Exhausted Schools - T(y)red Children?

Introduction to GIS

fall-2014

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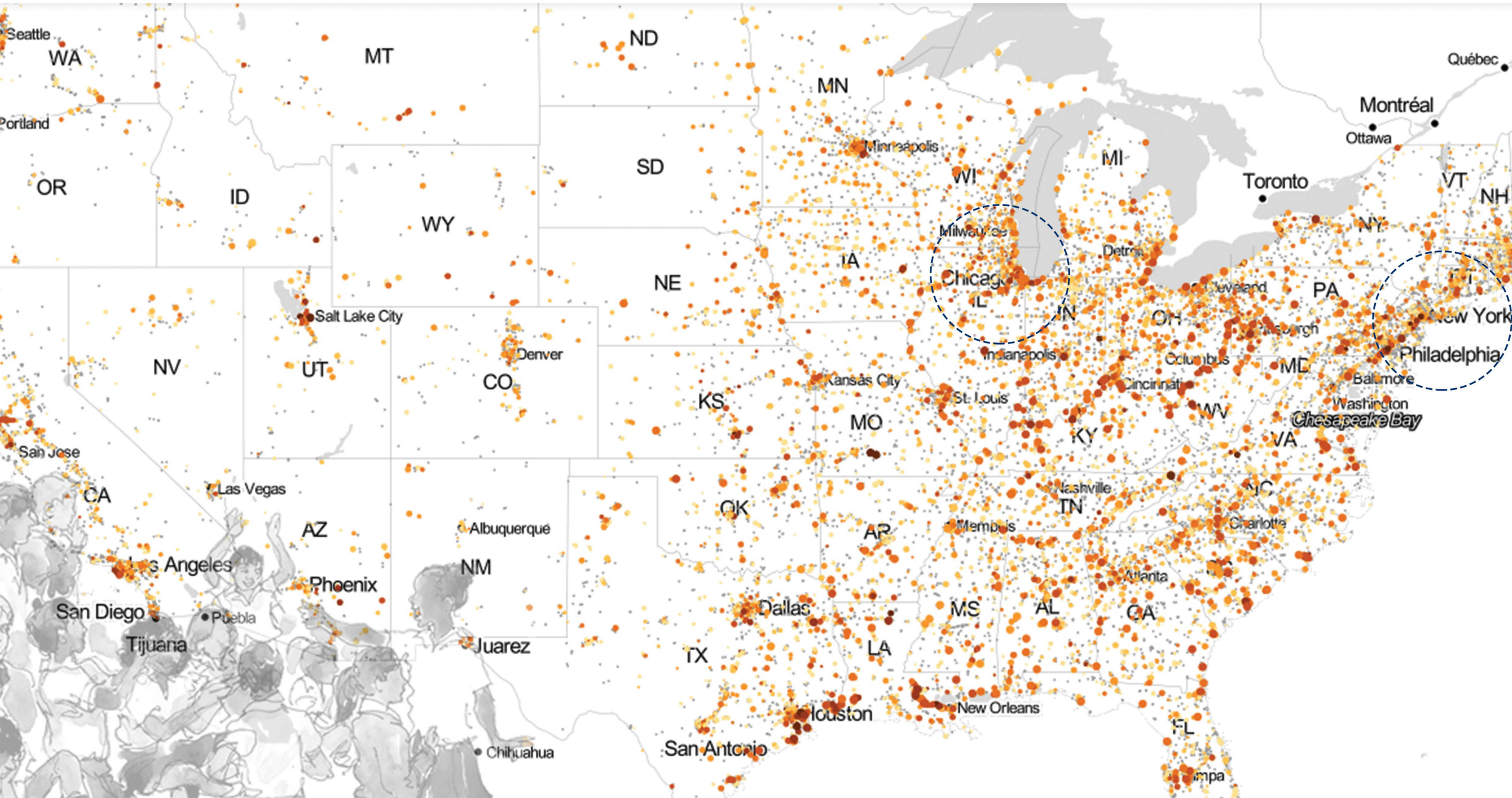
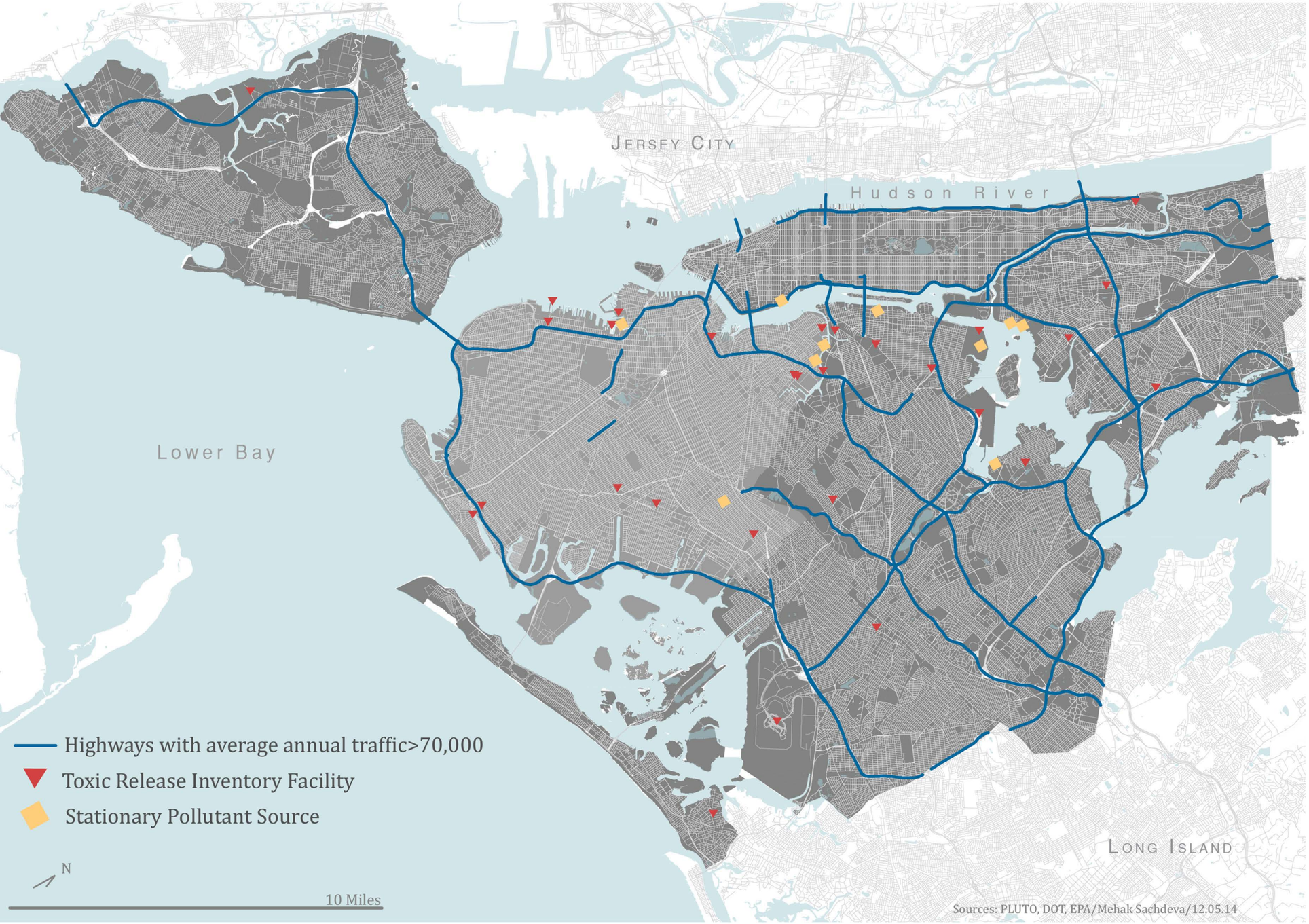
Concerned with environmental injustice and the many ill-impacts it has on the residents of affected neighborhoods, I realized through existing literature that there were sources of toxic air pollutants existing within close proximity to our daily land-uses. Looking at the major point source - pollutant map of United States, we clearly see a definite density in New York City and Chicago, taken as the two cases of comparison here.

