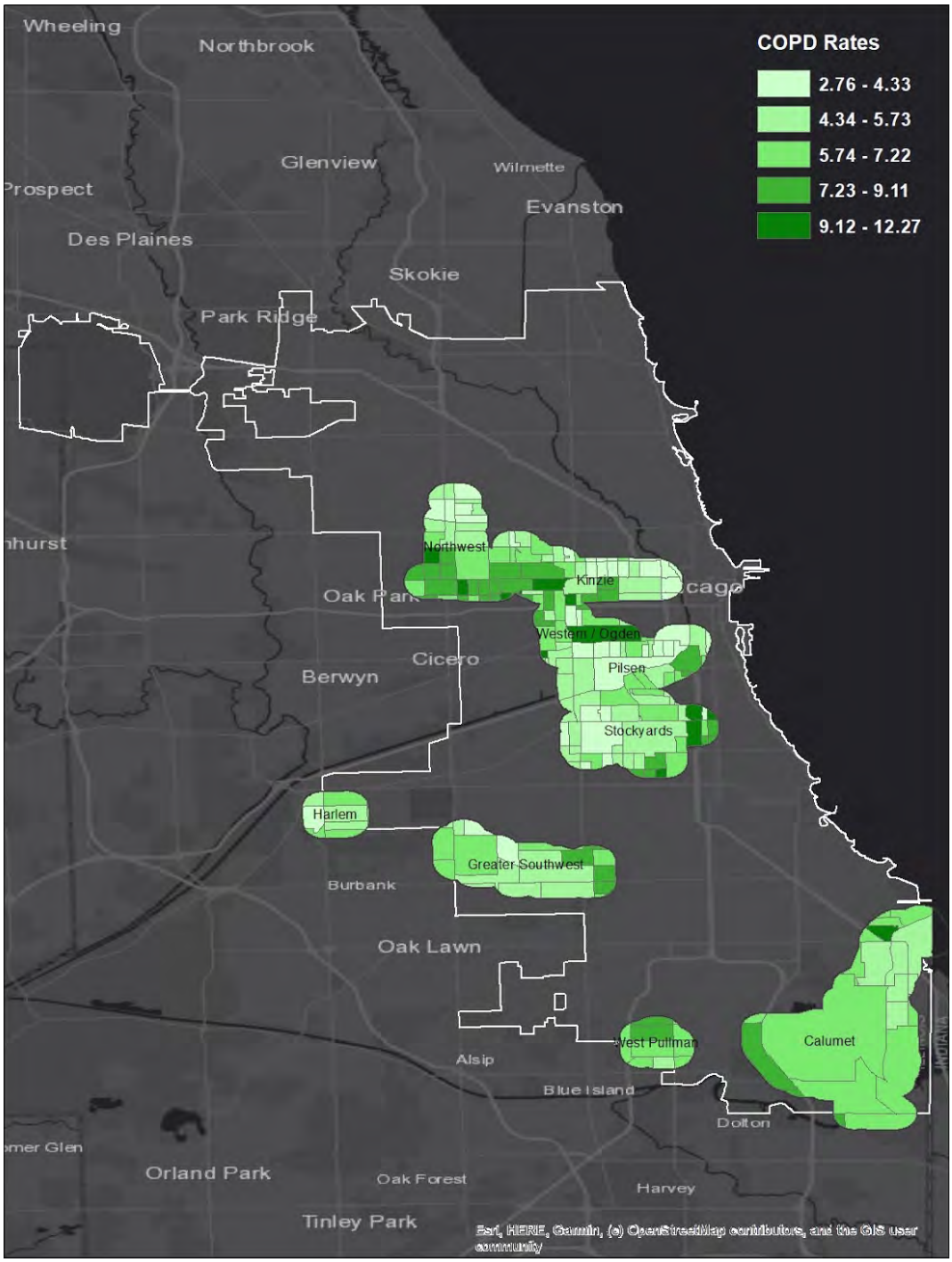


Table 21. Summary statistics for COPD prevalence rates

Geography Area	N	Mean	Minimum	Maximum
Calumet Industrial Corridor	22	6.68	4.93	11.03
9 Areas of Study	226	6.04	2.76	12.27
City of Chicago	868	6.04	2.76	12.27

Table 22. *t*-Test results comparing Calumet Industrial Corridor with other geographic areas on COPD rates

	9 Areas of Study	City of Chicago
Calumet Industrial Corridor	*t = 1.603, p = 0.055*	*t = 1.707, p = 0.044*

The tables above show the summary statistics and *t*-Test results comparing the Calumet Industrial Corridor with the City of Chicago and the 9 Areas of Study on COPD rates. The summary statistics table indicates that the Calumet Industrial Corridor average rate of COPD (6.68) is larger than that of the 9 Areas of Study (6.04) and City of Chicago's (6.04).

With the *t*-Test we wanted to determine whether these differences are statistically significant. The *t*-Test results indicate that only the difference in the average rate of COPD between the Calumet Industrial Corridor (6.68) and the City of Chicago (6.04) is statistically significant at the 5% level of significance. The null hypothesis always assumes that the means are equal, but because the p-value of 0.044 is less than the significance level of 0.05, we can reject the null hypothesis and conclude that at the 5% level of significance, the COPD rates at the Calumet Industrial Corridor are larger than that of the City of Chicago, on average.

Figure 75. Asthma rates within a half-mile radius of the Calumet Industrial Corridor and 8 comparison areas

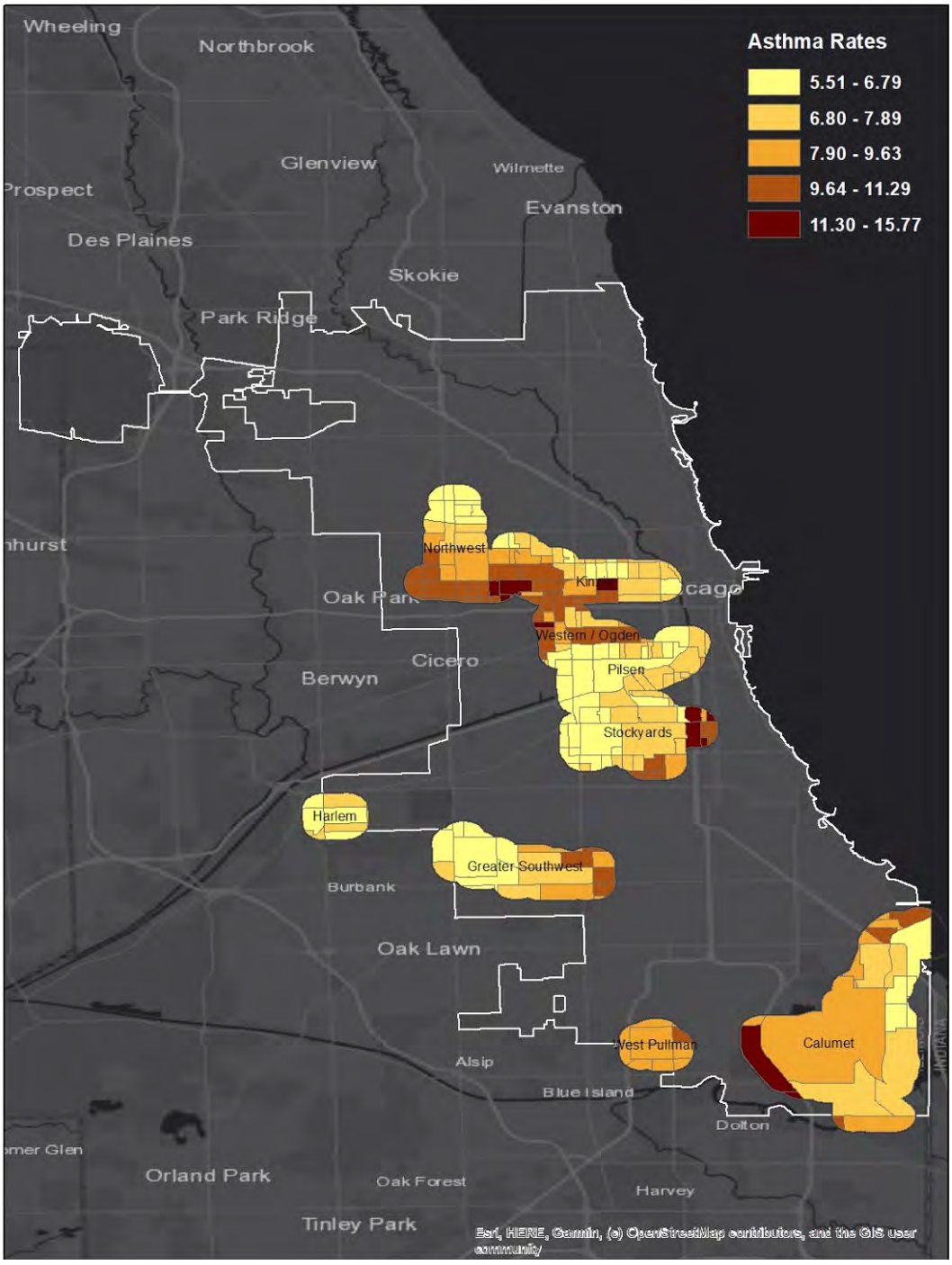


Table 23. Summary statistics for asthma prevalence rates

Geography Area	N	Mean	Minimum	Maximum
Calumet Industrial Corridor	22	8.55	6.26	12.17
9 Areas of Study	226	8.24	5.51	15.77
City of Chicago	869	8.14	5.51	15.77

Table 24. *t*-Test results comparing Calumet Industrial Corridor with other geographic areas on asthma rates

	9 Areas of Study	City of Chicago
Calumet Industrial Corridor	*t = 0.762, p = 0.223*	*t = 1.118, p = 0.132*

The tables above show the summary statistics and *t*-Test results comparing the Calumet Industrial Corridor with the City of Chicago and the 9 Areas of Study on asthma rates. The summary statistics table indicates that the average rates of asthma for the Calumet Industrial Corridor, the 9 Areas of Study, and the City of Chicago are 8.55, 8.24, and 8.14, respectively. However, the *t*-Test results indicate that these differences in the average rate of asthma are not statistically significant.

At the 5% level of significance, we cannot reject the null hypothesis that there are no differences between the groups, that is, we cannot conclude that the asthma rates at the Calumet Industrial Corridor are larger than that of the City of Chicago and the 9 Areas of Study, on average.

Figure 76. Coronary heart disease rates within a half-mile radius of the Calumet Industrial Corridor and 8 comparison areas

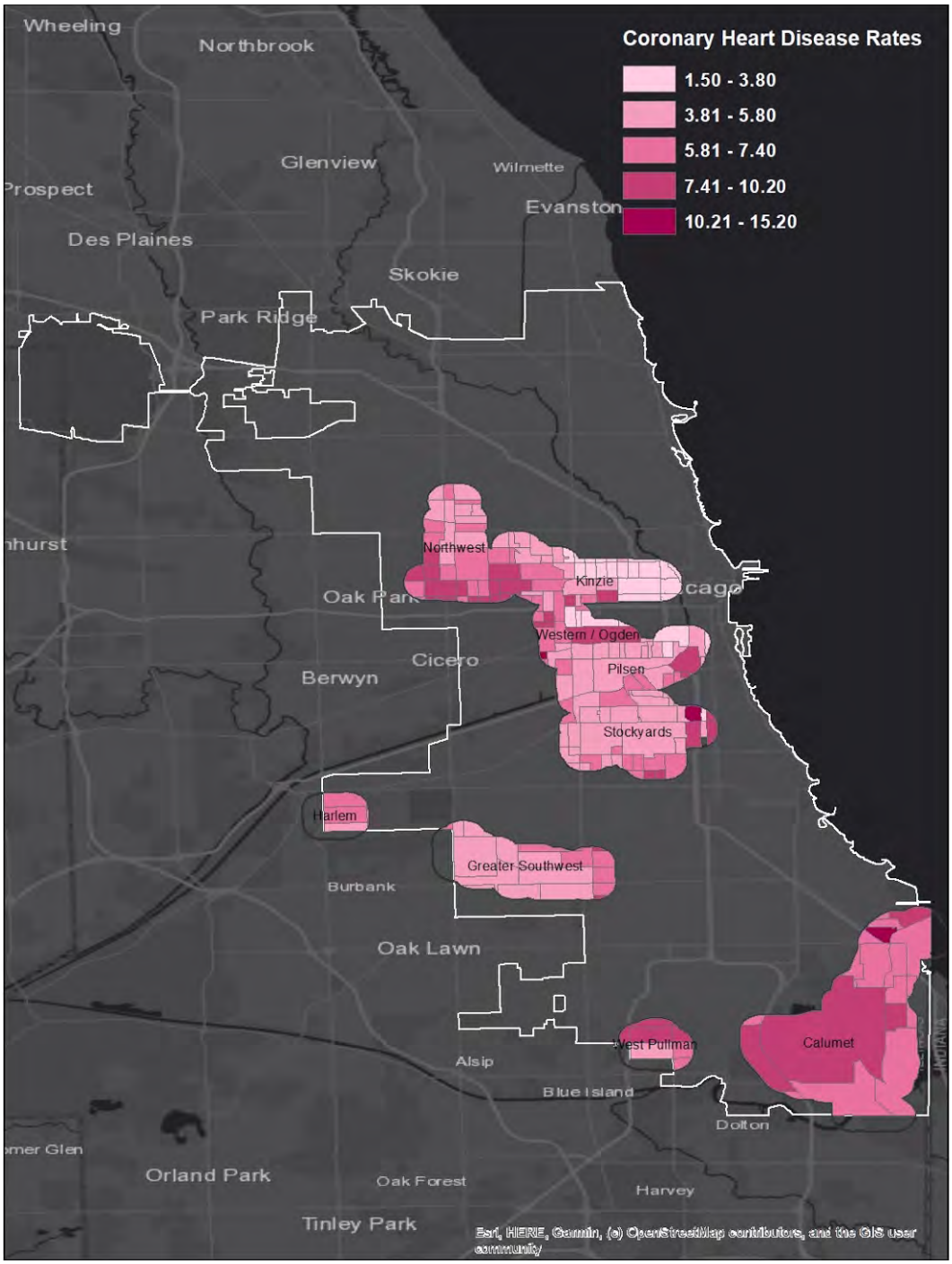


Table 25. Summary statistics for coronary heart disease prevalence rates

Geography Area	N	Mean	Minimum	Maximum
Calumet Industrial Corridor	20	7.38	6.10	15.20
9 Areas of Study	215	5.94	1.50	15.20
City of Chicago	803	5.48	1.20	15.20

Table 26. *t*-Test results comparing Calumet Industrial Corridor with other geographic areas on coronary heart disease rates

	9 Areas of Study	City of Chicago
Calumet Industrial Corridor	*t = 3.098, p = 0.001*	*t = 4.145, p = <0.001*

The tables above show the summary statistics and *t*-Test results comparing the Calumet Industrial Corridor with the City of Chicago and the 9 Areas of Study on coronary heart disease rates. The summary statistics table indicates that the average rate of coronary heart disease for the Calumet Industrial Corridor (7.38) is larger than that of the 9 Areas of Study (5.94), and the City of Chicago (5.48).

The *t*-Test results indicate that these differences in the average rate of coronary heart disease are statistically significant. Because both p-values of 0.001 are less than the significance level of 0.05, we can reject the null hypothesis and conclude that at the 5% level of significance, the coronary heart disease rates at the Calumet Industrial Corridor are larger than that of the 9 Areas of Study and the City of Chicago, on average.