01 Inspiration
Objective



02 Pollutant Sources
New York City

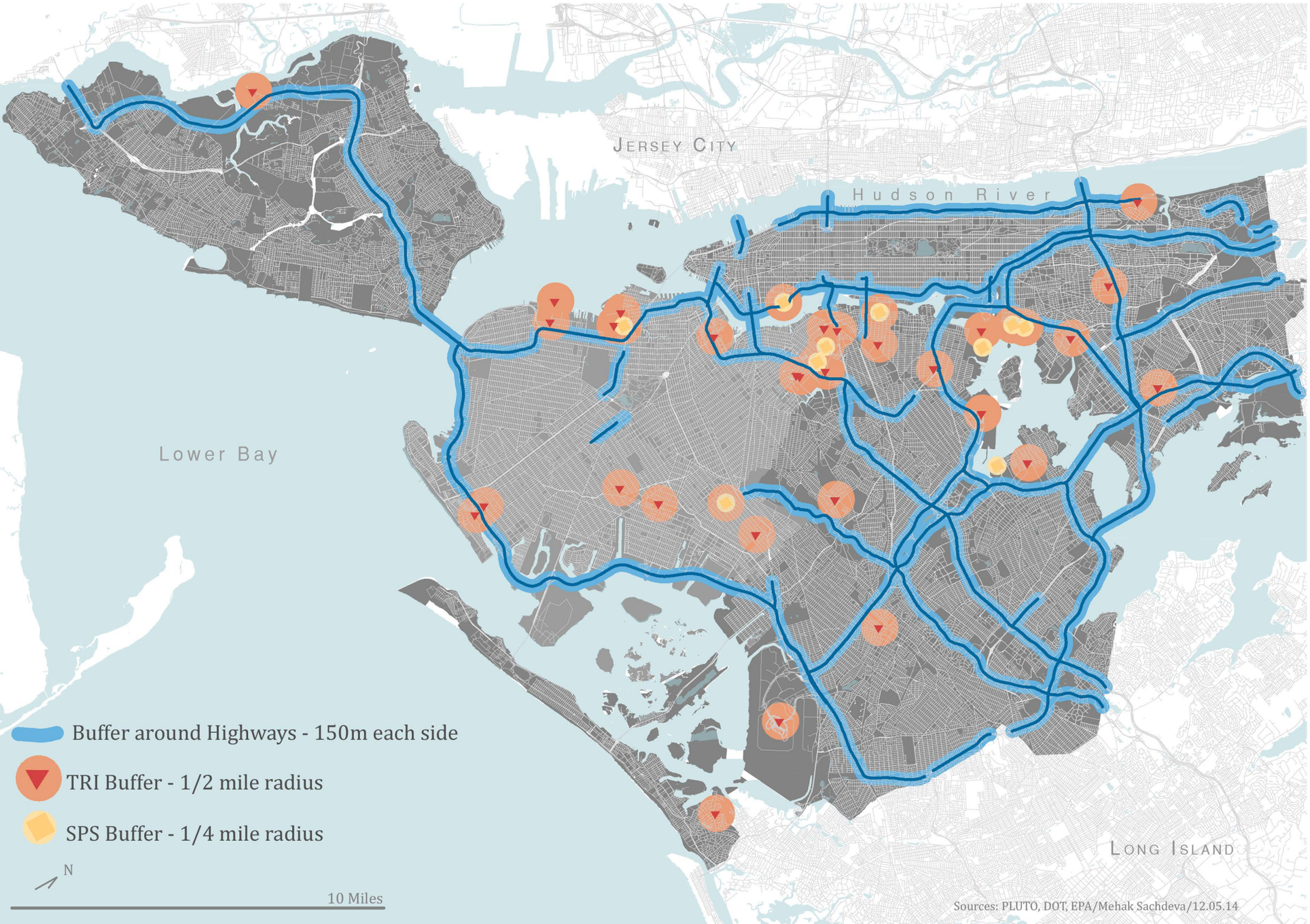


Taking New York City, first: The map shows the various sources of air pollution including industries listed in the Toxic release inventory, Point sources like waste management plants and major highways carrying an average annual traffic of more than 70,000 vehicles. Toxic Release Inventory(TRI) is an inventory that lists all the facilities in a city that cause pollution and suspension of more than the standard listed 650 toxic chemicals in the air. Stationary Point Sources(SPS) are other facilities like waste management plant and thermal power generators , which are less harmful in their release quotient than the TRI facilities. Since, highways are a source of mobile pollution as compared to the industrial stationary sources, it is considered less harmful.

TRI facilities - 104

SPS facilities - 20

03 Pollutant Buffers
Extent of effect



By creating a buffer of 150m on either side of the highway, a half mile radius buffer around the Toxic Release Inventory facilities and a quarter mile radius around the Stationary Point Sources, I intersected the buffers and carried a spatial analysis. Since the intersection of these buffers is not apparent, a spatial analysis did not result in many affected schools. The schools that intersected in the buffers of all three pollutant sources were marked, Degree 1. The ones that intersected the TRI facilities, considered as the most harmful, were marked as Degree 2 and those which intersected with the SPS facilities and highways only, were marked Degree 3 and Degree 4, respectively.

04 Proximity to Toxic Air Pollutants
Juxtaposition of public schools

Lower Bay

Jersey City

Hudson River

Long Island

Public Schools Points

No. of Public Schools - 17,00

N

10 Miles

Sources: PLUTO, DOT, EPA/Mehak Sachdeva/12.05.14

05 Proximity to Toxic Air Pollutants

Affected schools

Lower Bay

Jersey City

Hudson River

Long Island

One mile focus around areas of major concern

Degree 1 (Intersection with TRI, SPS, Highway)

Degree 2 (Intersection with TRI)

Degree 3 (Intersection with Highway)

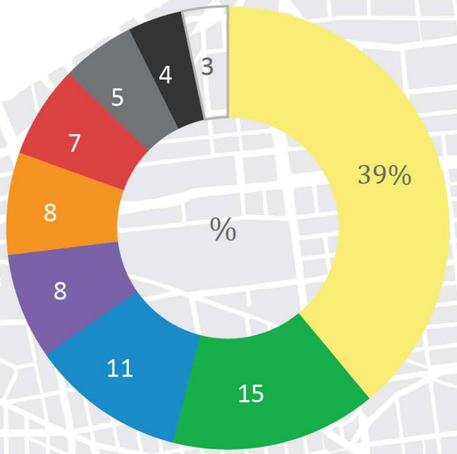
Degree 4 (Intersection with SPS)

N

10 Miles

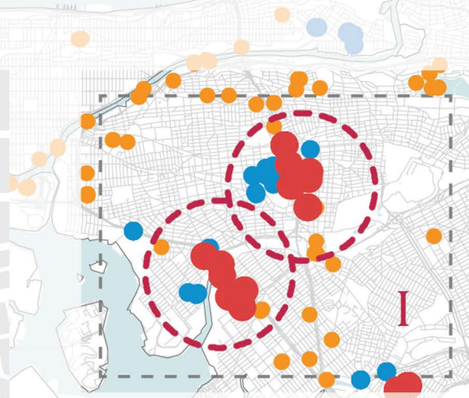
Sources: PLUTO, DOT, EPA/Mehak Sachdeva/12.05.14

06 Area of Concern I - Bronx
Studying land-use



Residential
Mixed Use
Commercial
Industrial
Institutional
Green Space
Transportation
Parking Facilities

1 Mile



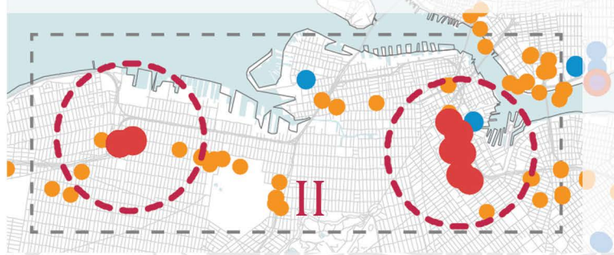
According to literature, students in elementary schools live within a one mile radius so it is important to identify those zones and see where these children reside to understand the environmental justice aspect. The impact was considered based on these criteria:

-Land-use
-Concentration of racial minority
-Low-income household concentration
-Concentration of households with one or more children in these neighborhoods.

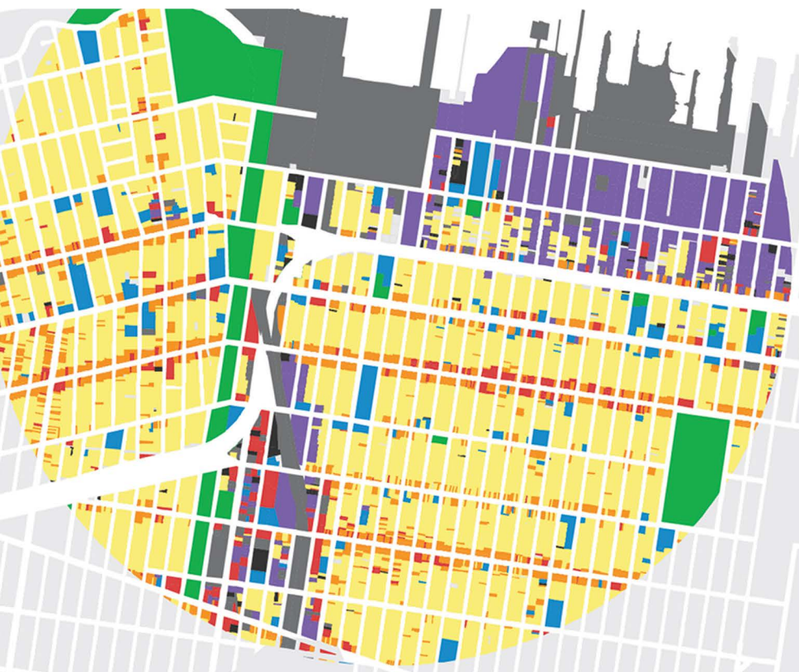
It is interesting to note through this analysis that residential land-use occupies a majority of the area around the areas of concern. In the first, it is 39% where industrial land-use is only an 8%.

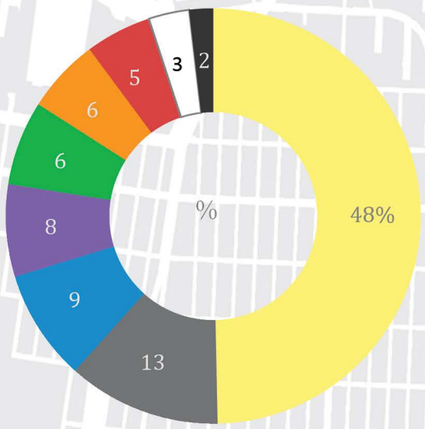
rces: PLUTO, DOT, EPA/Mehak Sachdeva/12.05.14

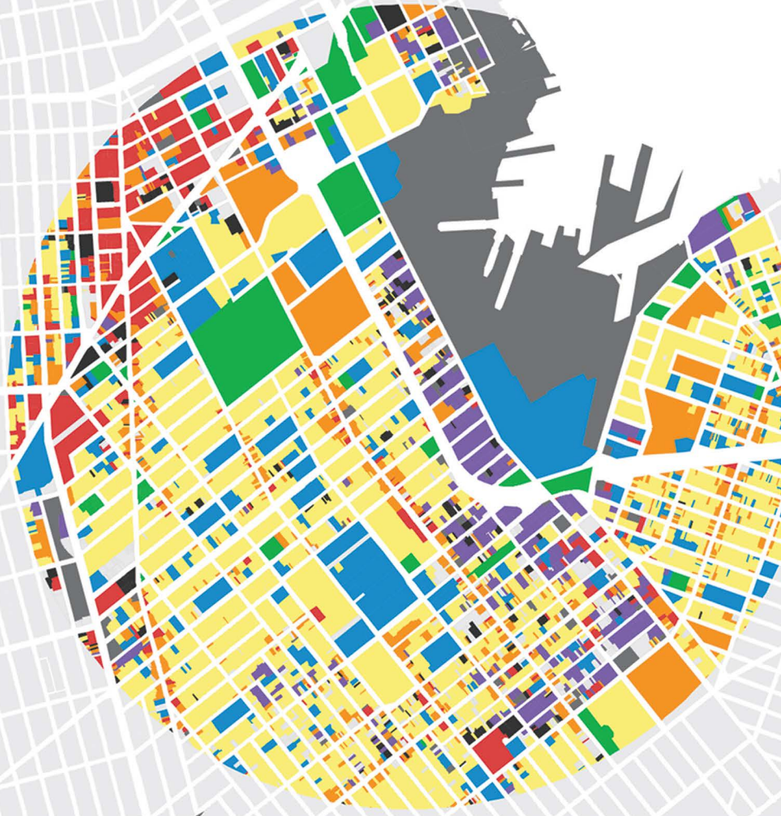
07 Area of Concern II - Brooklyn
Studying land-use



In the second Area of Concern in the Brooklyn borough, residential land-use intensifies to an even larger percentage at a 48% with only an 8% under industrial land-use. We also notice a number of green spaces in this area and a large number of institutional units. Though it is beyond the scope of this study, these land-use patterns when studied in detail can help yield interesting revelations.