Figure 77. NATA cancer risk within a half-mile radius of the Calumet Industrial Corridor and 8 comparison areas

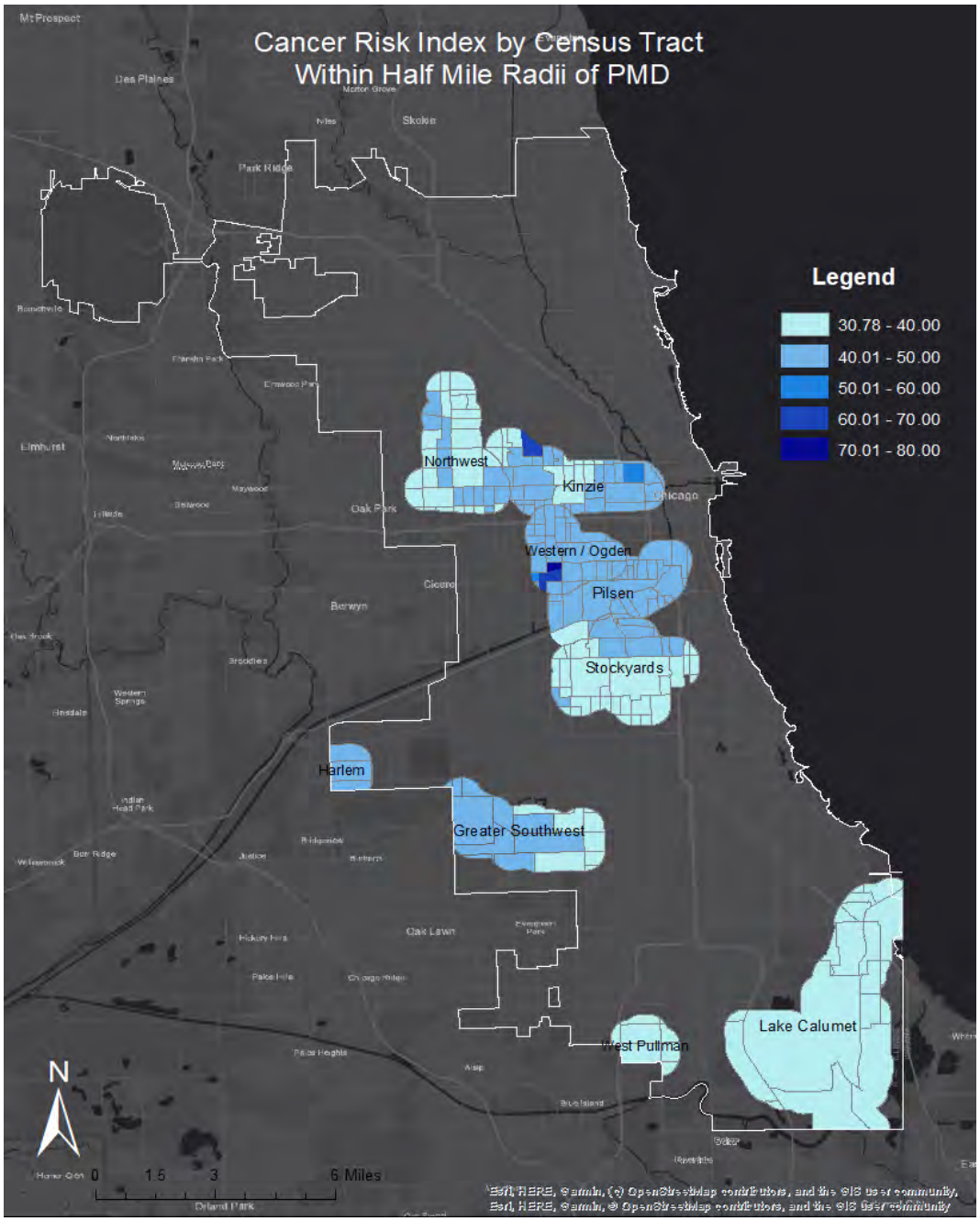


Table 27. Summary statistics for cancer prevalence risk index

Geography Area	N	Mean	Minimum	Maximum
Calumet Industrial Corridor	21	33.03	30.78	36.57
9 Areas of Study	224	40.83	30.78	76.29
City of Chicago	865	38.99	30.78	76.29

Table 28. *t*-Test results comparing Calumet Industrial Corridor with other geographic areas on cancer risk index

	9 Areas of Study	City of Chicago
Calumet Industrial Corridor	*t = -6.281, p = <0.001*	*t = -5.572, p = <0.001*

The tables above show the summary statistics and *t*-Test results comparing the Calumet Industrial Corridor with the City of Chicago and the 9 Areas of Study on cancer risk index. The summary statistics table indicates that the average cancer risk index for the Calumet Industrial Corridor (33.03) is smaller than that of the 9 Areas of Study (40.83), and the City of Chicago (38.99).

The *t*-Test results indicate that these differences in the average cancer risk index are statistically significant. Because both p-values of 0.001 are less than the significance level of 0.05, we can reject the null hypothesis and conclude that at the 5% level of significance, the cancer risk index at the Calumet Industrial Corridor are smaller than that of the 9 Areas of Study and the City of Chicago, on average.

Figure 78. NATA respiratory hazard risk within a half-mile radius of the Calumet Industrial Corridor and 8 comparison areas

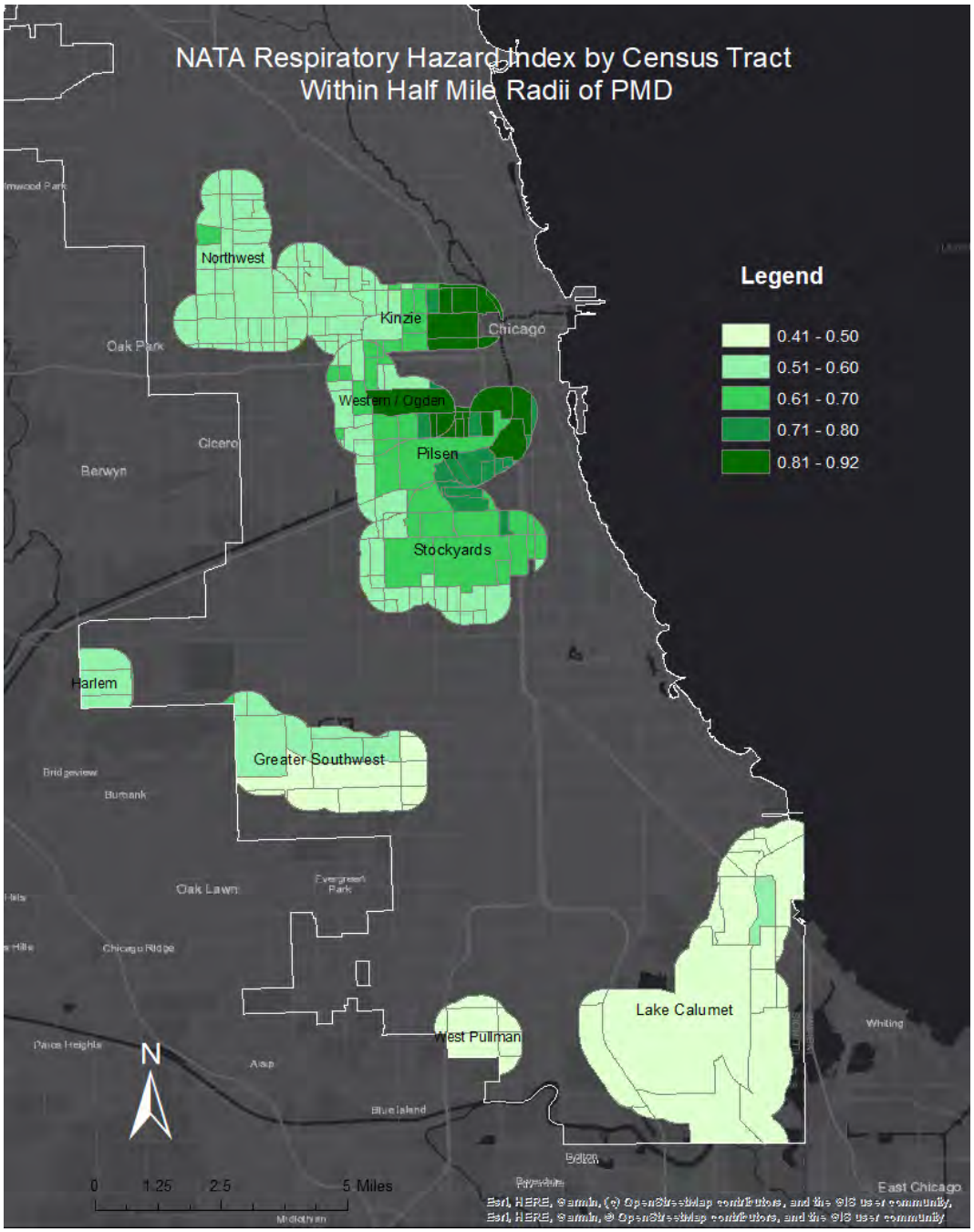


Table 29. Summary statistics for respiratory hazard prevalence index

Geography Area	N	Mean	Minimum	Maximum
Calumet Industrial Corridor	21	0.45	0.41	0.50
9 Areas of Study	224	0.59	0.41	0.92
City of Chicago	865	0.56	0.41	0.92

Table 30. *t*-Test results comparing Calumet Industrial Corridor with other geographic areas on respiratory hazard index

	9 Areas of Study	City of Chicago
Calumet Industrial Corridor	*t = -5.465, p = <0.001*	*t = -4.715, p = <0.001*

The tables above show the summary statistics and *t*-Test results comparing the Calumet Industrial Corridor with the City of Chicago and the 9 Areas of Study on the respiratory hazard index. The summary statistics table indicates that the average respiratory hazard index for the Calumet Industrial Corridor (0.45) is smaller than that of the 9 Areas of Study (0.59), and the City of Chicago (0.56).

The *t*-Test results indicate that these differences in the average respiratory hazard index are statistically significant. Because both p-values of 0.001 are less than the significance level of 0.05, we can reject the null hypothesis and conclude that at the 5% level of significance, the respiratory hazard index at the Calumet Industrial Corridor are smaller than that of the 9 Areas of Study and the City of Chicago, on average.

Figure 79. Neurological hazard risk within a half-mile radius of the Calumet Industrial Corridor and 8 comparison areas

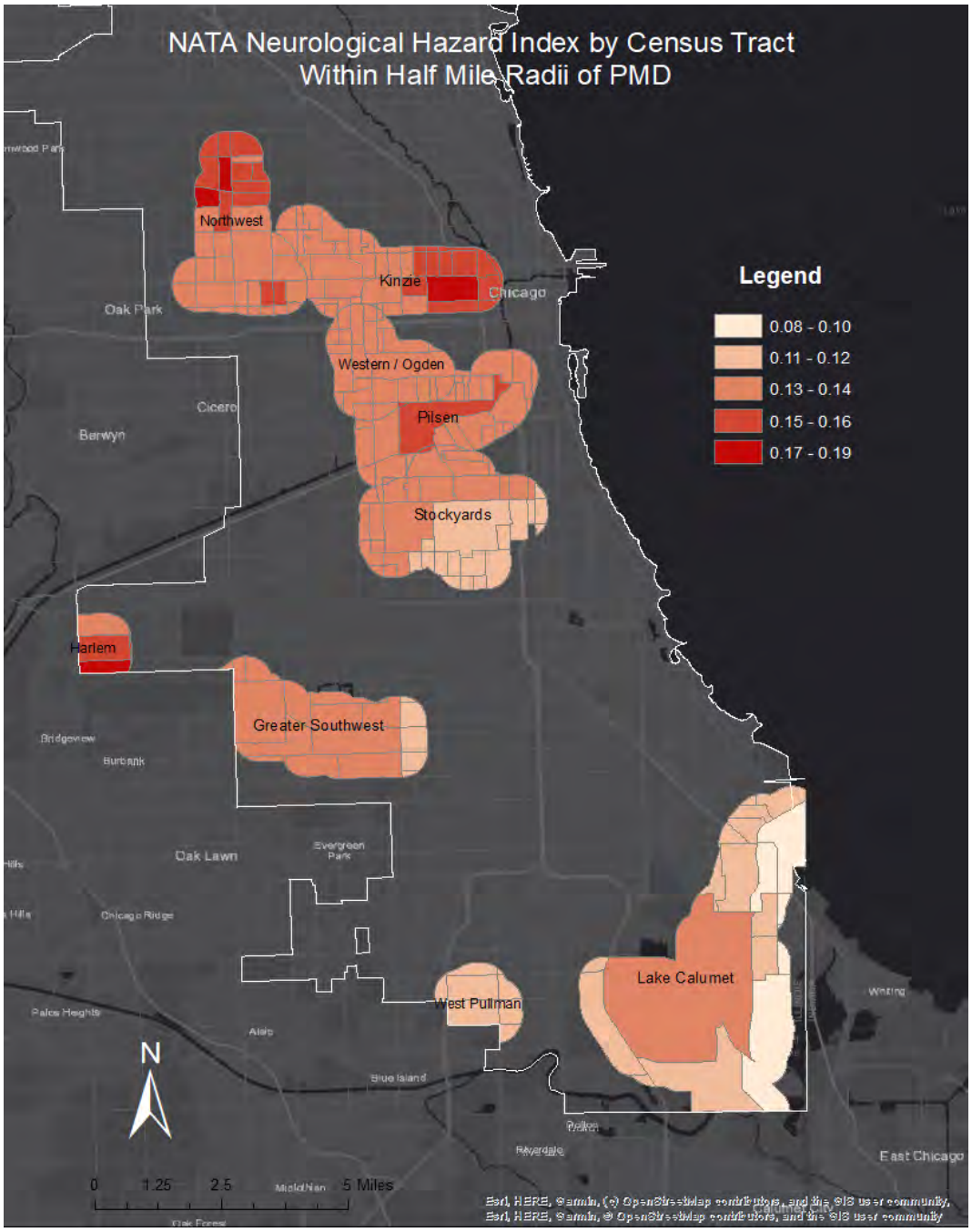


Table 31. Summary statistics for neurological hazard prevalence index

Geography Area	N	Mean	Minimum	Maximum
Calumet Industrial Corridor	21	0.10	0.08	0.12
9 Areas of Study	224	0.13	0.08	0.19
City of Chicago	865	0.13	0.08	0.49

Table 32. *t*-Test results comparing Calumet Industrial Corridor with other geographic areas on neurological hazard index

	9 Areas of Study	City of Chicago
Calumet Industrial Corridor	*t = -7.248, p = <0.001*	*t = -4.320, p = <0.001*

The tables above show the summary statistics and *t*-Test results comparing the Calumet Industrial Corridor with the City of Chicago and the 9 Areas of Study on neurological hazard index. The summary statistics table indicates that the average neurological hazard index for the Calumet Industrial Corridor (0.10) is smaller than that of the 9 Areas of Study (0.13), and the City of Chicago (0.13).

The *t*-Test results indicate that these differences in the average neurological hazard index are statistically significant. Because both p-values of 0.001 are less than the significance level of 0.05, we can reject the null hypothesis and conclude that at the 5% level of significance, the neurological hazard index at the Calumet Industrial Corridor are smaller than that of the 9 Areas of Study and the City of Chicago, on average.

Spatial clustering analysis of prevalence rate distribution

Below in Table 33, we display the ArcMap Getis-Ord General G test results for the 3 chronic conditions among adults that we gathered data for. Our test results indicate that the distribution of asthma rates at the census tract level show a statistically significant spatial clustering pattern within our study area (and surrounding areas). Given the z-score of 4.377006, there is a less than 1% likelihood that this high-clustered pattern could have occurred by random chance.

Table 33. Getis-Ord test results: Z-score and p-value for chronic conditions among adults

High/Low Clustering (Getis-Ord General G)			
Chronic Condition	**Observed General G**	**z-score**	**p-value**
Asthma	0.000322	4.377006	0.000012
Coronary	0.001171	7.811974	0.065
COPD	0.000730	9.132692	0.098

The Optimized Hot Spot analysis output displayed in Figure 80, below, shows the clusters of hot and cold spots for asthma rates across the city of Chicago (and Illinois as a whole). The hot spots (indicating high rates of asthma) are shown in various shades of reds, while the cold spots (indicating low rates of asthma) are displayed in shades of blues. We observed that the census tracts within and closer to most comparison industrial corridors show high rates of asthma (hot spots). Census tracts in and around the Calumet Industrial Corridor displayed statistically significant hot spots at the 99 percent confidence level. The presence of statistically significant hot spots in/immediately around our study area was strongest for asthma, as compared to COPD or coronary heart disease, which, as can be seen by the above p-values, did not produce statistically significant clusters; see output for each below, in Figures 81 and 82.

Figure 80. Optimized hot spot analysis for asthma rates across Illinois, overlaid with comparison boundaries

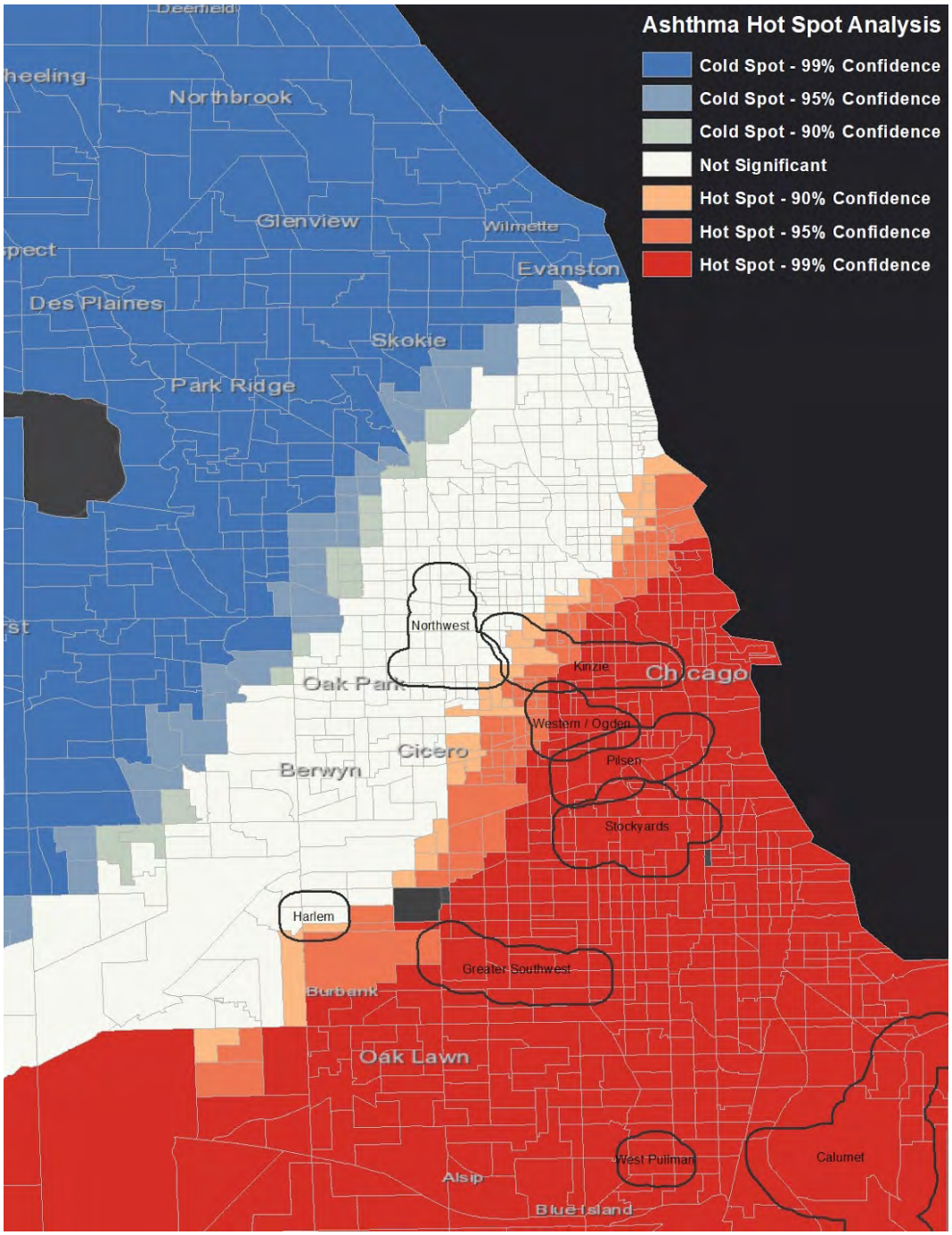
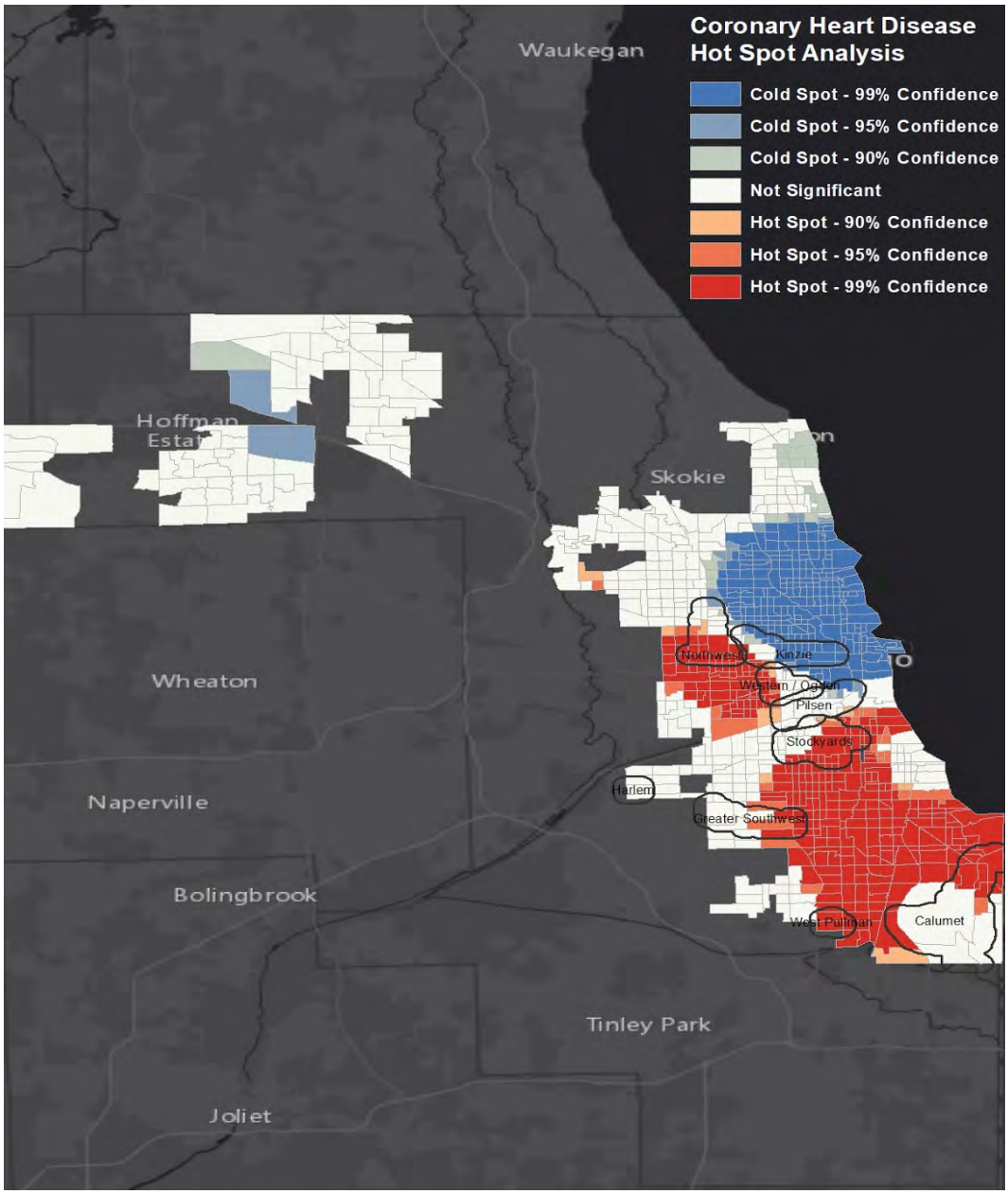
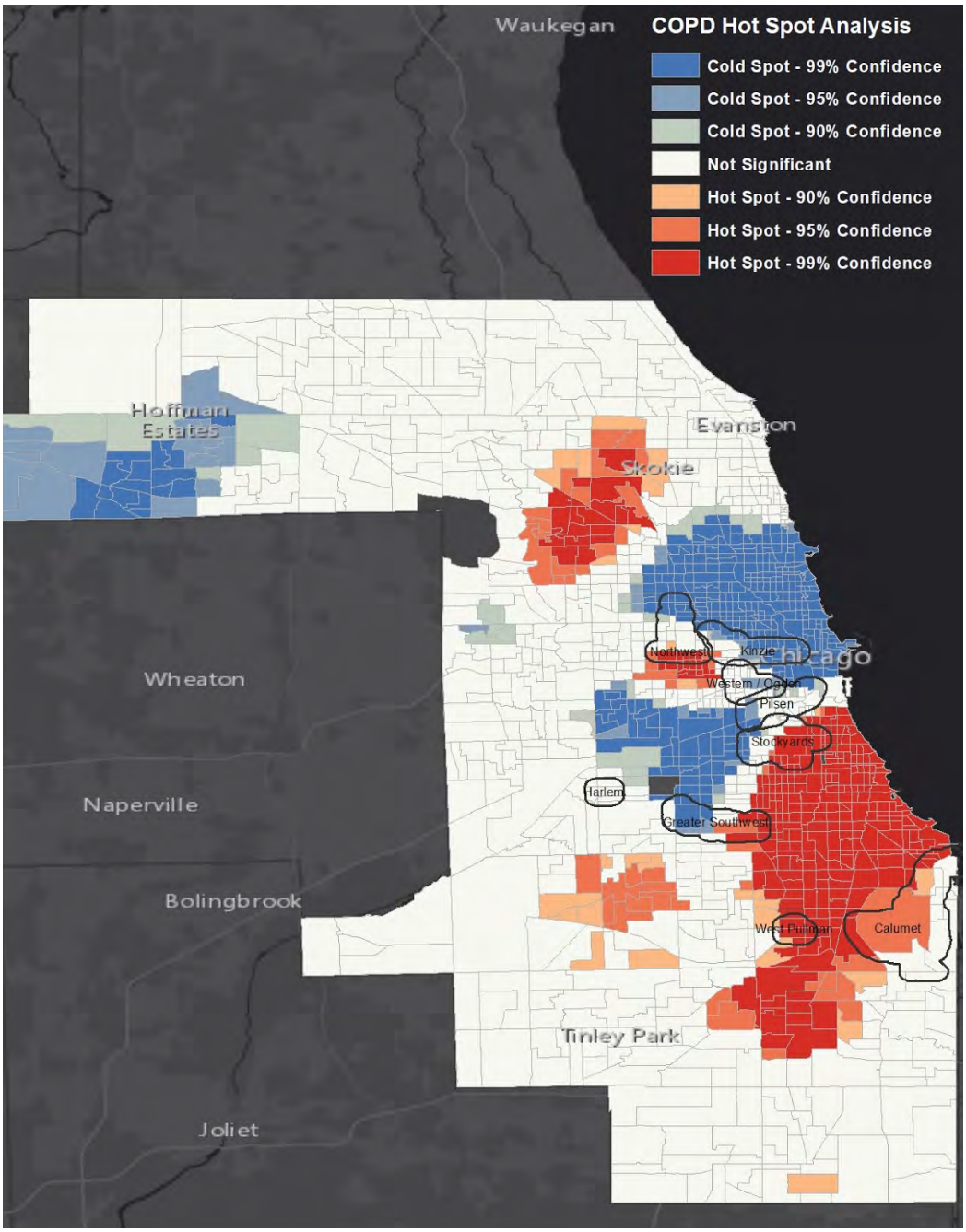


Figure 81. Optimized hot spot analysis for coronary heart disease rates across Cook County*, overlaid with comparison boundaries



*Note: though the research team decided to display the hot spot analysis output for the coronary heart disease variable, please view our write-up on ‘data limitations’ for this output on page 169.

Figure 82. Optimized hot spot analysis for COPD rates across Cook County, overlaid with comparison boundaries



Below, in Table 34, we display the ArcMap Getis-Ord General G test results for the 2 NATA indices we ran spatial cluster testing for: cancer risk and respiratory hazard risk. The full test could not be completed for neurological hazard risk due to reasons discussed in the 'data limitations' section on page 169. This analysis was completed for all census tracts within Cook County.

Given the observed General G values for cancer risk (with row standardization) and respiratory hazard risk (without row standardization), there is a less than 1% likelihood that this high-clustered pattern could be the result of random chance. Without row standardization, the cancer risk clustering analysis could not be completed, due to the lack of a "valid peak", as explained further in the 'data limitations' sub-section on page 169.

Table 34. Getis-Ord test results: Z-scores and p-values for NATA indices among adults in Cook County

High/Low Clustering (Getis-Ord General G)						
	With Row Standardization			**Without Row Standardization**		
Index	**Observed General G**	**z-score**	**p-value**	**Observed General G**	**z-score**	**p-value**
Cancer Risk	0.00077	14.356608	0.00000	N/A	N/A	N/A
Respiratory Hazard Risk	0.000786	15.801582	0.00000	0.21329	5.992411	0.0003

Figures 83 and 85, below, show the final spatial cluster maps for cancer risk and respiratory hazard risk, respectively. The areas in and around the Calumet Industrial Corridor display cold spots for both indices, meaning they are on the low end of prevalence values (when looking at Cook County as a whole), and are surrounded by areas also with low values at the 99% confidence interval. Despite this, many of the other comparison industrial corridors (such as Kinzie, Western/Ogden, and Pilsen) fall fully or partially into the hot-spot areas for both indices.

Figure 83. Optimized hot spot analysis for cancer risk across Cook County

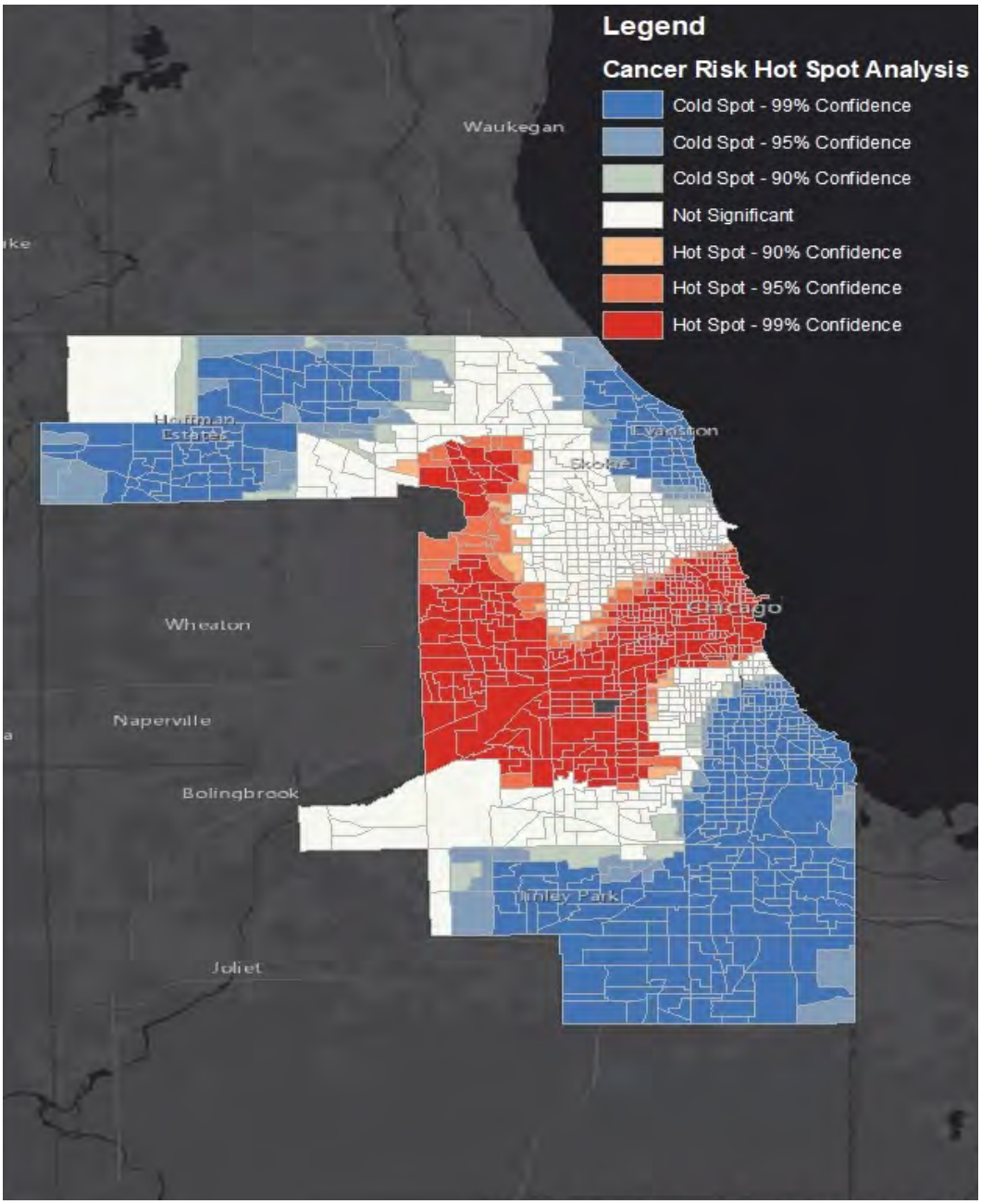


Figure 84. Optimized hot spot analysis for cancer risk across Cook County, overlaid with comparison boundaries