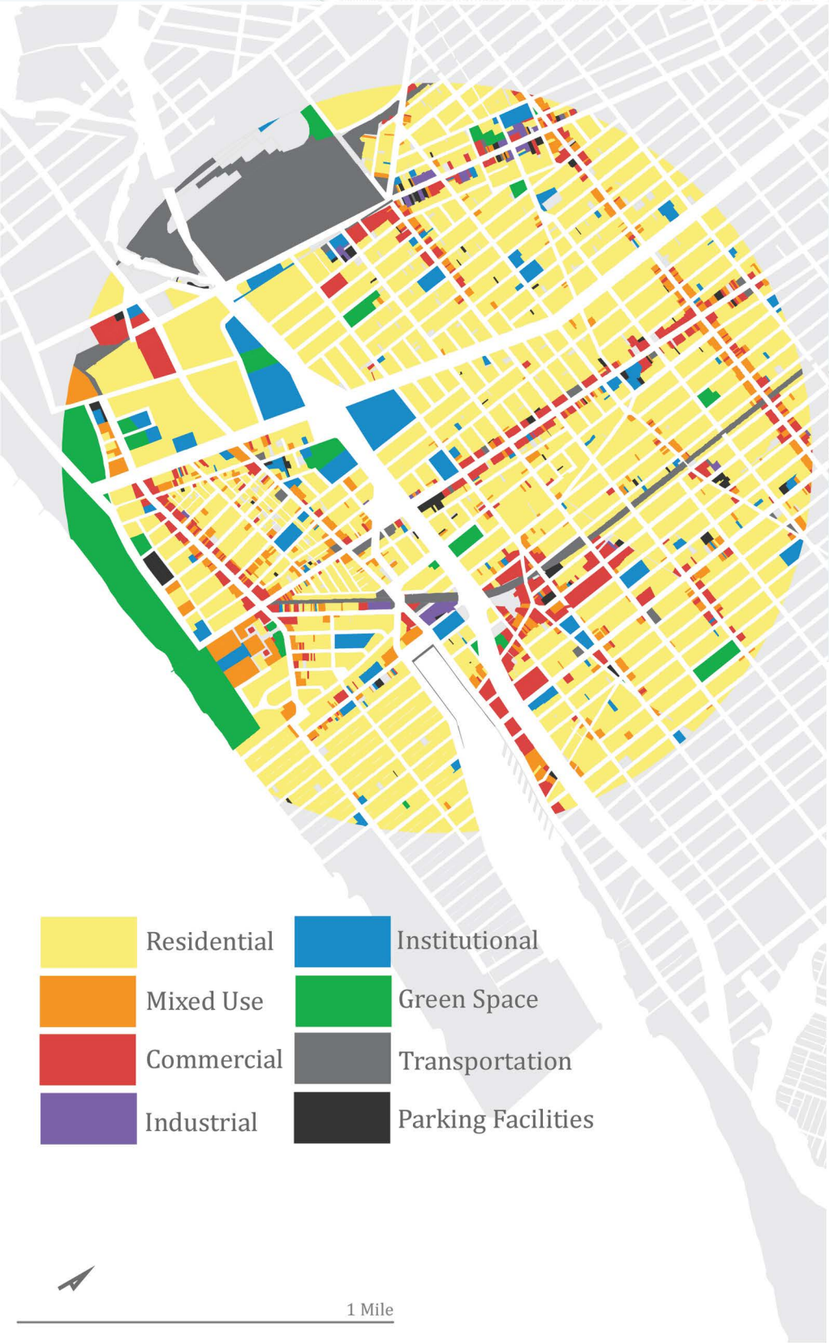


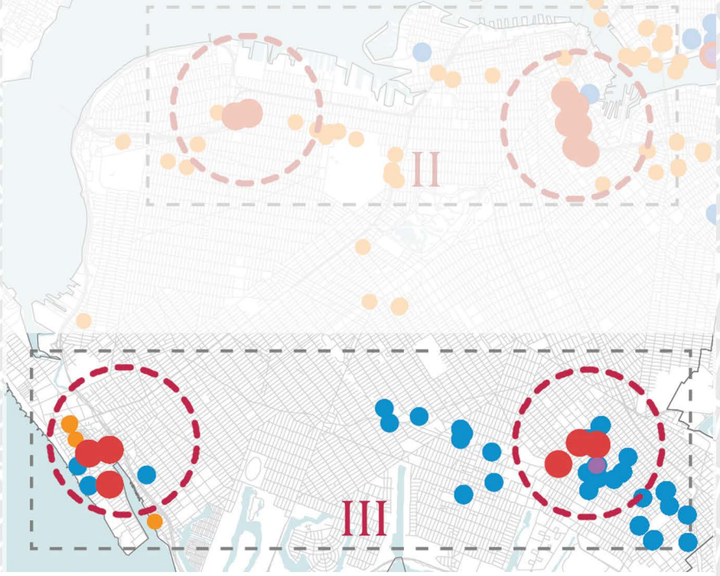


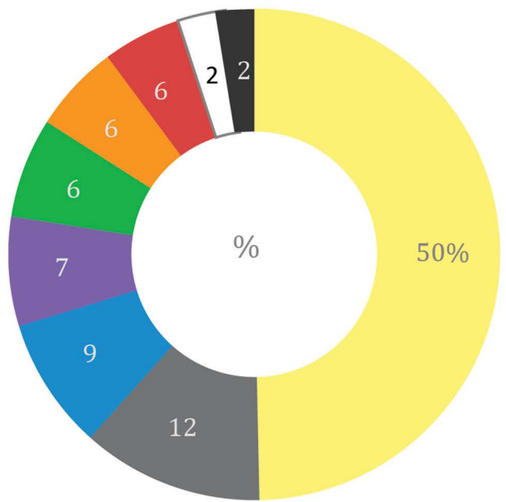
Residential
Mixed Use
Commercial
Industrial
Institutional
Green Space
Transportation
Parking Facilities

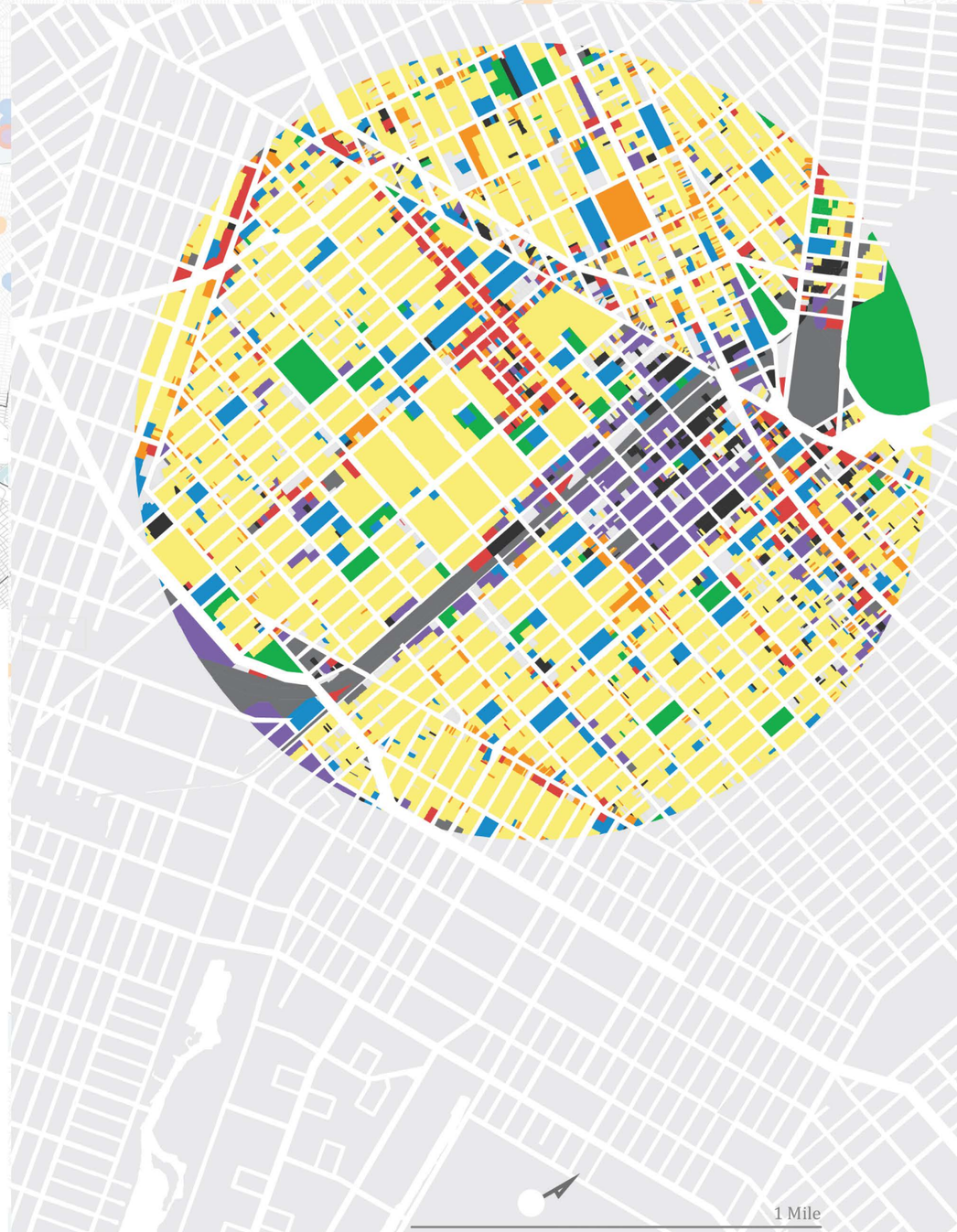
08 Area of Concern III - Brooklyn
Studying land-use