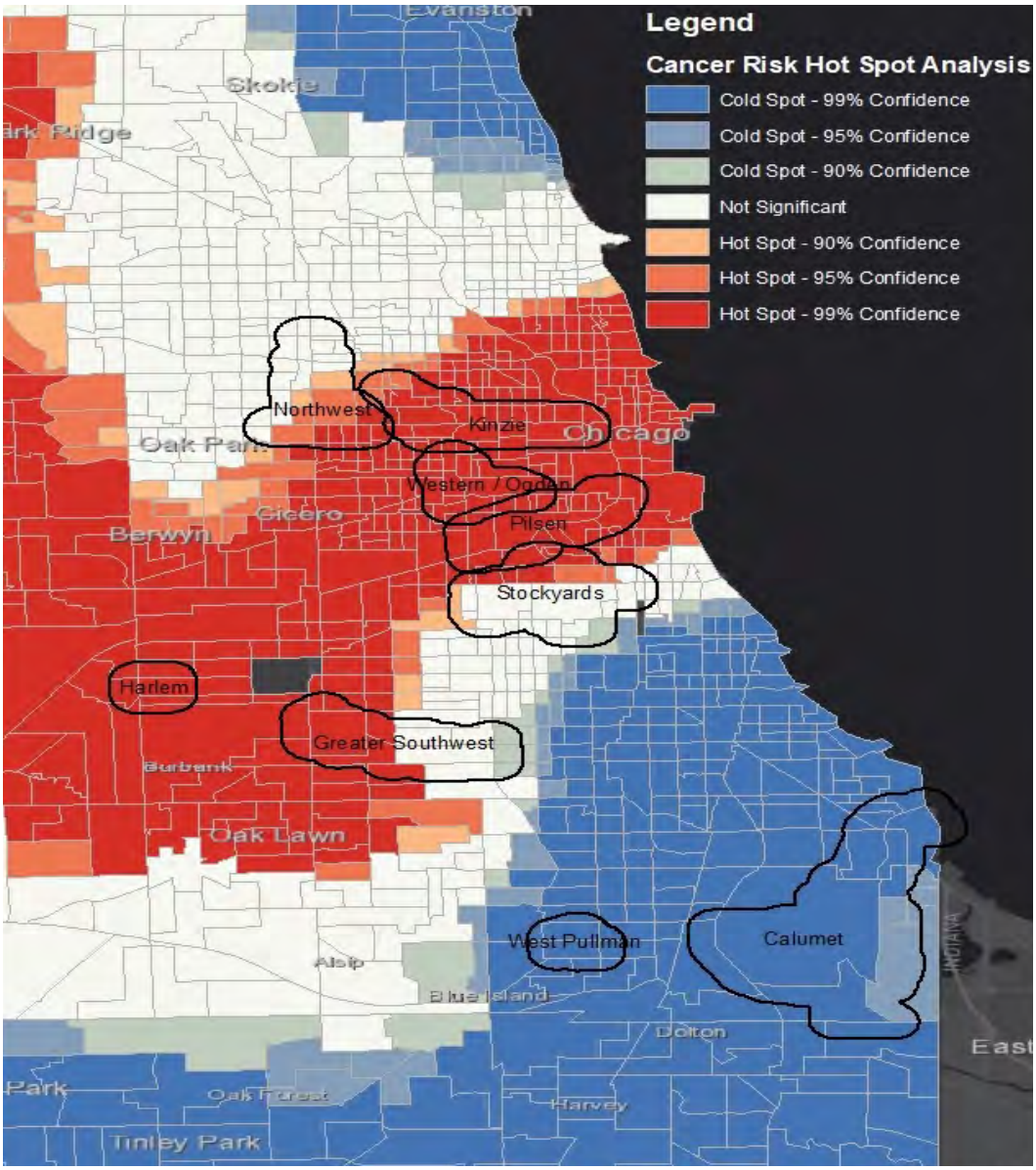
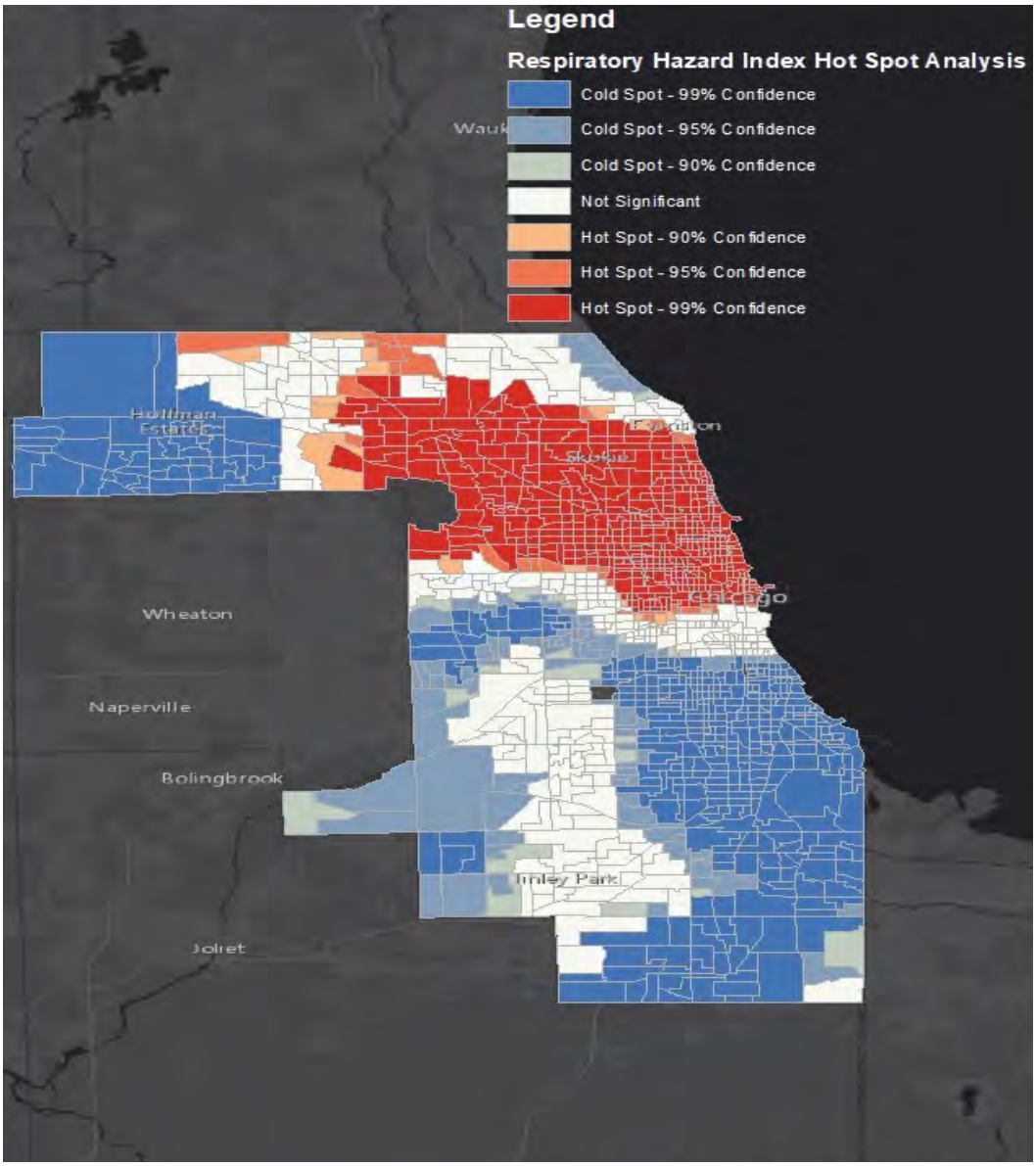


Figure 85. Optimized hot spot analysis for respiratory hazard risk across Cook County



Spatial distribution of health services

Figures 87 to 90, below, map the location of health services available to Calumet residents and workers, as well as their proximity to residential land, in 2009, 2012, 2015, and 2018. In general, we observed that the number of health services has increased over time, with 15 health assets in 2009 and 43 in 2018. Despite this increase, from 2015 to 2018, the number of health assets decreased by 7. The health assets are divided in several categories, with out-patient and dentist being the largests.

Figure 86. Number of health assets by year

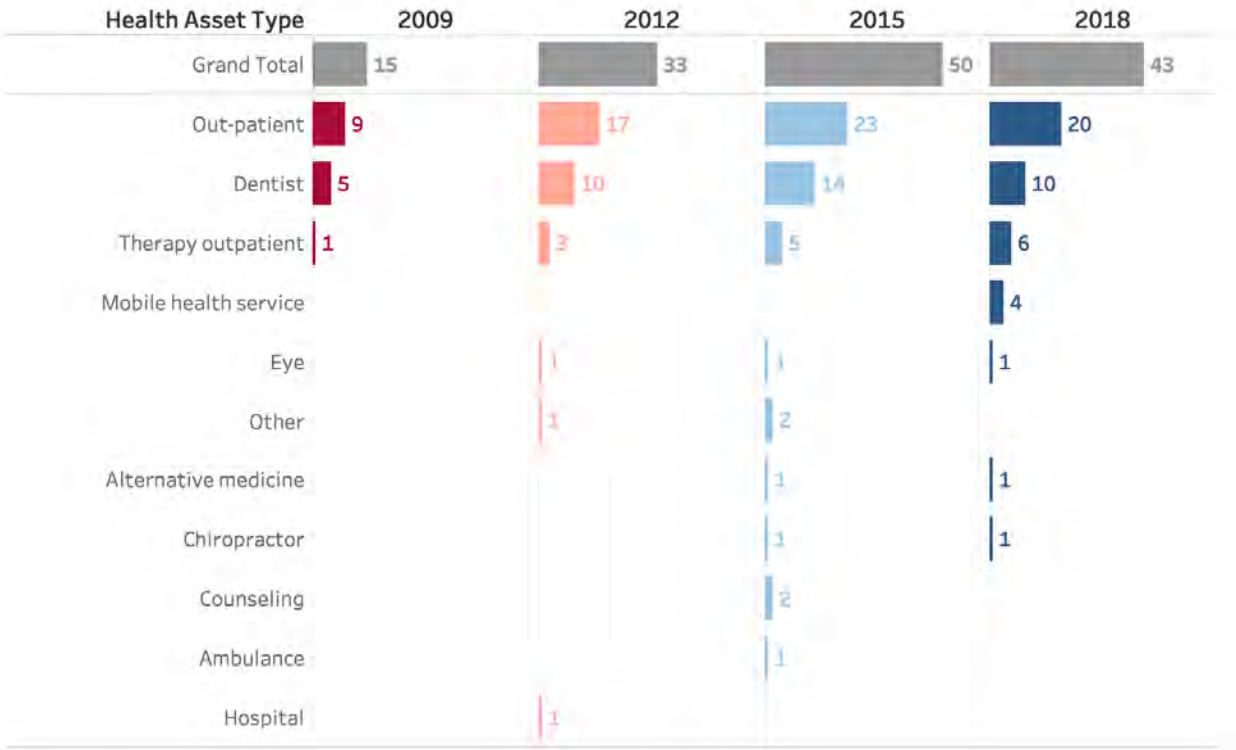
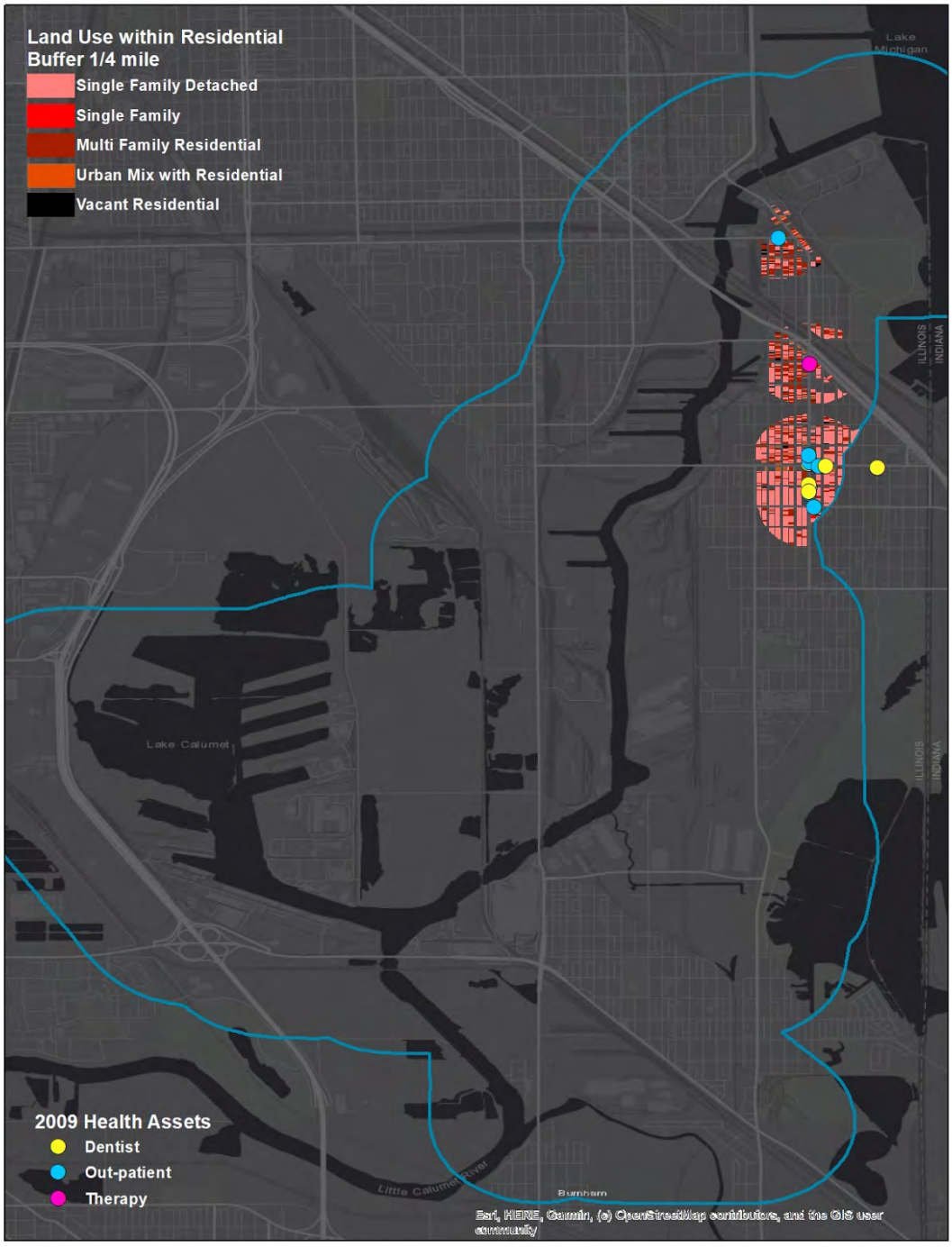


Figure 87. 2009 health assets with ¼ mile residential buffer

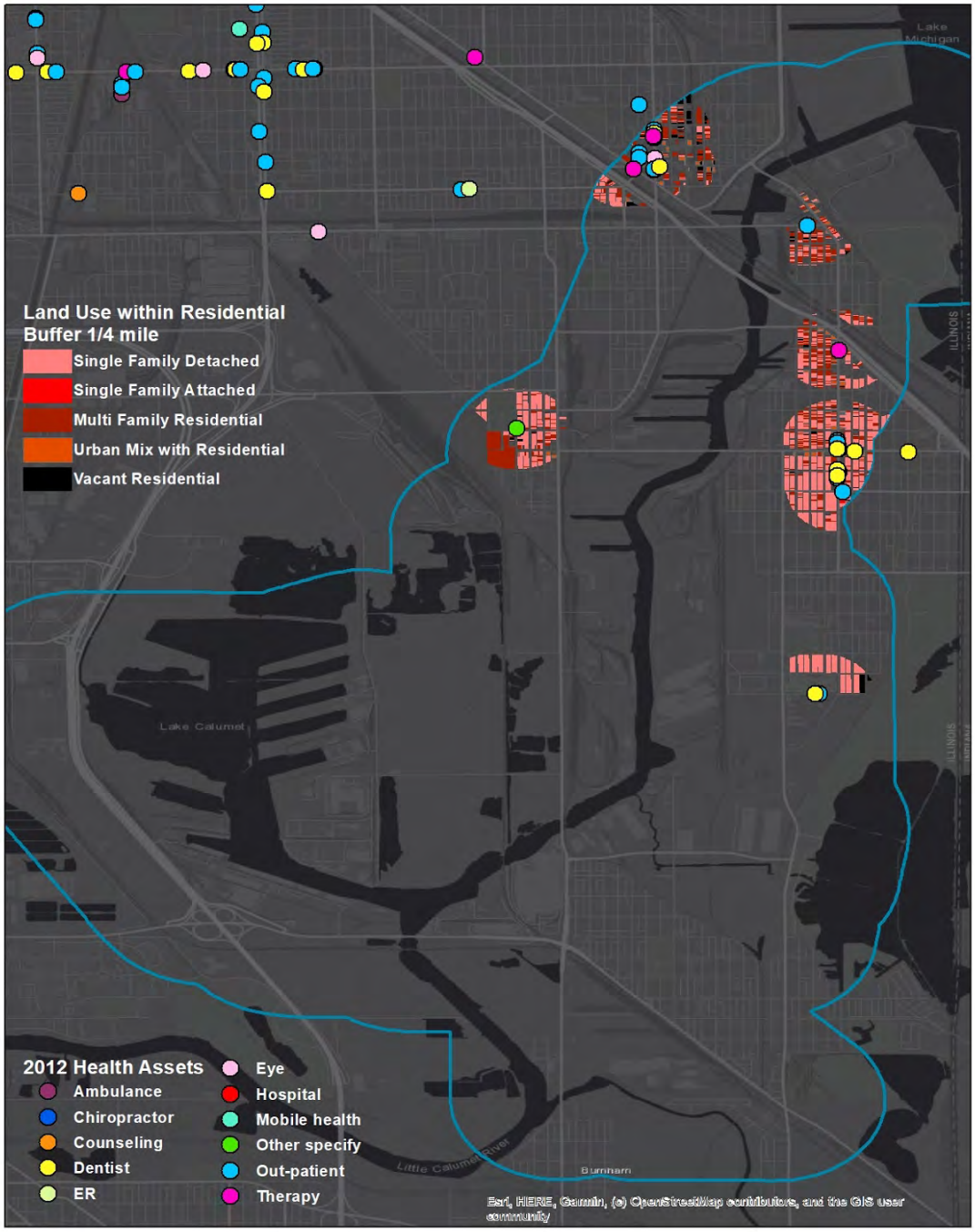


On each map we displayed all residential land in a ¼ mile buffer around each health asset. This residential land consists of single and multi-family residential housing, urban mix with residential, and/or vacant residential. In 2009, all health assets were concentrated on the east side of the Calumet River in the north section of the study area. Between 8.92% to 51.39% of the immediate land around the 15 health assets was allocated to residential housing.