Looking at the third Area of Concern, an even higher percentage of land-use is observed to be under residential with a 50% and the industrial was again low at a 7%. This study clearly tells us that the major affected zones are engulfed intensively with residences all around, which in itself is a concern for the residents living there. To understand now, whether economically low, racially minor or households with children are concentrated in these areas, these buffers are studied more in detail.

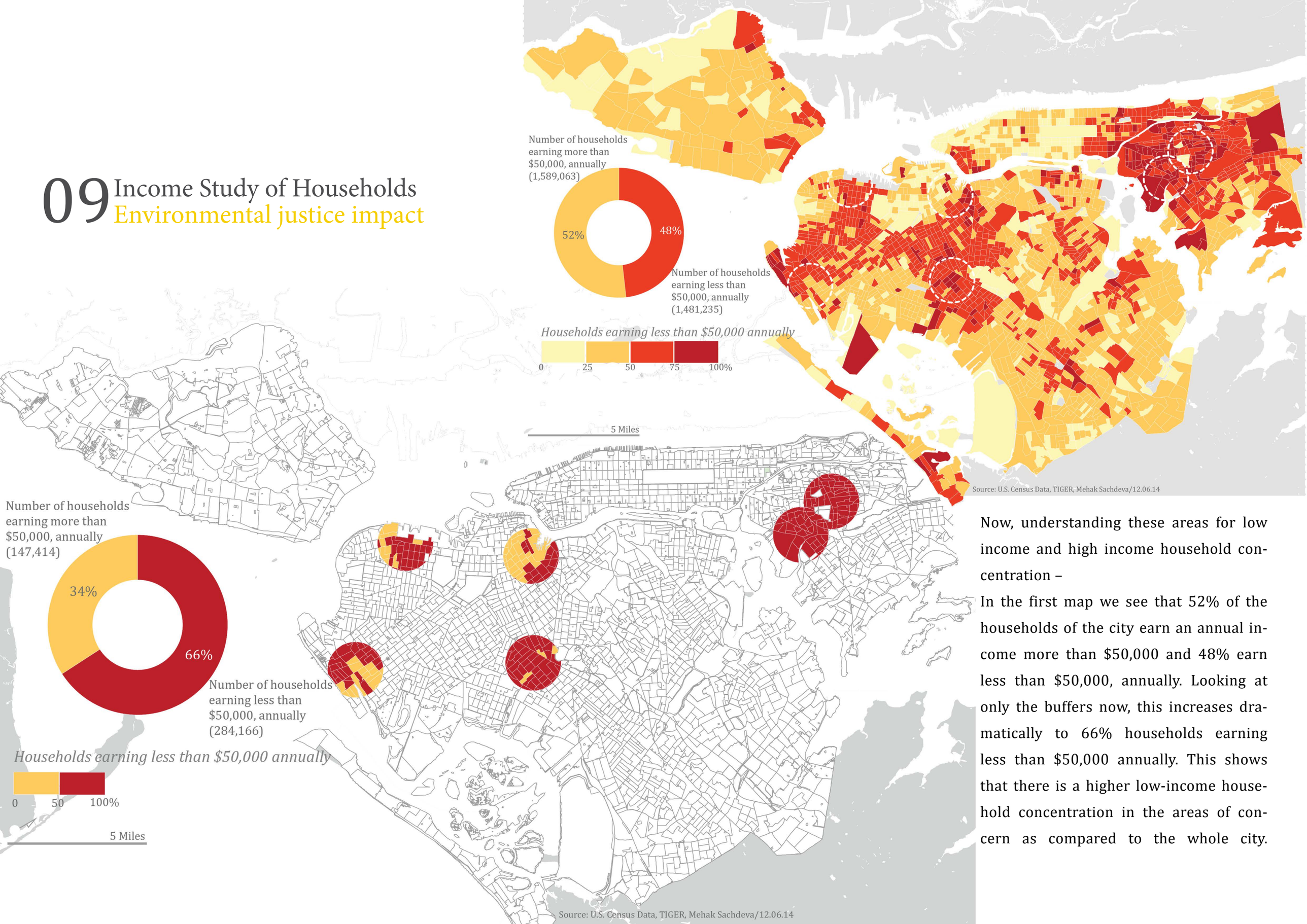








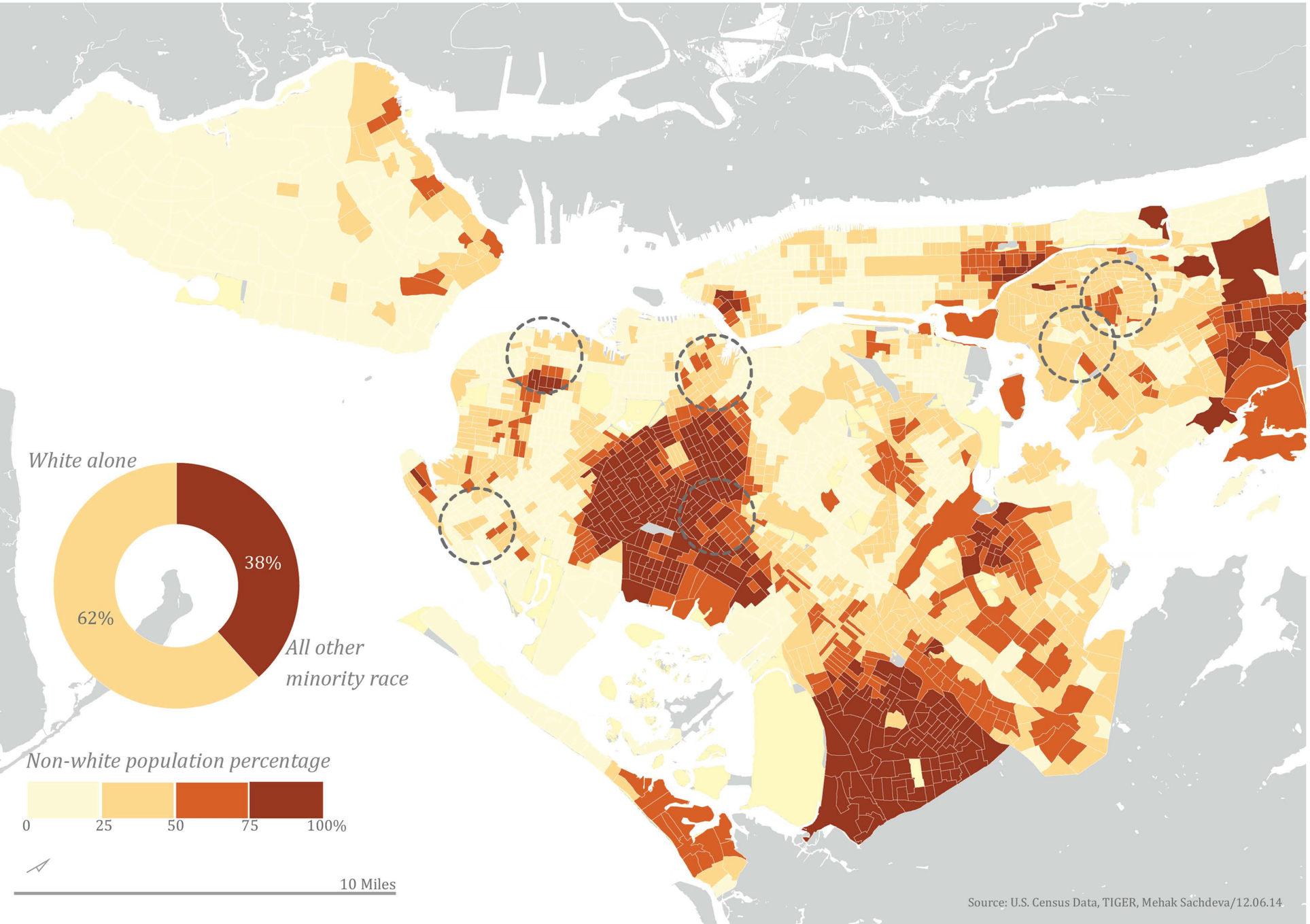
09 Income Study of Households
Environmental justice impact



Now, understanding these areas for low income and high income household concentration –

In the first map we see that 52% of the households of the city earn an annual income more than $50,000 and 48% earn less than $50,000, annually. Looking at only the buffers now, this increases dramatically to 66% households earning less than $50,000 annually. This shows that there is a higher low-income household concentration in the areas of concern as compared to the whole city.