Table 35. Percentage of residential land that is in close proximity (within a ¼ mile) to 2009 health assets

Health Service Type	Health Asset Name	
Out-patient	Foot Health Center	51.39
	Surgicore	50.38
	East Side Medical Health Center	50.34
	William Wai MD	50.27
	Eastside Medical Center	45.02
	Advancare Healthcare Services	44.72
	Medical Center	43.64
	Mohana Medical Center	38.84
	Midwest Physician Pain Center	18.27
Dentist	Ronald P Block DDS	50.64
	East Side Dental Office and Lab	45.68
	Robert Smiejek, DDS	44.05
	Sheth Dental Associates	40.63
	Family Dental Care	8.92
Therapy	Lake Edge Alcoholics Anonymous Club	30.70

Figure 88. 2012 health assets with ¼ mile residential buffer



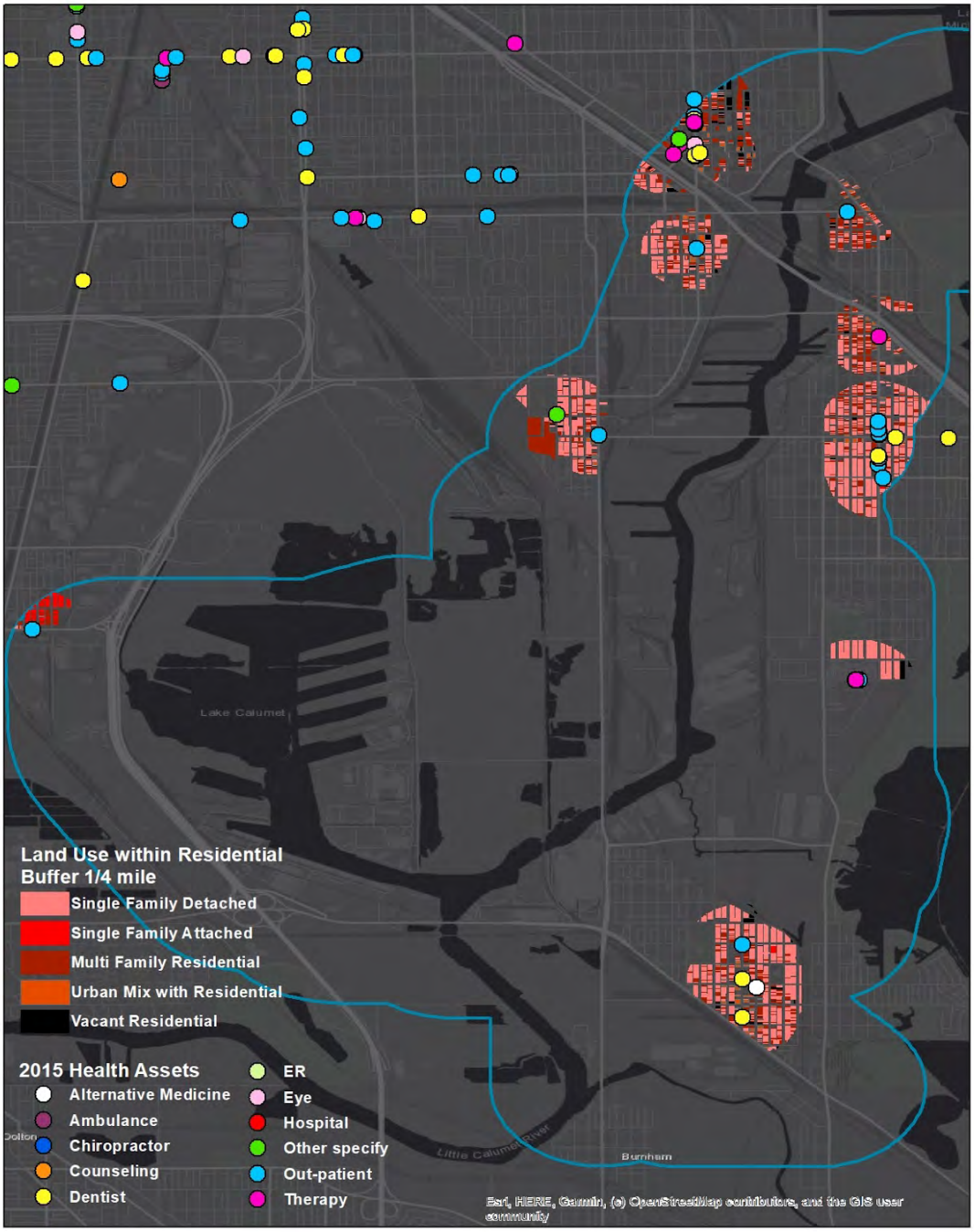
In 2012, health assets were concentrated on both sides of the Calumet River in the north section of the study area. All 2012 health assets were immediately surrounded by single, multifamily, urban mix, and/or vacant residential land. But as the table below shows, only 9.24% to 51.39% of the immediate land around the 33 health assets was zoned for residential activity, with the City of Chicago Department of Public Health being surrounded by the smallest portion of residential land.

Table 36. Percentage of residential land that is in close proximity (within a ¼ mile) to 2012 health assets

Health Service Type	Health Asset Name	Percentage of Residential Land
Out-patient	Foot Health Center	51.39
	Chicago Family Health Center East Side	51.04
	Surgicore	50.38
	East Side Medical Health Center	50.34
	William Wai MD	50.27
	Eastside Medical Center	45.02
	Medical Center	43.64
	Mohana Medical Center	38.84
	Midwest Physician Pain Center	18.27
	Advocate Medical Group	17.79
	Heart Care Center of South Chicago	17.56
	South Chicago Sleep Lab	17.56
	South Chicago Medical Center - Foot Clinic	17.46
	Cyrus Akrami MD	16.09
	Exchange Medical Center	12.34
	Chicago Family Health Center	11.83
	City of Chicago - Department of Public Health	9.24
Dentist	ESS Dental	50.64
	East Side Dental Office and Lab	45.68
	Robert Smiejek, DDS	44.05
	Sheth Dental Associates	40.63
	Family Dental Care	25.54
	Plaza Dental	17.31
	United Dental Centers	16.91
	Centro Medico	16.17
	My Dentist	16.09
Therapy	Lake Edge Alcoholics Anonymous Club	30.70
	United Rehab Providers	16.86
	Fresenius Medical Care South Chicago	14.98
Other specify	We Care Home Health	41.50
Hospital	Akinwole Ogunlola	16.09
Eye	Tropical Optical Company	15.70

Percentage of Residential Land
9.24 51.39

Figure 89. 2015 health assets with ¼ mile residential buffer



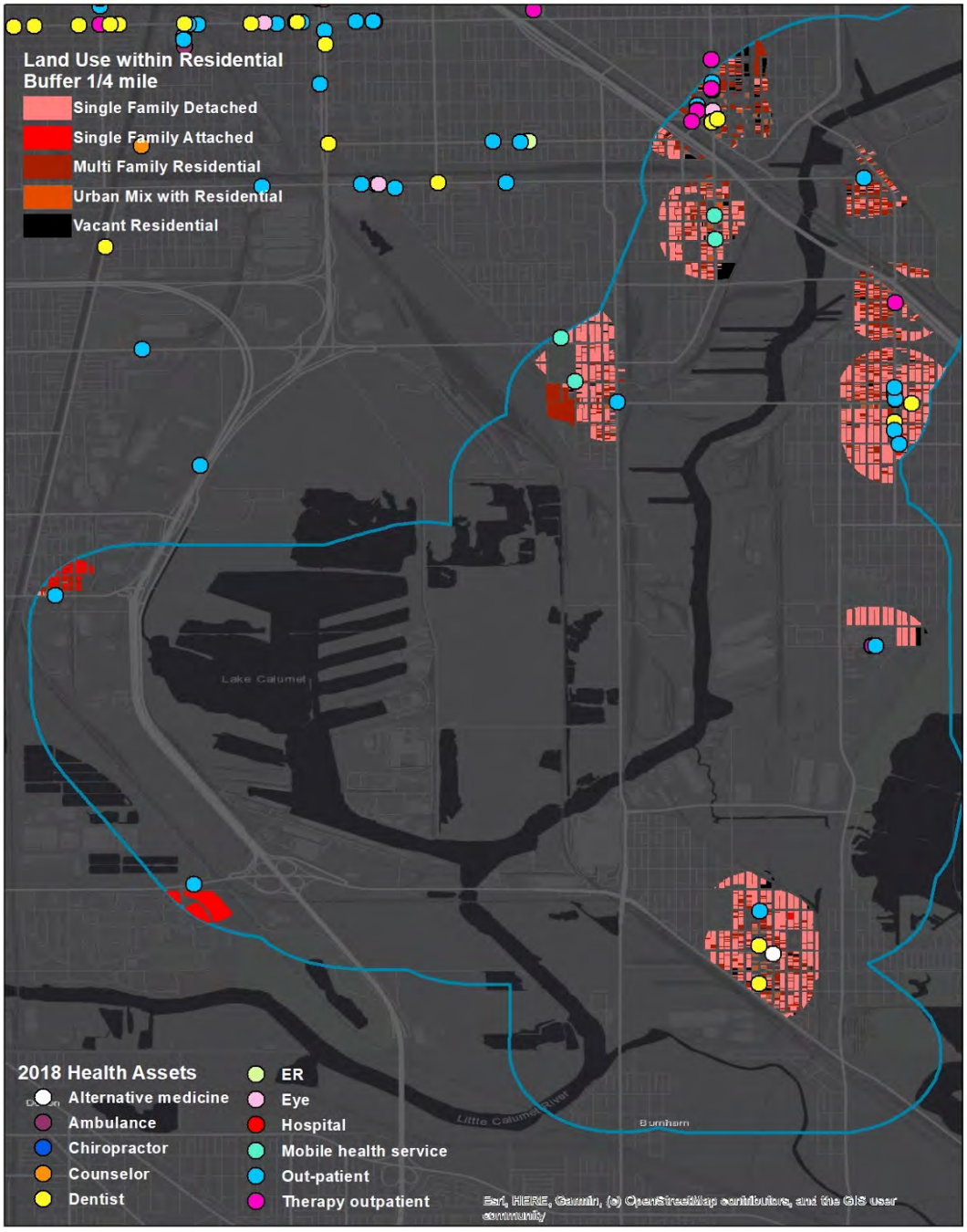
In 2015, health assets were concentrated on both sides of the Calumet River in the north and south sections of the study area. All 2015 health assets were immediately surrounded by single, multifamily, urban mix, and/or vacant residential land. Of the land that was in close proximity (within ¼ mile) to the 50 health assets, we found that only 10.30% to 52.75% of that land was zoned for residential activity (see Table below).

Table 37. Percentage of residential land that is in close proximity (within a ¼ mile) to 2015 health assets

Health Service Type	Health Asset Name	
Out-patient	Prohealth Care Center	52.75
	Foot Health Center	51.39
	Chicago Family Health Center East Side	51.04
	Surgicore	50.38
	East Side Medical Health Center	50.34
	William Wai MD	50.27
	Eastside Medical Center	45.02
	Med Star Lab	44.04
	P K Alexander MD	44.04
	Medical Center	43.64
	Mohana Medical Center	38.84
	Good Health Home Care	37.72
	Fresenius Medical Center	30.11
	Midwest Physician Pain Center	18.27
	Advocate Medical Group	17.79
	Heart Care Center of South Chicago	17.56
	South Chicago Sleep Lab	17.56
	South Chicago Medical Center - Foot Clinic	17.46
	Providence Nursing Services LLC	16.09
	Neighborhood Family Clinic	15.00
	Exchange Medical Center	12.34
	Chicago Family Health Center	11.83
	Chicago Family Health Center Pullman	10.30
Dentist	James M Goril DDS	52.41
	East Side Dental Office and Lab	45.68
	Sheth Dental Associates	40.63
	Daniel J Rak DDS	38.47
	My Dentist	32.18
	Family Dental Care	25.54
	Plaza Dental	17.31
	United Dental Centers	16.91
	Centro Medico	16.17
	Par Dental	16.17
	David Yu DDS	16.09
	Dr Thomas Wiese	16.09

Health Service Type	Health Asset Name	
Therapy	Lake Edge Alcoholics Anonymous Club	30.70
	ATI Rehabilitation	17.07
	United Rehab Providers	16.86
	Fresenius Medical Care South Chicago	14.98
	Rehab Team Physical Therapy	12.39
Alt. Medicine	Forma Vital	53.85
Other specify	We Care Home Health	41.50
	Health Leads at Chicago Family Health Center	11.83
Dentist	Par Dental	16.17
	David Yu DDS	16.09
	Dr Thomas Wiese	16.09
Chiropractor	James Egan DC	44.04
Counseling	Charlene Hill LCSW	16.09
	Sheila Hassan LCSW	16.09
Ambulance	Advantage Medical Services	16.09
Eye	Tropical Optical Company	15.70

Figure 90. 2018 health assets with ¼ mile residential buffer



In 2018, all health assets were concentrated on both sides of the Calumet River in the north and south sections of the study area. All 2018 health assets were immediately surrounded by single, multifamily, urban mix, and/or vacant residential land. But as the table below shows, 10.30% to 53.85% of the immediate land around the 43 health assets was zoned for residential activity, with the Chicago Family Health Center Pullman being surrounded by the smallest portion of residential land.

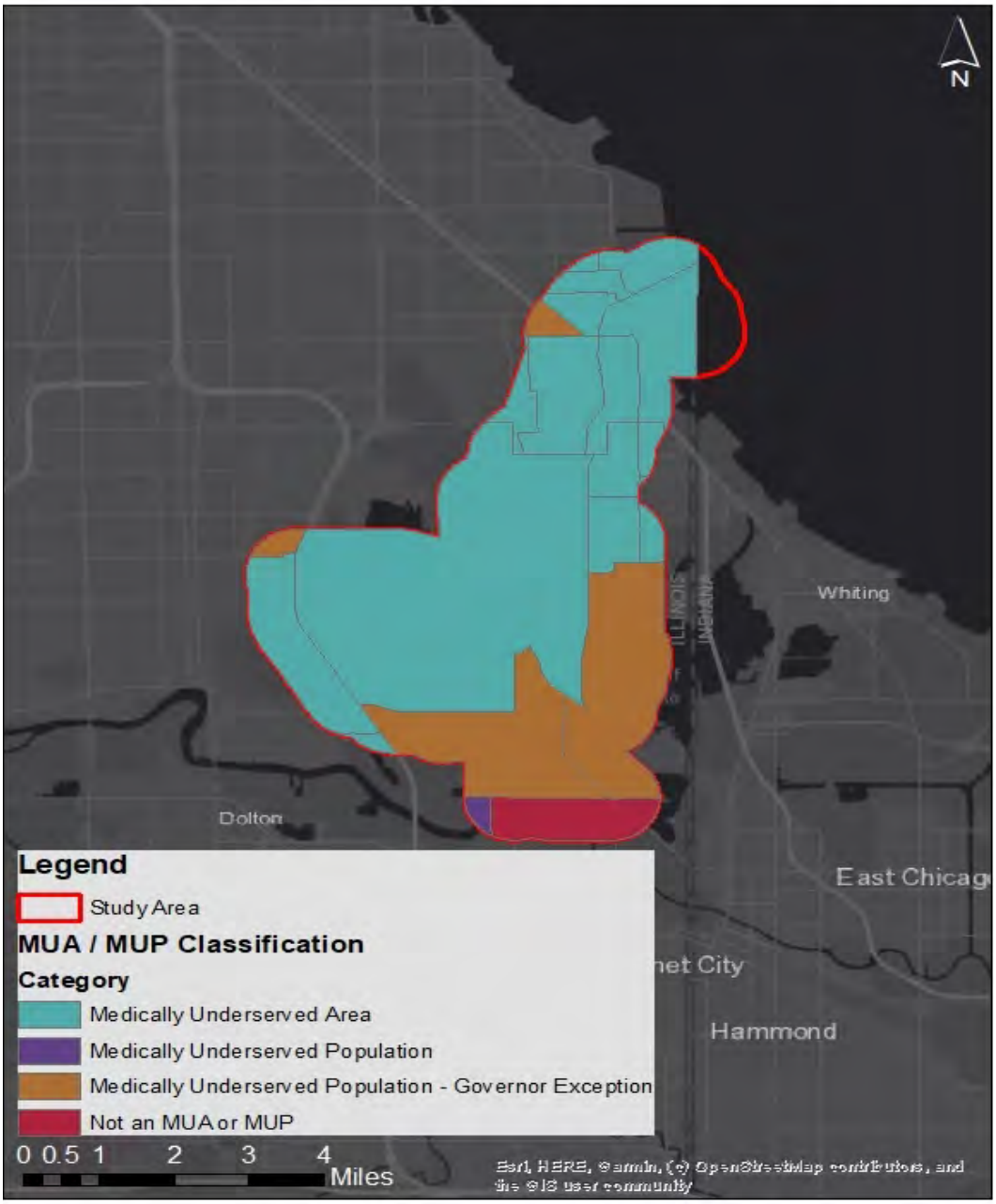
Table 38. Percentage of residential land that is in close proximity (within a ¼ mile) to 2018 health assets

Health Service Type	Health Asset Name	Percentage of Residential Land
Out-patient	Prohealth Care Center	52.75
	Foot Health Center	51.39
	Chicago Family Health Center East Side	51.04
	Surgicore	50.38
	East Side Medical Health Center	50.34
	P K Alexander, MD	44.04
	Medical Center	43.64
	Mohana Medical Center	38.84
	Fresenius Medical Center	30.11
	Midwest Physician Pain Center	18.27
	Advocate Medical Group	17.79
	Heart Care Center of South Chicago	17.56
	South Chicago Sleep Lab	17.56
	South Chicago Medical Center - Foot Clinic	17.46
	Cyrus Akrami, MD	16.09
	TCA Health	14.88
	Exchange Medical Center	12.34
	Chicago Family Health Center	11.83
	Health Leads at Chicago Family Health Center	11.83
	Chicago Family Health Center Pullman	10.30
Dentist	James M Goril, DDS	52.41
	East Side Dental Office and Lab	45.68
	Sheth Dental Associates	40.63
	Daniel J Rak, DDS	38.47
	Plaza Dental	17.31
	United Dental Centers	16.91
	Family Dental Care	16.62
	Centro Medico	16.17
	Par Dental	16.17
	My Dentist	16.09
Mobile health service	We Care Home Health	41.50
	Bertha's Nutrition Center	39.24
	Good Health Home Care	37.72
	Extraordinary Care Home Health	21.71
Therapy outpatient	Lake Edge Alcoholics Anonymous Club	30.70
	ATI Rehabilitation	17.07
	United Rehab Providers	16.86
	Fresenius Medical Care South Chicago	14.98
	Athletico	14.47
	Rehab Team Physical Therapy	12.39
Alternative medicine	Forma Vital	53.85
Chiropractor	James Egan	44.04
Eye	Tropical Optical Company	15.70

Percentage of Residential Land
10.30 — 53.85

In addition to mapping the distribution of health service options for study area workers and residents, we turned to data compiled by the Health Resources and Services Administration (HRSA) that delineates the nation's "medically underserved areas" (MUA's) and populations (MUP's) (see Table 20, row 14 for full source information).