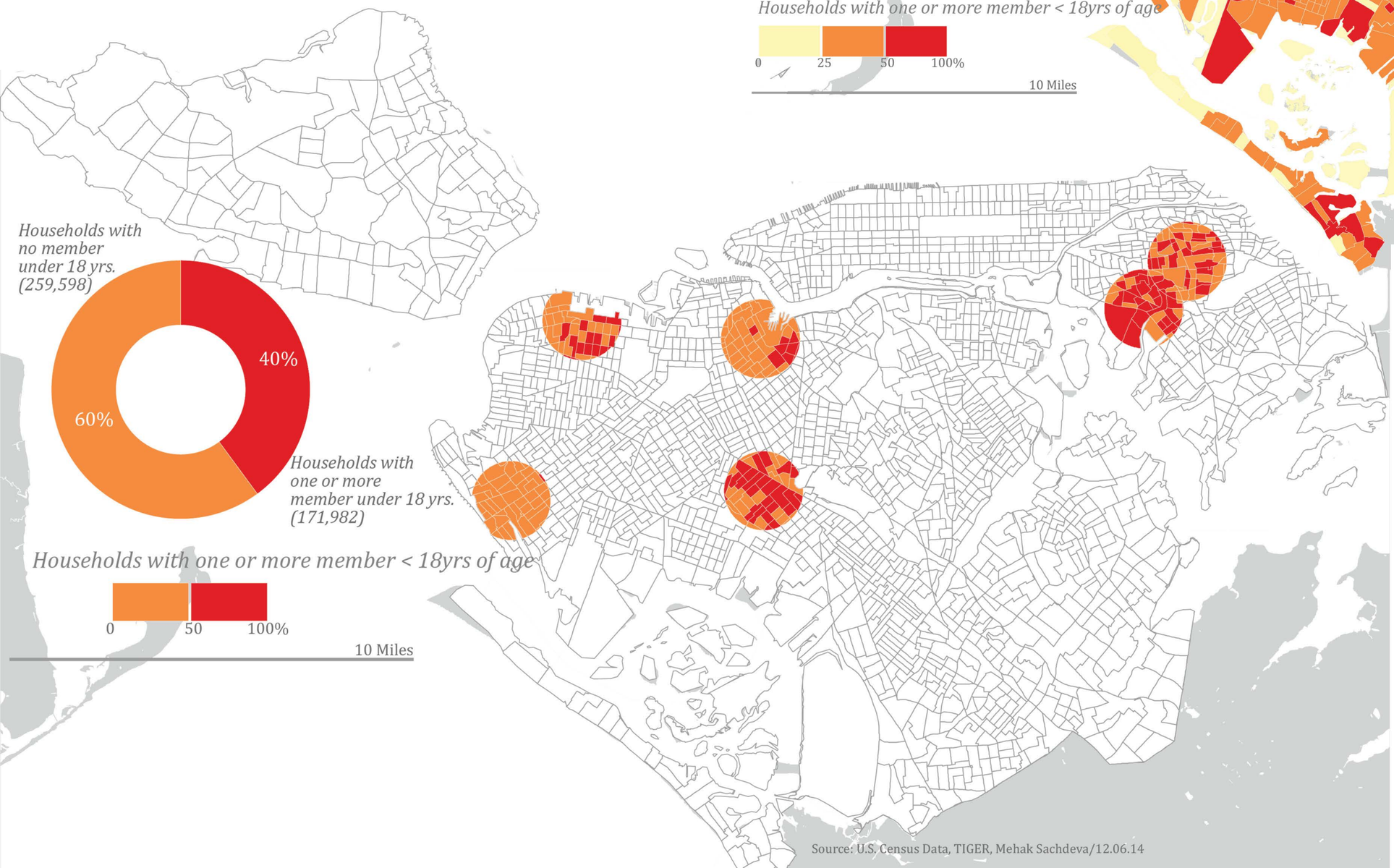
10 Minority Population Study
Environmental justice impact



Looking at racially minor population concentration of the city, this map shows a 62% white population and a 38% minor race population accross the city. Through eye-ball testing we realise that there is no major difference in the buffer zones than in the over-all city average. Since it is apparent that the effect of concentration is not much, these buffers were not studied in isolation. This could be one possible limitation of this study as this effect was rejected before detailing.

Also, since the data for only racial difference is taken, hispanic and non-hispanic origin differences are not considered in this study. This could also be a reason of deviation.

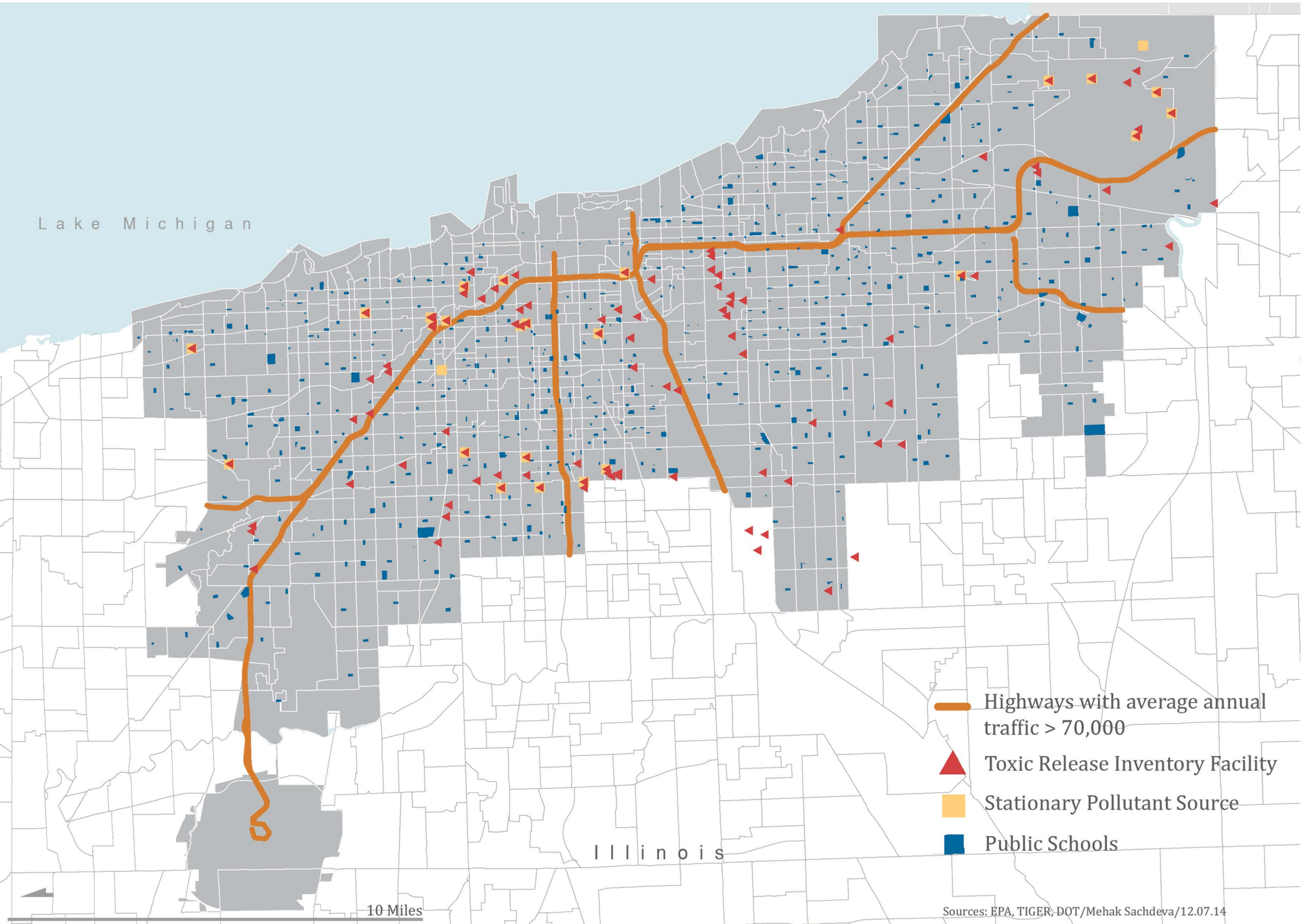
11 Households with Children
Environmental justice impact



For households with children, 69% households have no members less than 18 years of age and 31% have at least one member below 18 years of age. This increases to a 40%, only for the buffers which implies that there is significant concentration of households with children, in these buffers.

Hence, for New York City, we see a relationship of low-income housholds and those with children concentrating more in the areas of concern, cummulatively. This is an indicative of environmental injustice pertaining to these neighborhoods.

12 Pollutant Sources
Chicago, Illinois



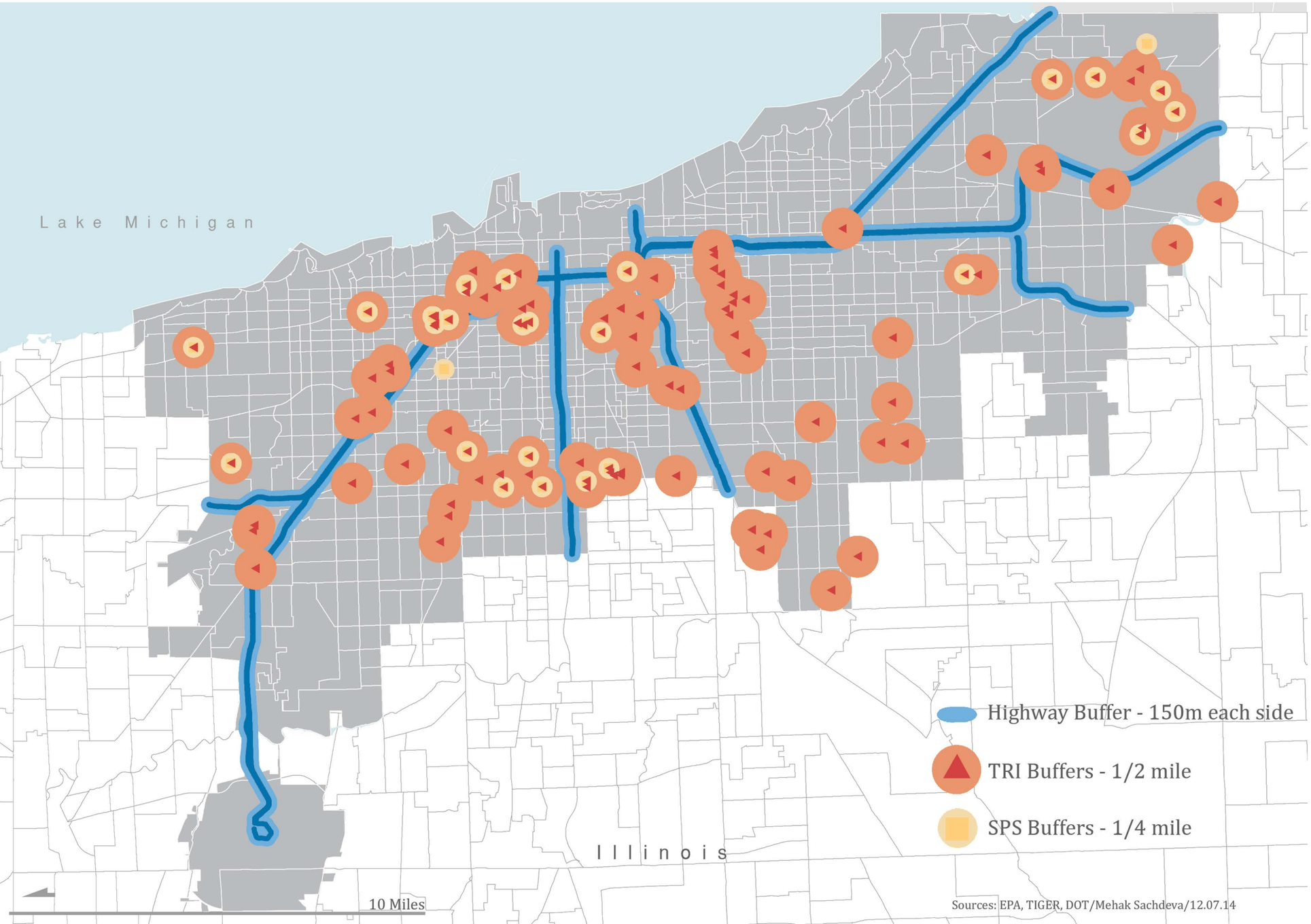
Taking Chicago next: This map shows the various sources of air pollution including industries listed in the Toxic release inventory, Point sources like waste management plants and major highways carrying an average annual traffic of more than 70,000 vehicles, similar to the New York City case. It is interesting to realise here that the number of TRI facilities is more than double as compared to NYC where the population of the city is a quarter and the area about a half, of that of NYC. The schools are also much lesser in number, as compared to NYC, but is relevant to the population of the city.

TRI facilities: 311

SPS facilities: 122

Public schools: 635

13 Pollutant Buffers
Extent of effect



Similar to methodology follwed for New York City case, creating a buffer of 150m on either side of the highway, a half mile radius buffer around the Toxic Release Inventory facilities and a quarter mile radius around the Stationary Point Sources, I intersected the buffers and carried a spatial analysis. Since the intersection of these buffers is not apparent, a spatial analysis did not result in many affected schools. The schools that intersected in the buffers of all three pollutant sources were marked, Degree 1. The ones that intersected the TRI facilities, considered as the most harmful, were marked as Degree 2 and those which intersected with the SPS facilities and highways only, were marked Degree 3 and Degree 4, respectively.

The areas of concern should all be a radius of one mile, but for two cases where there is an accumulation of many affected schools I extended that to a 1.5 mile.

14 Proximity to Toxic Air Pollutants
Juxtaposition of public schools

Lake Michigan

Illinois

Public Schools

10 Miles

Sources: EPA, TIGER, DOT/Mehak Sachdeva/12.07.14

15 Proximity to Toxic Air Pollutants
Affected schools

Lake Michigan

Areas of High concern

Degree 1 (SPS, Highway, TRI)

Degree 2 (TRI)

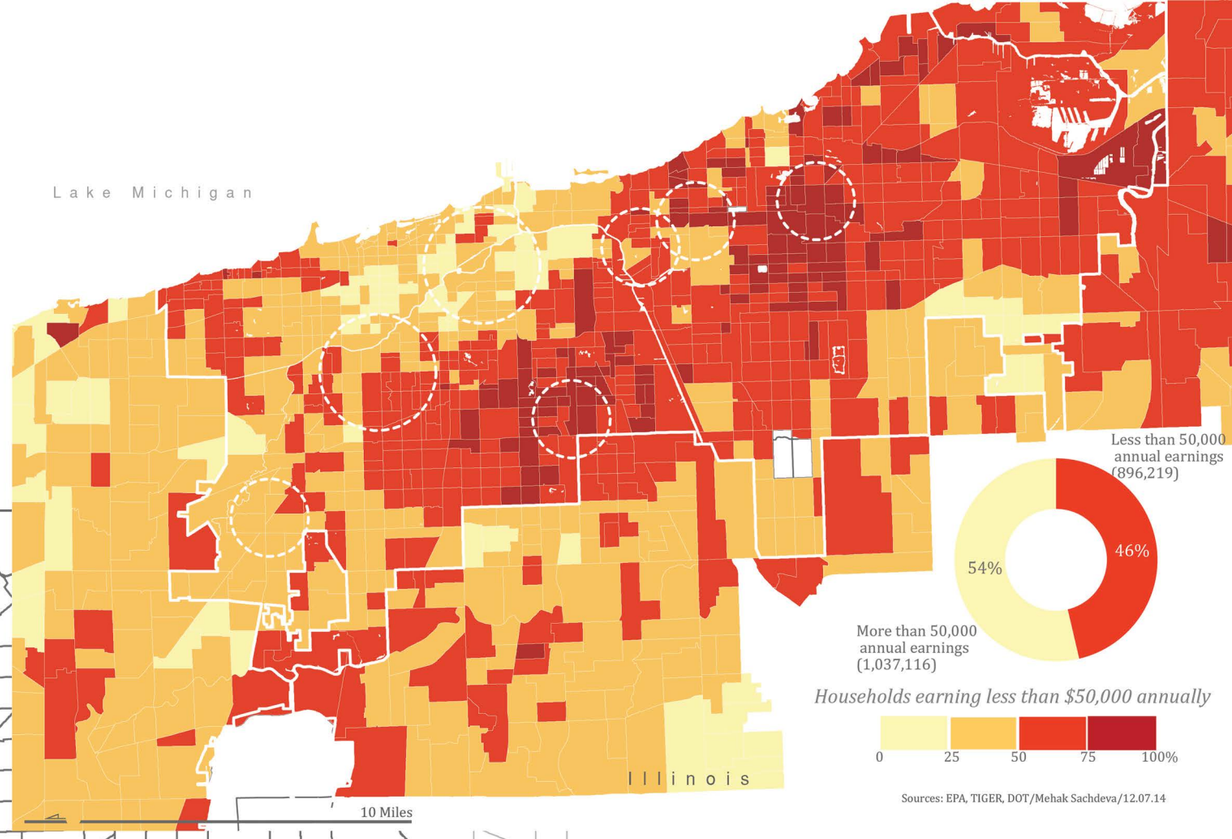
Degree 3 (Highway)