Figure 91. Medically underserved areas and populations within the study area



A medically underserved area (MUA) has a shortage of primary health care services for residents within a certain geographic area. A medically underserved population (MUP) is a specific sub-group of people living in a defined area that have a shortage of primary health care services. These groups may face a mixture of barriers to health care such as economic, cultural, and linguistic. Examples of medically underserved populations include low-income populations, homeless populations, and Medicaid-eligible populations.

A large portion of the study area is determined to be a Medically Underserved Area. This implies that the residents of the study area are designated as having a shortage of primary health care services. Comparing the 2018 Health Assets map with the Medically Underserved Status map, many of the areas that do contain health asset locations are designated as Medically Underserved Populations with a Governor's Exception. Even though there exist some health assets within the study area boundary, the populations living near these health assets still have barriers to accessing these services.

Worker Health

Data compilation and visualization of prevalence rates

The COPD and asthma rates for the top 25 home location census tracts of study-area workers are shown below in Figures 92 and 93. See the Residential Health 'Methods' sub-section on page 151 for information on the data compilation and visualization of these rates.

Figure 92. COPD rates for the top 25 home location census tracts of workers

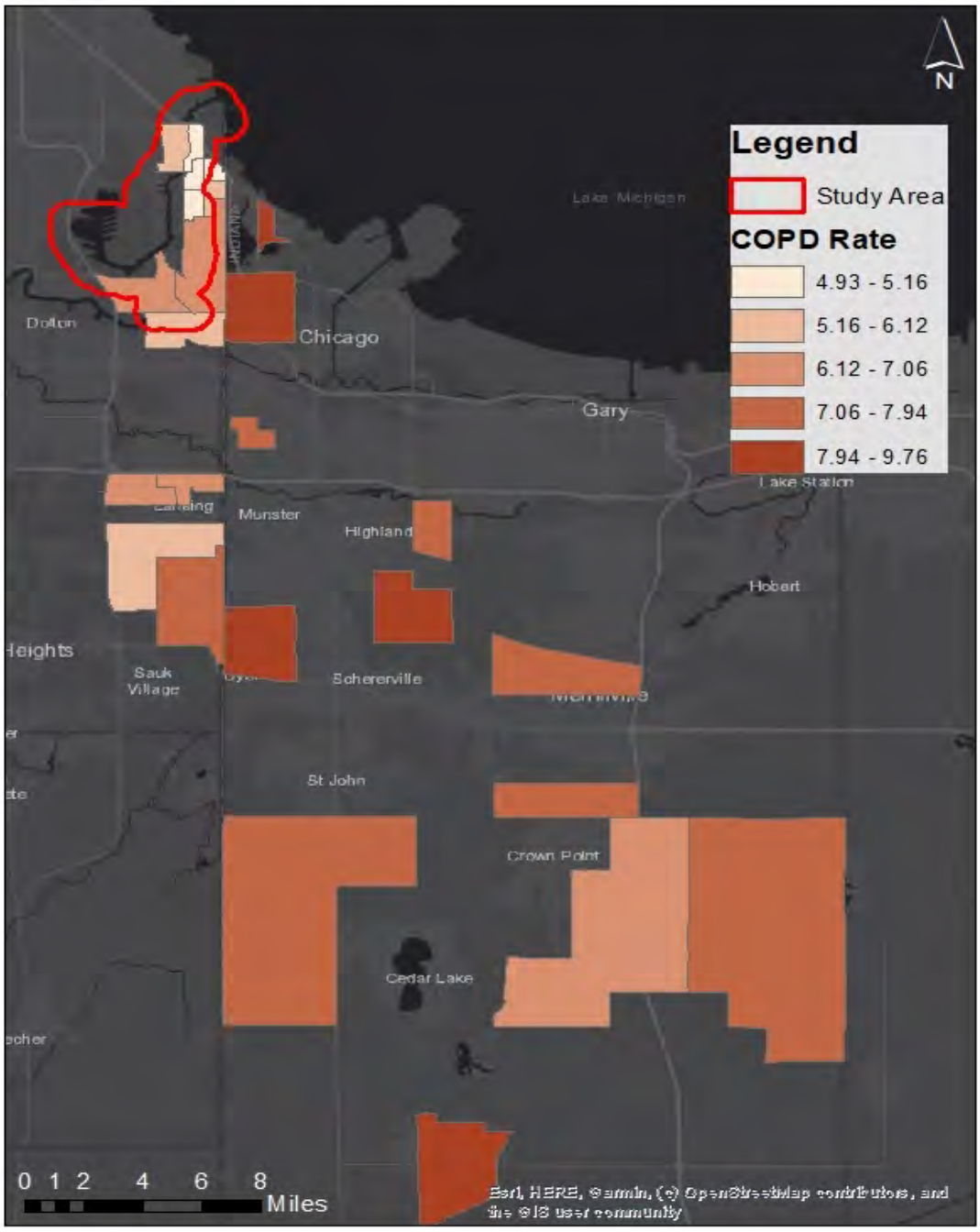
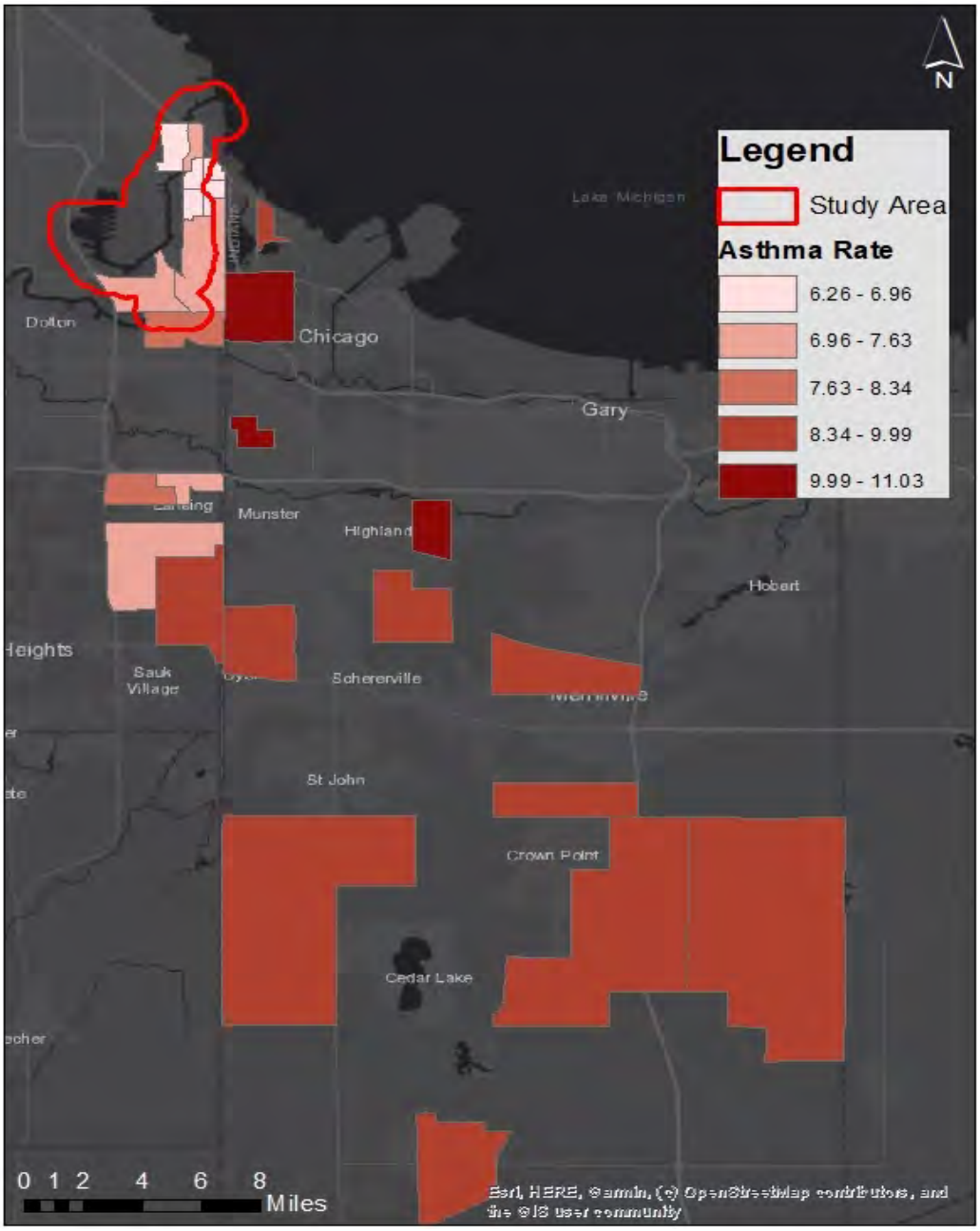


Figure 93. Asthma rates for the top 25 home location census tracts of workers



Among the 25 census tracts, the ones with the lowest rates of both COPD and asthma are located within or on the border of the Calumet Industrial Corridor's half-mile buffer. Overall, the census tracts located in Indiana have higher rates of both COPD and asthma as compared to the census tracts in Illinois. However, due to the small number of workers in each of these tracts as compared to the population of the entire tract, not much can be concluded from these maps about worker health. We cannot conclude that the people in these home location tracts that have COPD or asthma are those who work in the Calumet Industrial Corridor.

The research team also completed analysis on coronary heart disease rates for these 25 tracts, but did not include these findings in this sub-section for reasons addressed in the 'Data Limitations' sub-section (on page 167).

Spatial distribution of health services

The research team did not repeat the process of mapping out individual health service locations for the top 25 home location tracts of workers. Since these locations span across tracts in both Illinois and Indiana, we would have had to track down data of equivalent quality and scope as the MAPSCorps health asset data in both states. Due to the difficulties we faced in finding such a comprehensive list for both states, we mapped each tract using the HRSA's 'medically underserved' status instead.

We then also mapped out the variable "Percent of Adults Reporting to Have a Personal Doctor or Health Care Provider" obtained from PolicyMap, to gain more information on health service access in the home location tracts of workers. The results of both visualizations are shown below, in Figures 94 and 95.

The areas with the lowest percent of adults reporting a personal doctor or health care provider are tracts located within the study area; in fact, we noted that the only tracts that are 'Medically Underserved' are within the study area boundary. The top 5 census tract home locations of workers (Figure 73 on page 161) shows that the most common places of residence are the tracts along the eastern side of the study area boundary, which are all 'Medically Underserved Areas' or 'Medically Underserved Populations with a Governor's Exception'.

Figure 94. Medically underserved areas and populations of the top 25 home location census tracts

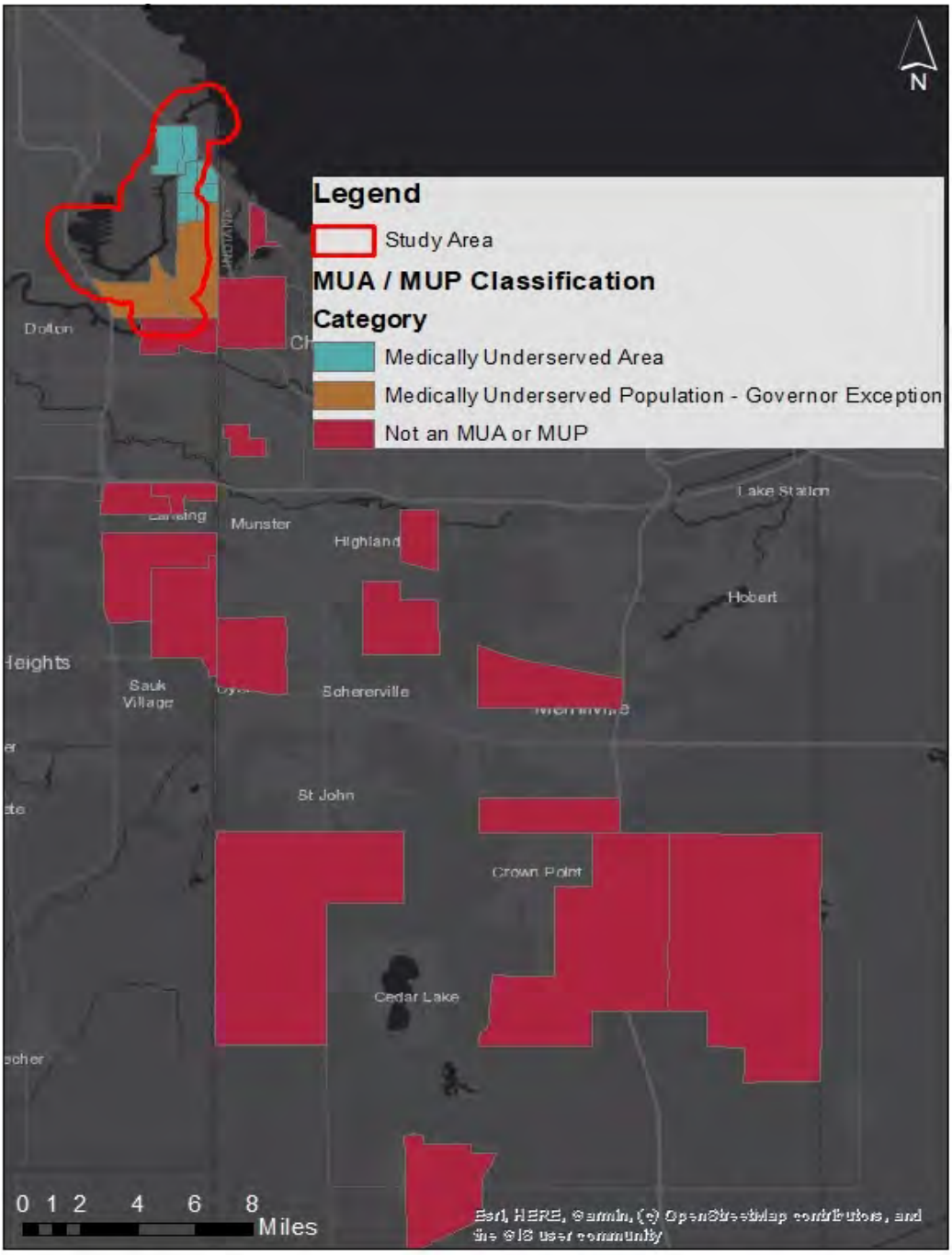
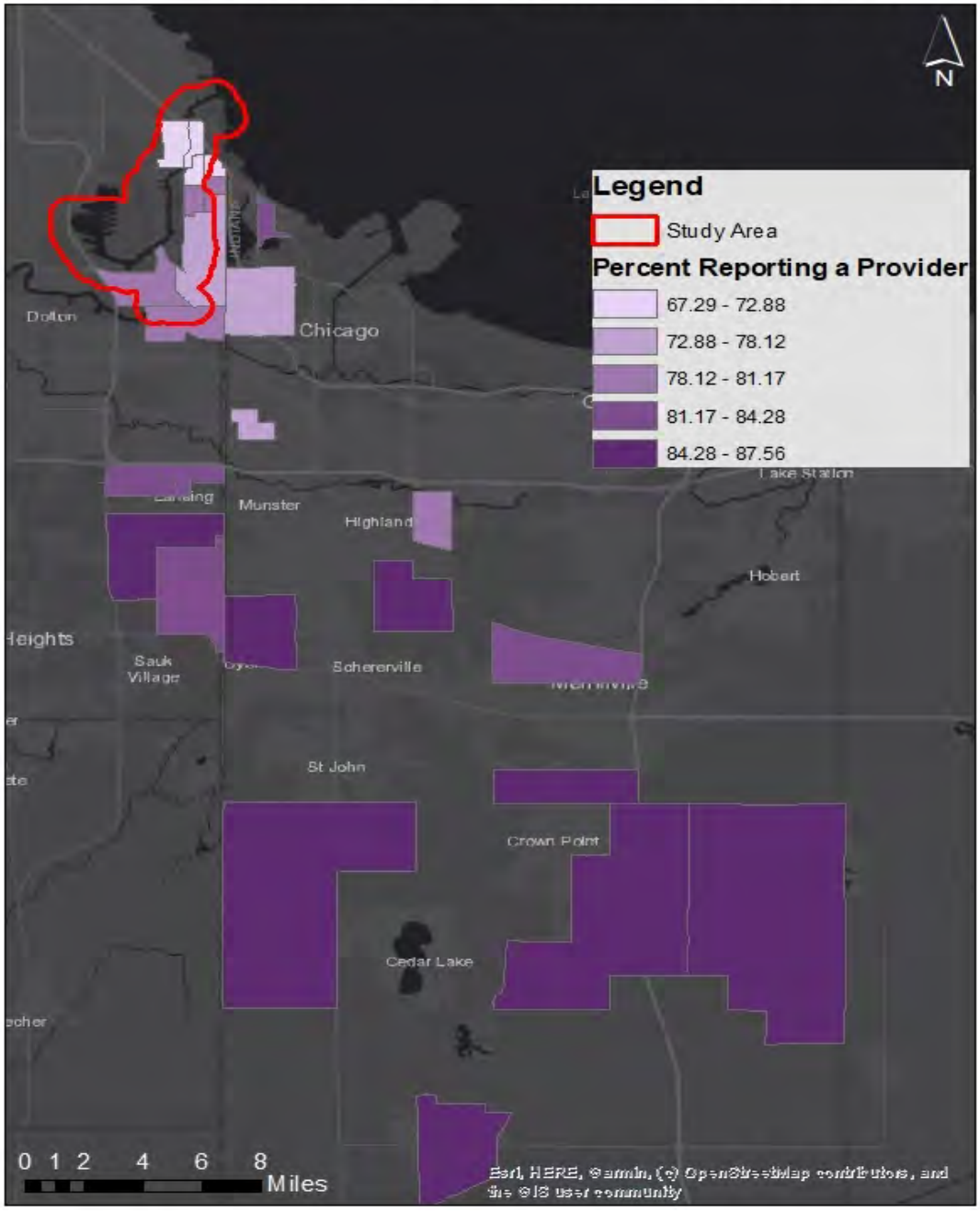