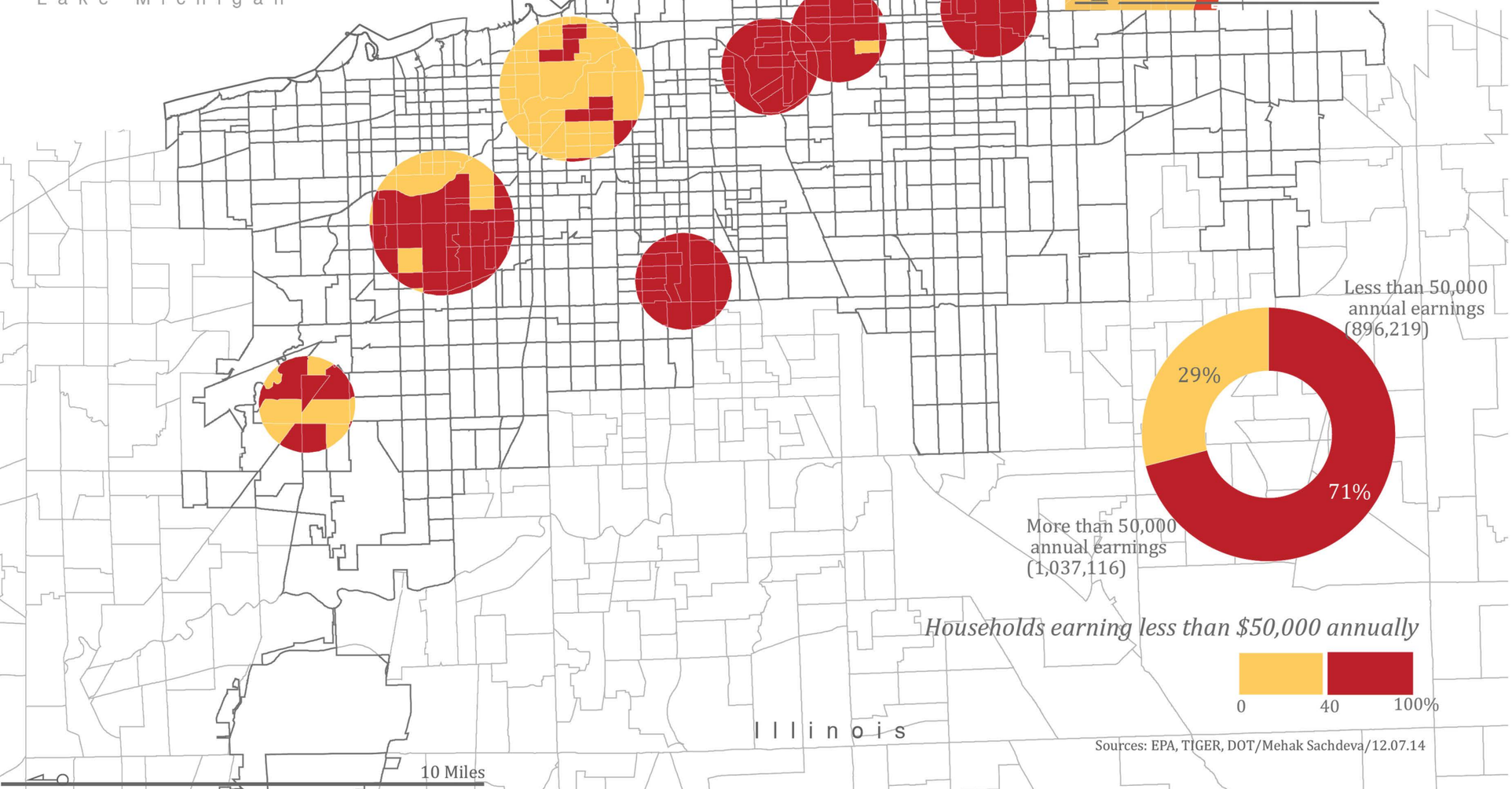
Illinois

10 Miles

Sources: EPA, TIGER, DOT/Mehak Sachdeva/12.07.14

16 Income Study of Households
Environmental justice impact

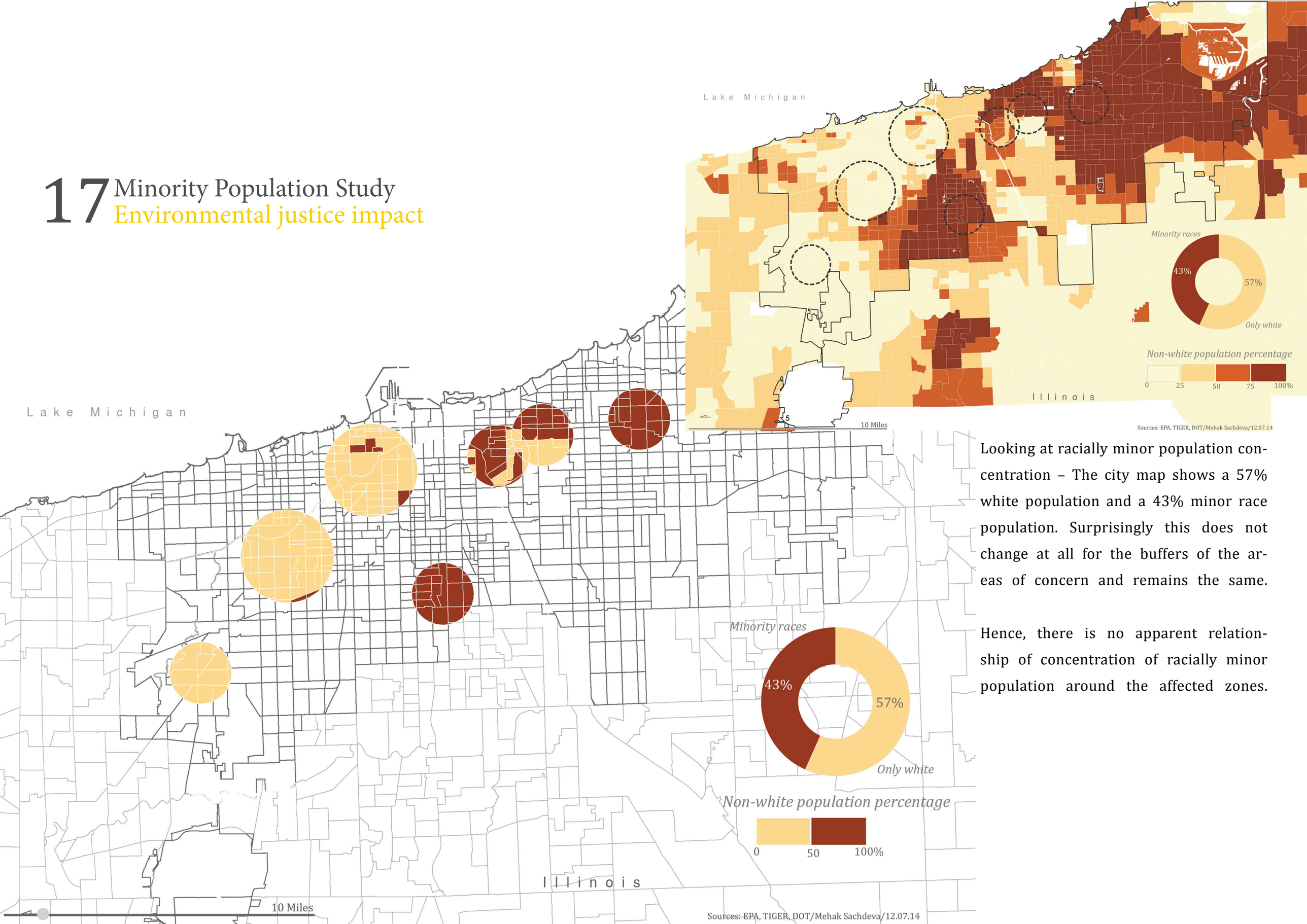




Since the affected schools are so many and are spread over such a large area, a land-use study was not considered necessary for this case. Understanding these areas for low income and high income household concentration in this first map we see that 54% of the households of the city earn an annual income more than 50,000 dollars and 46% earn less than 50,000 dollars, annually. Looking at only the buffers now, this increases radically to a 71% households earning less than 50,000 dollars annually.

This shows that there is a higher low-income household concentration in the areas of concern as compared to the whole city.

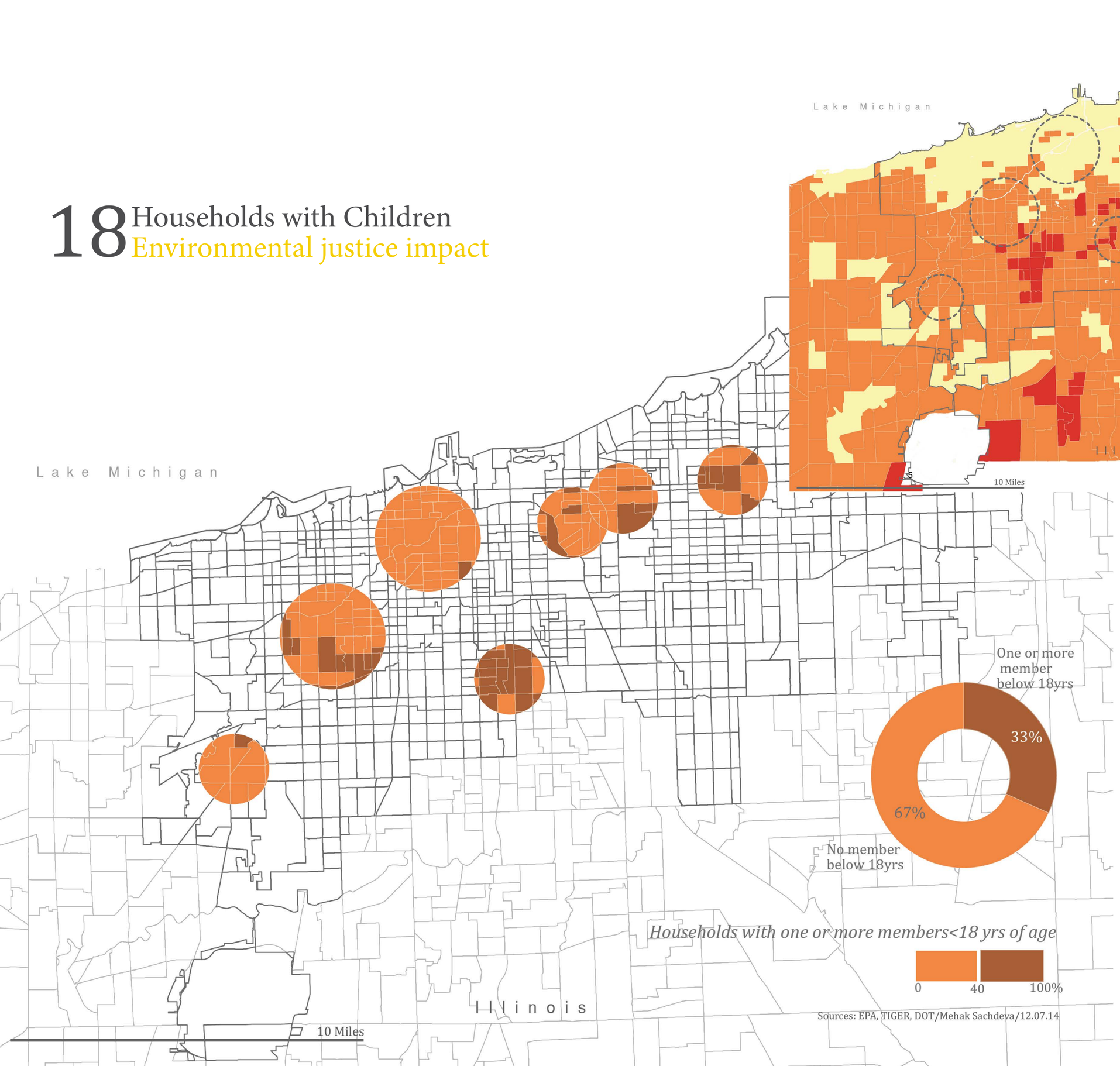
17 Minority Population Study
Environmental justice impact



Looking at racially minor population concentration – The city map shows a 57% white population and a 43% minor race population. Surprisingly this does not change at all for the buffers of the areas of concern and remains the same.

Hence, there is no apparent relationship of concentration of racially minor population around the affected zones.