Figure 95. Percent of people reporting having a primary care doctor or health care provider in the top 25 home location census tracts of workers



Areas for Further Research

As was the case for the prior 2 sub-sections, our team ran into significant barriers when trying to conduct parts of our analysis. For one, more recently available data on chronic disease and NATA indices were unavailable to us beyond 2013 and 2014. In addition, for the data that was available to us, certain tracts outside of the corridor itself but still included in our buffer area were missing data, due to the fact that these tracts fall outside the Chicago metropolitan area limits. In particular, this affected our ability to perform spatial cluster analyses for the full scope of the 6 variables we collected data for. For this reason, we suggest that entities such as the Department of Planning and Development coordinate with entities such as the EPA, and Cook County Department of Public Health to share publicly available data and aggregated trend findings on changes in the prevalence of these 6 variables beyond 2013/2014.
--
As noted in the 'Methods' portion of the sub-section, our team used asset-mapping data from MAPSCorps to perform the analysis on the density and distribution of health services across the study area. This dataset only contained businesses and organizations for Chicago's South and West Sides, however. Given the lack of available data for all areas of Chicago, our team was unable to determine whether a difference in health service density/distribution exists when comparing the access to, and distribution of, health services of the Calumet Industrial Corridor to other industrial corridors with a similar mix of heavy industries on the city's North Side. Additionally, due to a combination of lack of data access (as referenced above), as well as constraints on time/staff capacity, the team was unable to replicate our health service spatial distribution analysis for the 8 comparison corridors that we employed for our significance testing noted on pages 170-183.

Due to this, we request that the city Department of Planning and Development explore the viability of replicating our health service spatial distribution analysis for--at minimum--the 8 comparison corridors we outline in the DRAFT Databook Google Doc. Replicating this analysis would require DPD staff to acquire/create a dataset similar in scope to the one our team acquired from MAPSCorps for the Chicago community areas that intersect/overlap the 8 comparison corridors. In particular, this would involve some form of aggregating community asset data on the spread of emergency room clinics, dental offices, mental health clinics, chiropractic services, etc.

Conclusion

Key findings

1. Given the legacy of environmental racism within the Calumet Industrial Corridor, the first priority in industrial corridor planning efforts must be to protect public health and the environment, while fostering new patterns of economic and job growth.
    a. Our analysis revealed that the most employees of Calumet Industrial Corridor facilities live within the study area boundary itself, meaning that they comprise a large share of those in the residential population that are frequently exposed to toxic releases/environmental health hazards
    b. The Environmental Protection Agency uses Risk Screening Environmental Indicators (RSEI) scores to highlight companies + toxic releases that would potentially pose greater risk to public health over a lifetime of exposure. A low RSEI score indicates low potential concern from reported TRI releases, while a high RSEI score indicates the opposite
        i. Transportation Equipment was the corridor industry sector with the highest RSEI scores in 2007 and 2012 (specific companies: Ford Motor Company and Tower Automotive). Primary Metals sector had the highest RSEI scores in 2017 (specific companies: American Zinc Recycling Corp, Atlas Tube, Inc, Nacme Steel Processing LLC).
        ii. NAICS Industry median RSEI scores in 2012 and 2017 indicate that Automobile Manufacturing and Secondary Smelting sub-sectors have the highest median industry scores. Ford Motor Company and American Zinc belong to these sub-sectors, respectively.

2. Rates of chronic disease--in particular, coronary heart disease and COPD--are statistically higher in the Calumet Industrial Corridor compared with the rest of the city.
    a. The data is clear that rates of COPD are higher in the corridor compared with the rest of the city, but the data is not clear that rates of COPD are higher in the corridor than other industrial areas.
        i. Summary statistics indicate that the average rate of COPD for the corridor (6.68) is larger than that of the other comparison areas, (6.04) and the City of Chicago (6.04)
        ii. At the 5% level of significance, the COPD rates for the corridor are larger than that of the City of Chicago, on average
    b. The data is clear that rates of coronary heart disease in the Calumet Industrial Corridor are higher when compared with both other industrial areas and the city as a whole.

i. Summary statistics indicate that the average rate of coronary heart disease for the corridor (7.38) is larger than that of the other comparison areas (5.94) and the City of Chicago (5.48)
ii. At the 5% level of significance, the coronary heart disease rates for the corridor are larger than that of the 9 areas of study, and the City of Chicago, on average

3. Despite an increase over time in the number of health service providers located in the Calumet Industrial Corridor (and surrounding area), large portions of the community remain medically underserved. Medically underserved areas have a shortage of primary health care services for residents within a certain geographic area.

4. Chicago's land use and zoning policies are not expansive enough to fully support the community's goals for a healthy and environmentally just corridor.
    a. Analysis of recent land use (2013) compared with historical zoning/land use data reveals that the Calumet Industrial Corridor has increased in its viability for transportation and institutional uses, rather than residential or commercial uses
        i. From 1990 to 2013, the study area observed a notable increase in transportation facilities, terminals, and docks, which grew to be the largest land use allocation by share (22.43%) in 2013

5. Stricter regulations, more frequent inspections, more severe penalties, and greater transparency are needed to reduce the high frequency of toxic releases by facilities in the Calumet Industrial Corridor.
    a. 91 companies were researched; 17 had records of OSHA violations in the past ten years with a combined total of 71 initial violations of OSHA rules; 70% of these were classified as 'severe' by inspectors.
        i. In order to determine whether these numbers (17, 71) are considered to be in a 'normal range, analysis of other industrial corridors over the same time period would be needed. Our analysis suggests that these numbers are artificially low, likely due to infrequent inspection processes.
            1. Similarly, we found that in recent years, the number of violations issued by the city Department of Buildings to companies in the study area was quite low; while in 2016, 56 violations were issued, only 18, 19, and 13 violations were issued in the years after. It would not be appropriate to conclude that companies have improved in their building code safety practices, as our team strongly suspects that a lack of frequent inspections is the primary cause for the decreases.

2. Of these 91 companies, 34 total had violation records per the city's Dept. of Buildings for the time period we analyzed. Over the 24 year period of analysis, there were 791 total recorded violations. Ford Motor Company was #1 with 123 violations followed by PVS Chemical Solutions with 86 violations.

b. Given the findings from the Office of Inspector General's 2019 audit of city worker/health safety inspections, we urge the Department of Public Health and other entities (Department of Buildings, Occupational Health and Safety Administration, Illinois EPA etc.) to collaborate to make synthesized data/findings on worker and company health/safety more readily available and understandable. In particular, we feel that trend analysis on building and occupational safety violations, inspection and penalty frequencies, and severity of toxic releases within the city's industrial corridors should be tabulated by these entities and publicly shared.

Appendix

Table 39. Southeast Chicago businesses list, compiled by the Chicago Center for Health and Environment (CACHET)

Industry	Company name	Address
	S. H. Bell Company	10218 S Avenue O, Chicago, IL 60617
Basic Chemical Manufacturing	Plastics Color Corporation	14201 Paxton Ave, Calumet City, IL 60409
	Dover Chemical Corporation	3000 Sheffield Ave, Hammond, IN 46327
	Praxair Inc	2551 Dickey Rd, East Chicago, IN 46312
	PVS Chemical Solutions Inc	12260 S Carondolet Ave, Chicago, IL 60633
Cement and Concrete Product Manufacturing	Lafarge North America	2150 E 130th St, Chicago, IL 60633
		3210 Watling St , East Chicago, IN 46312
	Ozinga Chicago Ready Mix Concrete, Inc	1818 E 103rd St, Chicago, IL 60617
	Skyway Cement Company, LLC	3020 E 103rd St, Chicago, IL 60617
	St. Marys Cement	12101 S Doty Ave, Chicago, IL 60633
Chemical Wholesale	Chemtrade Refinery Services Inc.	2250 E 130th St, Chicago, IL 60633
Commercial Real Estate Leasing	Watco Transloading LLC- Chicago Arrow Terminal	12600 S Stony Island Ave, Chicago, IL 60633
Food Manufacturing	Cargill Inc	12201 S Torrence Ave, Chicago, IL 60617
	Domino Foods Inc.	2400 E 130th St, Chicago, IL 60633

	Pullman Innovations	2701 E 100th St, Chicago, IL 60617
Gasoline Stations and Fuel Dealers	Amoco pipeline Co	1611 129th St, Whiting, IN 46394
	Marathon Petroleum Corporation	4206 Columbia Ave, Hammond, IN 46327
Grocery Wholesale	Arro corporation	10459 S Muskegon Ave, Chicago, IL 60617
	Del Monte Fresh Produce Company	9880 S Dorchester Ave, Chicago, IL 60628
Industrial Machinery Repair and Maintenance	Calumet Tank & Equipment Co Inc	12440 S Stony Island Ave, Chicago, IL 60633
Machinery and Equipment Manufacturing	Safety-Kleen Systems	601 Riley Rd, East Chicago, IN 46312
	GMI Packaging	1600 E 122nd St, Chicago, IL 60633
Machinery Wholesale; Construction and Hardware Materials Wholesale	Nidera	11700 S Torrence Ave, Chicago, IL 60617
Metal Products Manufacturing	Arcelor Mittal	3001 Dickey Rd, East Chicago, IN 46312
		3133 E 106th St, Chicago, IL 60633
	All Star Powder Coating	12653 S Doty Ave, Chicago, IL 60633
	American Zinc Recycling Corp. (Horsehead)	2701 E 114th St, Chicago, IL 60617
	Atlas Tube	1855 E 122nd St, Chicago, IL 60633
	ELG Metals, Inc	10321 S Calumet Access Rd, Chicago, IL 60617
	Nacme Steel Processing, LLC	429 W 127Th St, Chicago, IL 60628-7109
	National Material L.P. (Interstate Steel Processing)	12100 S Stony Island Ave, Chicago, IL 60633

Metals and Minerals Wholesale	Kloeckner Metals Corporation	141 141st St, Hammond, IN 46327
		12900 S Metro Dr, Chicago, IL 60633
		13535 S Torrence Ave # C, Chicago, IL 60633
	Berlin Metals, LLC	3200 Sheffield Ave, Hammond, IN 46327
	Blackhawk Steel Corp. (Dockside Steel Processing?)	11828 S Stony Island Ave, Chicago, IL 60617
	North America Stevedoring Company, LLC (Nasco?)	12700 S Butler Dr, Chicago, IL 60633
	Reserve Ftl, LLC (Reserve Marine Terminal)	11600 S Burley Ave, Chicago, IL 60617
Miscellaneous Chemical Manufacturing	Diamond Peak Distributors, Inc	1600 E 122nd St, Chicago, IL 60633
	Qualawash Holding LLC	803 E 120th St, Chicago, IL 60628
	Unilever United States, Inc.	1200 Calumet Ave, Hammond, IN 46320
Miscellaneous Wholesale	Cronimet corporation	10602 S Buffalo Ave, Chicago, IL 60617
	Maryland Pig Iron of Illinois	12901 S Stony Island Ave, Chicago, IL 60633
	Napuck Salvage of Waupaca, LLC	11600 South Burley Avenue, Chicago, IL 60617
	Scrap Metal Services, LLC	13830 Brainard Ave, Chicago, IL 60633-16388
Motor Vehicle and Parts Dealers	Ford Chicago Assembly Plant	12600 S Torrence Ave, Chicago, IL 60633
Motor Vehicle Manufacturing	Dakkota Integrated Systems, LLC	12525 S Carondolet Ave, Chicago, IL 60633
Motor Vehicle Parts Manufacturing	Flex-N-Gate Corporation (Biagi Brothers?)	2924 E 126th Pl, Chicago, IL 60633
	Ford Motor Company	12600 S Torrence Ave, Chicago, IL 60633

	Tower Automotive	12350 S Avenue O, Chicago, IL 60633
	Troy Design & Manufacturing Co.	12359 S Burley Ave, Chicago, IL 60633-1296
	ZF Chassis Systems Chicago LLC	3400 E 126th Pl, Chicago, IL 60633
Natural Gas Distribution	Peoples Energy Corporation	2580 E 122nd St, Chicago, IL 60633
Non-Metallic Mineral Product Manufacturing	Dri-Rite	11600 S Avenue O, Chicago, IL 60617
Paint, Coating, and Adhesive Manufacturing	One Shot LLC	1701 E 122Nd St, Chicago, IL 60633-2362
	PPG Industries, Inc.	1701 E 122Nd St, Chicago, IL 60633-2362
Petroleum Product Manufacturing	Calumet Lubricants Co or Calumet Refining, LLC	14000 S Mackinaw Ave, Chicago, IL 60633
	Lub-Tek Petroleum Products Corp	14000 S Mackinaw Ave, Chicago, IL 60633
Pipeline Transportation	Kinder Morgan Kansas, Inc.	2926 E 126th Pl, Chicago, IL 60633
Plastic Fabrication Company	Polyjohn Enterprises Corporation	2500 Gaspar Ave, Whiting, IN 46394
Railroad Transport	Norfolk Southern Calumet Rail Yard	2040 E 106Th St, Chicago, IL 60617-6455
	Norfolk Southern Railway Company	13227 S Torrence Ave, Chicago, IL 60633-1813
Residential and Commercial Building Construction	Service Steel Warehouse	141 141st St, Hammond, IN 46327
	Walsh Construction	2711 E 112Th St, Chicago, IL 60617
Road Transportation Services	Kinder Morgan Liquids Terminals LLC	12200 S Stony Island Ave, Chicago, IL 60633
Rubber and Plastic Product Manufacturing	Plastics Color Corporation	14201 Paxton Ave, Calumet City, IL 60409
	Ade Inc	1430 E 130th St, Chicago, IL 60633

	Calumet Container Corp.	12440 S Stony Island Ave, Chicago, IL 60633
Shipping and Water Transportation Services	Emesco Marine Services Corp	12100 S Stony Island Ave # 1, Chicago, IL 60633
	Transfer Logistics, Inc.	12800 S Butler Dr, Chicago, IL 60633
Specialty Construction Trade Contractors	Asphalt Operating Services of Chicago, LLC	2835 E. 106th St., Chicago IL 60617
	Diamond Coring Company	11800 S Ewing Ave, Chicago, IL 60617
Storage and Warehousing	S. H. Bell Company	12800 S Butler Dr # 4, Chicago, IL 60633
Storage and Warehousing?	Norfolk Southern Thoroughbred Bulk Transfer Terminal	1702 E 103rd St, Chicago, IL 60617
Synthetic Chemical Manufacturing	Ashland Chemical Incorporated	14303 Paxton Ave, Calumet City, IL 60409
Trucking	Canadian Pacific Railway	2040 E 106th St, Chicago, IL 60617
	Cassens Transport Co	13511 S Torrence Ave, Chicago, IL 60633
	First Choice Logistics, Inc	12550 S Stony Island Ave, Chicago, IL 60633
	Great Lakes Reloading	13535 S Torrence Ave, Chicago, IL 60633
	JWK Enterprise Inc	13803 S Saginaw Ave, Chicago, IL 60633
	United Road Services	13227 S Torrence Ave, Chicago, IL 60633
Waste Management	Safety-Kleen Systems	615 E 138th St, Dolton, IL 60419
	South Shore Recycling / Reserve management group	11600 South Burley Avenue, Chicago, IL 60617
		11610 S Avenue O, Chicago, IL 60617-7329
	Liquid Environmental Solutions	12123 S Stony Island Ave, Chicago, IL 60633

	Optimus Recycling	11500 S State St, Chicago, IL 60628
	Regency Technologies, Ltd.	11600 S Burley Ave, Chicago, IL 60617
	Waste Management - South Chicago Recycle Center	13707 S Jeffery Ave, Chicago, IL 60617
	Waste Management of Illinois, Inc.	1825 E 130th St, Chicago, IL 60633
	WMI CID Recycling and Disposal	138th Bishop Ford Fwy, Chicago, IL 60633
Wood Product Manufacturing	Peco Pallet, Chicago	2924 E 126th Pl, Chicago, IL 60633

Table 40. Table of study area industry group and sub-sector definitions, as per the 2017 Manual of the North American Industrial Classification System (NAICS)

NAICS Industry Group/Sub-Sector Name	Group/Sub-Sector Code	Group/ Sub-Sector Description
Basic Chemical Manufacturing	3251	This industry group comprises establishments primarily engaged in manufacturing chemicals using basic processes, such as thermal cracking and distillation. Chemicals manufactured in this industry group are usually separate chemical elements or separate chemically-defined compounds.
Cement and Concrete Product Manufacturing	3273	This industry group comprises establishments primarily engaged in one of the following: (1) manufacturing portland, natural, masonry, pozzolanic, and other hydraulic cements; (2) acting as batch or mixing plants, manufacturing concrete delivered to a purchaser in a plastic and unhardened state; (3) manufacturing concrete pipe, brick, and block; or (4) manufacturing other concrete products (except block, brick, and pipe).
Chemical and Allied Products Merchant Wholesalers	4246	This industry group comprises establishments primarily engaged in the merchant wholesale distribution of chemicals, plastics materials and basic forms and shapes, and allied products.
Lessors of Nonresidential Buildings (except	53112	This industry comprises establishments primarily engaged in acting as lessors of buildings (except

Miniwarehouses)		miniwarehouses and self-storage units) that are not used as residences or dwellings. Included in this industry are: (1) owner-lessors of nonresidential buildings; (2) establishments renting real estate and then acting as lessors in subleasing it to others; and (3) establishments providing full service office space, whether on a lease or service contract basis. The establishments in this industry may manage the property themselves or have another establishment manage it for them.
Food Manufacturing	311	Industries in the Food Manufacturing subsector transform livestock and agricultural products into products for intermediate or final consumption. The industry groups are distinguished by the raw materials (generally of animal or vegetable origin) processed into food products. The food products manufactured in these establishments are typically sold to wholesalers or retailers for distribution to consumers, but establishments primarily engaged in retailing bakery and candy products made on the premises not for immediate consumption are included.
Gasoline Stations	447	Industries in the Gasoline Stations subsector retail automotive fuels (e.g., gasoline, diesel fuel, gasohol, alternative fuels) and automotive oils or retail these products in combination with convenience store items. These establishments have specialized equipment for storing and dispensing automotive fuels.
Grocery and Related Product Merchant Wholesalers	4244	This industry group comprises establishments primarily engaged in the merchant wholesale distribution of (1) a general line of groceries; (2) packaged frozen food; (3) dairy products; (4) poultry and poultry products; (5) confectioneries; (6) fish and seafood; (7) meats and meat products; (8) fresh fruits and vegetables; and (9) other grocery and related products.
Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair	8113	This industry group comprises establishments primarily engaged in renting or leasing commercial-type and industrial-type machinery and equipment. Establishments included in this industry group are generally involved in providing capital or investment-type equipment that clients use in their business operations. These establishments typically cater to a business clientele and do not generally operate a retail-like or storefront facility.

Machinery, Equipment, and Supplies Merchant Wholesalers	4238	This industry group comprises establishments primarily engaged in the merchant wholesale distribution of construction, mining, farm, garden, industrial, service establishment, and transportation machinery, equipment, and supplies.
Machinery Manufacturing	333	Industries in the Machinery Manufacturing subsector create end products that apply mechanical force, for example, the application of gears and levers, to perform work. Some important processes for the manufacture of machinery are forging, stamping, bending, forming, and machining that are used to shape individual pieces of metal. Processes, such as welding and assembling are used to join separate parts together. Although these processes are similar to those used in metal fabricating establishments, machinery manufacturing is different because it typically employs multiple metal forming processes in manufacturing the various parts of the machine. Moreover, complex assembly operations are an inherent part of the production process.
Primary Metal Manufacturing	331	Industries in the Primary Metal Manufacturing subsector smelt and/or refine ferrous and nonferrous metals from ore, pig or scrap, using electrometallurgical and other process metallurgical techniques. Establishments in this subsector also manufacture metal alloys and superalloys by introducing other chemical elements to pure metals. The output of smelting and refining, usually in ingot form, is used in rolling, drawing, and extruding operations to make sheet, strip, bar, rod, or wire, and in molten form to make castings and other basic metal products.
Metal and Mineral (except Petroleum) Merchant Wholesalers	4235	This industry group comprises establishments primarily engaged in the merchant wholesale distribution of products of the primary metals industries (including metal service centers) and coal, coke, metal ores, and/or nonmetallic minerals (except precious and semiprecious stones and minerals used in construction).
All Other Miscellaneous Chemical Product and Preparation Manufacturing	325998	This U.S. industry comprises establishments primarily engaged in manufacturing chemical products (except basic chemicals, resins, and synthetic rubber; cellulosic and noncellulosic fibers and filaments; pesticides, fertilizers, and other agricultural chemicals; pharmaceuticals and

		medicines; paints, coatings and adhesives; soaps, cleaning compounds, and toilet preparations; printing inks; explosives; custom compounding of purchased resins; and photographic films, papers, plates, and chemicals).
Miscellaneous Durable Goods Merchant Wholesalers	4239	This industry group comprises establishments primarily engaged in the merchant wholesale distribution of sporting, recreational, toy, hobby, and jewelry goods and supplies, and precious stones and metals.
Motor Vehicle Manufacturing	3361	This industry group comprises establishments primarily engaged in (1) manufacturing complete automobiles, light duty motor vehicles, and heavy duty trucks (i.e., body and chassis or unibody) or (2) manufacturing motor vehicle chassis only.
Motor Vehicle Parts Manufacturing	3363	This industry group comprises establishments primarily engaged in manufacturing motor vehicle gasoline engines and engine parts, motor vehicle electrical and electronic equipment, motor vehicle steering and suspension components (except springs), motor vehicle brake systems, motor vehicle transmission and power train parts, motor vehicle seating and interior trim, motor vehicle metal stampings, and other motor vehicle parts and accessories. This industry group includes establishments that rebuild motor vehicle parts.
Motor Vehicle and Parts Dealers	441	Industries in the Motor Vehicle and Parts Dealers subsector retail motor vehicles and parts from fixed point-of-sale locations. Establishments in this subsector typically operate from a showroom and/or an open lot where the vehicles are on display. The display of vehicles and the related parts require little by way of display equipment. The personnel generally include both the sales and sales support staff familiar with the requirements for registering and financing a vehicle as well as a staff of parts experts and mechanics trained to provide repair and maintenance services for the vehicles. Specific industries included in this subsector identify the type of vehicle being retailed. Sales of capital or durable nonconsumer goods, such as medium- and heavy-duty trucks, are always included in wholesale trade. These goods are virtually never sold through retail methods.
Natural Gas Distribution	221210	This industry comprises: (1) establishments

		primarily engaged in operating gas distribution systems (e.g., mains, meters); (2) establishments known as gas marketers that buy gas from the well and sell it to a distribution system; (3) establishments known as gas brokers or agents that arrange the sale of gas over gas distribution systems operated by others; and (4) establishments primarily engaged in transmitting and distributing gas to final consumers.
Non-Metallic Mineral Product Manufacturing	327	The Nonmetallic Mineral Product Manufacturing subsector transforms mined or quarried nonmetallic minerals, such as sand, gravel, stone, clay, and refractory materials, into products for intermediate or final consumption. Processes used include grinding, mixing, cutting, shaping, and honing. Heat often is used in the process and chemicals are frequently mixed to change the composition, purity, and chemical properties for the intended product. For example, glass is produced by heating silica sand to the melting point (sometimes combined with cullet or recycled glass) and then drawn, floated, or blow molded to the desired shape or thickness. Refractory materials are heated and then formed into bricks or other shapes for use in industrial applications.
Paint, Coating, and Adhesive Manufacturing	3255	This industry group comprises establishments primarily engaged in one or more of the following: (1) mixing pigments, solvents, and binders into paints and other coatings; (2) manufacturing allied paint products; and (3) manufacturing adhesives, glues, and caulking compounds.
Other Petroleum and Coal Products Manufacturing	32419	This industry comprises establishments primarily engaged in manufacturing petroleum products (except asphalt paving, roofing, and saturated materials) from refined petroleum or coal products made in coke ovens not integrated with a steel mill.
Pipeline Transportation	486	Industries in the Pipeline Transportation subsector use transmission pipelines to transport products, such as crude oil, natural gas, refined petroleum products, and slurry. Industries are identified based on the products transported (i.e., pipeline transportation of crude oil, natural gas, refined petroleum products, and other products). The Pipeline Transportation of Natural Gas industry includes the storage of natural gas because the storage is usually done by the pipeline

		establishment and because a pipeline is inherently a network in which all the nodes are interdependent.
Plastics Material and Resin Manufacturing	325211	This U.S. industry comprises establishments primarily engaged in (1) manufacturing resins, plastics materials, and nonvulcanizable thermoplastic elastomers and mixing and blending resins on a custom basis and/or (2) manufacturing noncustomized synthetic resins.
Rail Transportation	482	Industries in the Rail Transportation subsector provide rail transportation of passengers and/or cargo using railroad rolling stock. The railroads in this subsector primarily either operate on networks, with physical facilities, labor force, and equipment spread over an extensive geographic area, or operate over a short distance on a local rail line. Scenic and sightseeing rail transportation and street railroads, commuter rail, and rapid transit are not included in this subsector but are included in Subsector 487, Scenic and Sightseeing Transportation, and Subsector 485, Transit and Ground Passenger Transportation, respectively.
Residential Building Construction	2361	This industry comprises establishments primarily responsible for the construction or remodeling and renovation of single-family and multifamily residential buildings. Included in this industry are residential housing general contractors (i.e., new construction, remodeling, or renovating existing residential structures), for-sale builders and remodelers of residential structures, residential project construction management firms, and residential design-build firms.
Nonresidential Building Construction	2362	This industry group comprises establishments primarily responsible for the construction (including new work, additions, alterations, maintenance, and repairs) of nonresidential buildings. This industry group includes nonresidential general contractors, nonresidential for-sale builders, nonresidential design-build firms, and nonresidential project construction management firms.
General Freight Trucking, Local	484110	This industry comprises establishments primarily engaged in providing local general freight trucking. General freight trucking establishments handle a wide variety of commodities, generally palletized and transported in a container or van trailer. Local

		general freight trucking establishments usually provide trucking within a metropolitan area which may cross state lines. Generally the trips are same-day return.
Plastics and Rubber Products Manufacturing	326	Industries in the Plastics and Rubber Products Manufacturing subsector make goods by processing plastics materials and raw rubber. The core technology employed by establishments in this subsector is that of plastics or rubber product production. Plastics and rubber are combined in the same subsector because plastics are increasingly being used as a substitute for rubber; however the subsector is generally restricted to the production of products made of just one material, either solely plastics or rubber.
Water Transportation	483	Industries in the Water Transportation subsector provide water transportation of passengers and cargo using watercraft, such as ships, barges, and boats. The subsector is composed of two industry groups: (1) one for deep sea, coastal, and Great Lakes; and (2) one for inland water transportation. This split typically reflects the difference in equipment used.
Specialty Trade Contractors	238	The Specialty Trade Contractors subsector comprises establishments whose primary activity is performing specific activities (e.g., pouring concrete, site preparation, plumbing, painting, and electrical work) involved in building construction or other activities that are similar for all types of construction, but that are not responsible for the entire project. The work performed may include new work, additions, alterations, maintenance, and repairs. The production work performed by establishments in this subsector is usually subcontracted from establishments of the general contractor type or for-sale builders, but especially in remodeling and repair construction, work also may be done directly for the owner of the property. Specialty trade contractors usually perform most of their work at the construction site, although they may have shops where they perform prefabrication and other work. Establishments primarily engaged in preparing sites for new construction are also included in this subsector.
Warehousing and Storage	493	Industries in the Warehousing and Storage subsector are primarily engaged in operating

		warehousing and storage facilities for general merchandise, refrigerated goods, and other warehouse products. These establishments provide facilities to store goods. They do not sell the goods they handle. These establishments take responsibility for storing the goods and keeping them secure. They may also provide a range of services, often referred to as logistics services, related to the distribution of goods. Logistics services can include labeling, breaking bulk, inventory control and management, light assembly, order entry and fulfillment, packaging, pick and pack, price marking and ticketing, and transportation arrangement. However, establishments in this industry group always provide warehousing or storage services in addition to any logistic services. Furthermore, the warehousing or storage of goods must be more than incidental to the performance of services, such as price marking
Synthetic Dye and Pigment Manufacturing	325130	This industry comprises establishments primarily engaged in manufacturing synthetic organic and inorganic dyes and pigments, such as lakes and toners (except electrostatic and photographic).
General Freight Trucking, Long-Distance	48412	This industry comprises establishments primarily engaged in providing long-distance general freight trucking. General freight trucking establishments handle a wide variety of commodities, generally palletized and transported in a container or van trailer. Long-distance general freight trucking establishments usually provide trucking between metropolitan areas which may cross North American country borders. Included in this industry are establishments operating as truckload (TL) or less than truckload (LTL) carriers.
Waste Management and Remediation Services	562	Industries in the Waste Management and Remediation Services subsector group establishments engaged in the collection, treatment, and disposal of waste materials. This includes establishments engaged in local hauling of waste materials; operating materials recovery facilities (i.e., those that sort recyclable materials from the trash stream); providing remediation services (i.e., those that provide for the cleanup of contaminated buildings, mine sites, soil, or ground water); and providing septic pumping and other

		miscellaneous waste management services. There are three industry groups within the subsector that separate these activities into waste collection, waste treatment and disposal, and remediation and other waste management.
Wood Product Manufacturing	321	Establishments in the Wood Product Manufacturing subsector manufacture wood products, such as lumber, plywood, veneers, wood containers, wood flooring, wood trusses, manufactured homes (i.e., mobile homes), and prefabricated wood buildings. The production processes of the Wood Product Manufacturing subsector include sawing, planing, shaping, laminating, and assembling wood products starting from logs that are cut into bolts, or 178 NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM T—Canadian, Mexican, and United States industries are comparable. census.gov/naics lumber that then may be further cut, or shaped by lathes or other shaping tools. The lumber or other transformed wood shapes may also be subsequently planed or smoothed, and assembled into finished products, such as wood containers. The Wood Product Manufacturing subsector includes establishments that make wood products from logs and bolts that are sawed and shaped, and establishments that purchase sawed lumber and make wood products. With the exception of sawmills and wood preservation establishments, the establishments are grouped into industries mainly based on the specific products manufactured.

Table 41. Table of CoStar property types and definitions

Property Type	**Definition**	**Data Availability Notes**
Industrial (General)	A type of building(s) adapted for a combination of uses such as assemblage, processing, and/or manufacturing products from raw materials or fabricated parts. Additional uses include warehousing, distribution, and maintenance facilities.	Self-storage facilities are also tracked as an industrial type, but CoStar does not list such space for lease in the database.

Industrial (Distribution)	These are typically large buildings, both single and multi-tenant, used for the warehousing and distribution of inventory. Buildings are typically 200,000 sf or more, with clear heights 28 feet plus, up to 5% office space and the balance being warehouse/storage space. These buildings typically have one loading door for every 10,0000 sf of RBA and site coverage up to 40%. These buildings are often cross-docked with trailer parking.	
Industrial (Manufacturing)	These buildings are typically 300,000 sf or greater with one loading dock for every 15,000 sf of RBA. Office area up to 50%.	
Industrial (Service)	Industrial zoned building designed for vehicle repair. It may include cranes for moving engine blocks, electric or hydraulic lifts, and numerous drive-in doors.	
Industrial (Warehouses)	They are typically 25,000 sf or greater in size, box shape, with one loading dock for every 15,000 sf of RBA. Up to 20% office area with clear heights of 22 feet or greater. Site coverage is typically up to 50%.	
Brownfield	Abandoned, idled or underused industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination.	
Flex	A type of building(s) designed to be versatile, which may be used in combination with office (corporate headquarters), research and development, quasi-retail sales, and including but not limited to industrial, warehouse, and distribution uses. At least half of the rentable area of the building must be used as office space. Flex buildings typically have ceiling heights under 18', with light industrial zoning. Flex buildings have also been called Incubator, Tech and Showroom buildings in markets throughout the country.	