18 Households with Children
Environmental justice impact

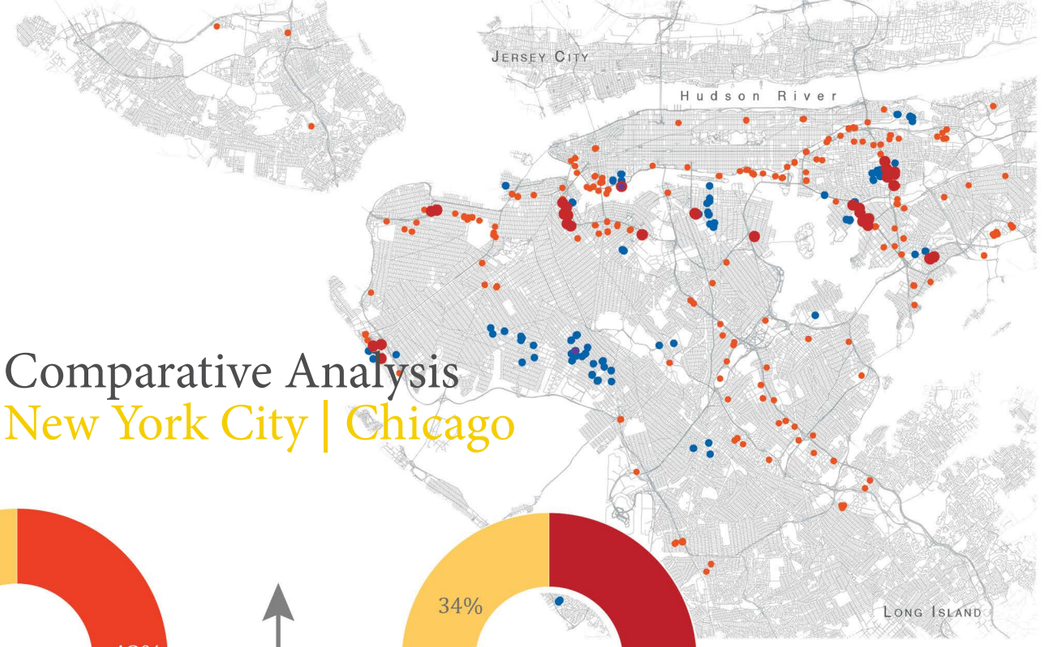


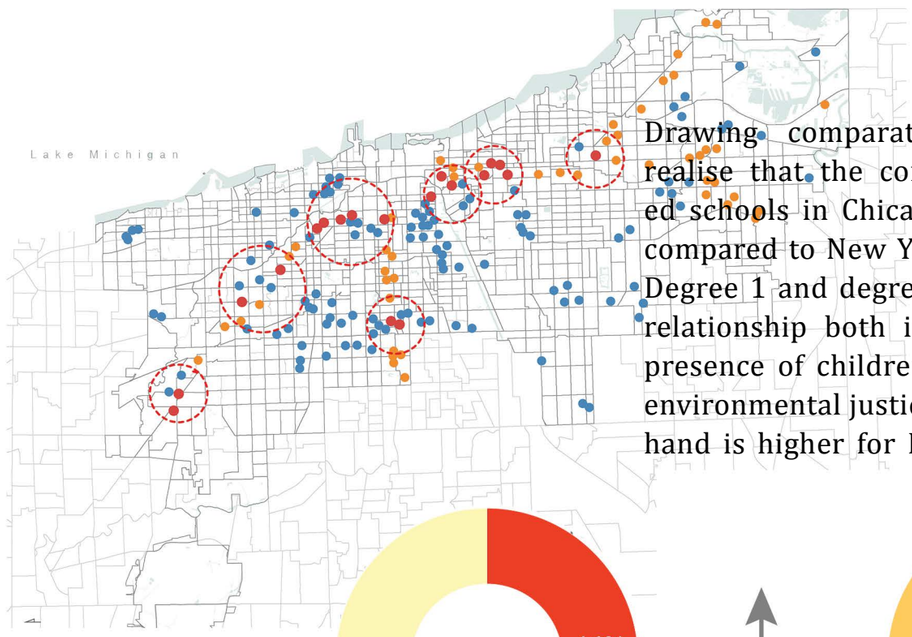
For households with children, 68% households have no member less than 18 years of age and 32% have at least one member below 18 years of age. This cahngs very slightly for the buffered zones.

And, hence, there is no relationship of concentration of households with children around the affected area.

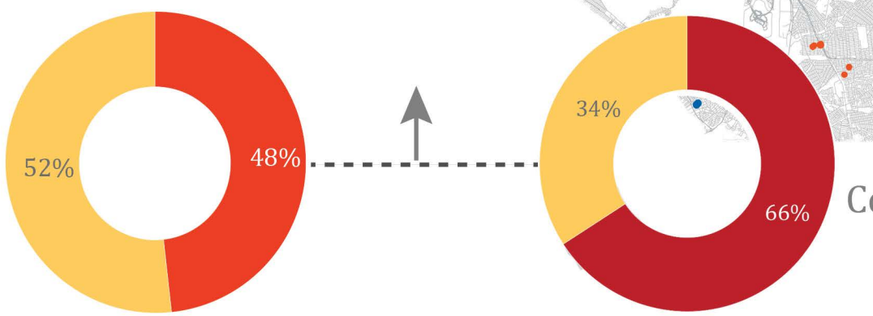
Cummulatively, this city shows less environmental injustice impact with only low-income households concentrated around the areas of concern. This could also be because with many facilities in a small area, instead of special groups being affected, the extent of effect is over-all.

19 Comparative Analysis
New York City | Chicago

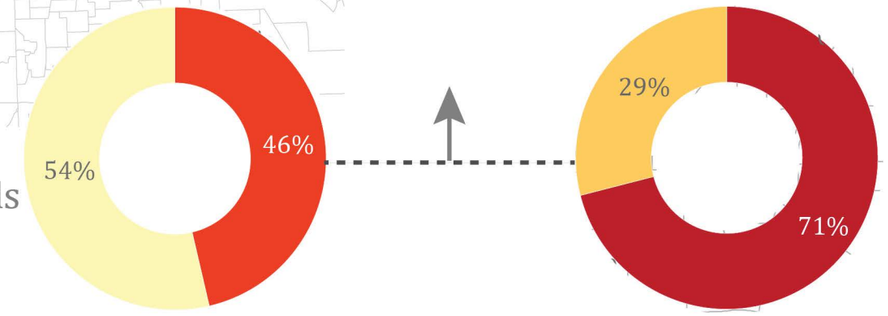


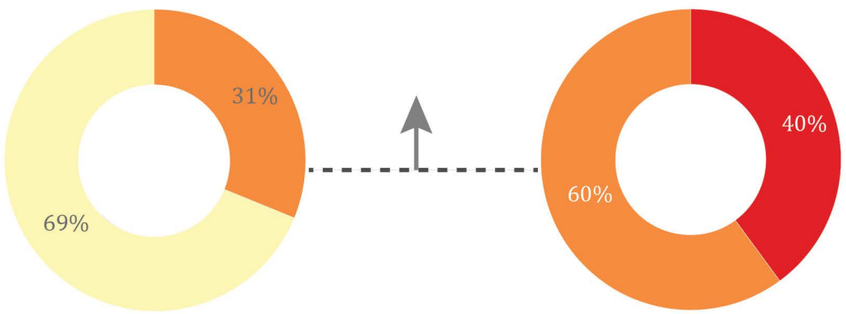


Drawing comparative conclusions we realise that the concentration of affected schools in Chicago is much higher as compared to New York city especially for Degree 1 and degree 2. Since NYC shows relationship both in income status and presence of children for these zones the environmental justice impact on the other hand is higher for NYC than for Chicago.



Concentration of Low Income Households





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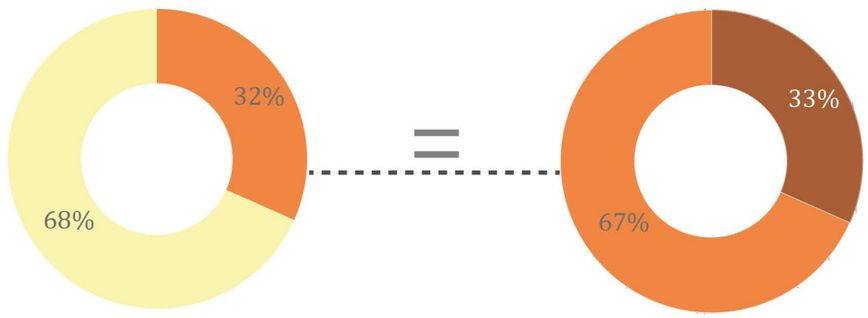
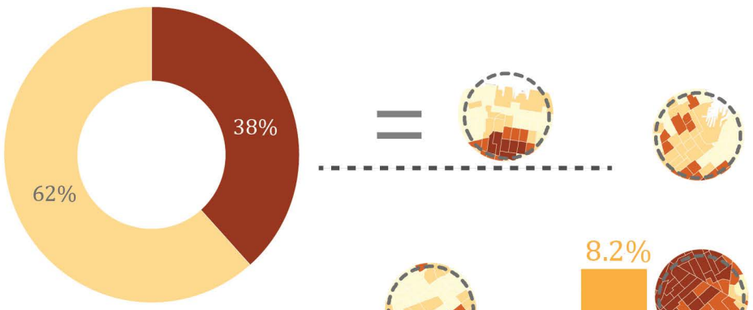
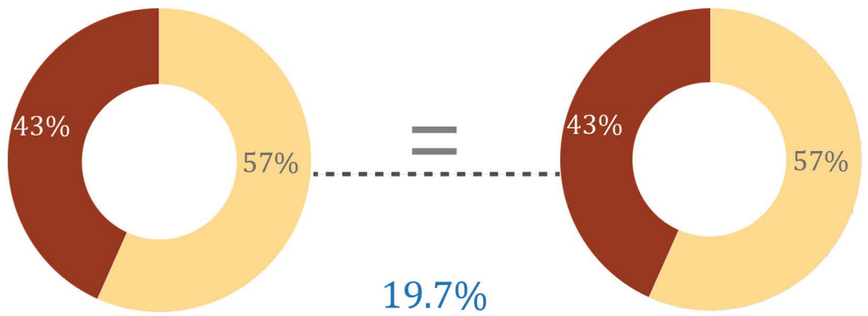
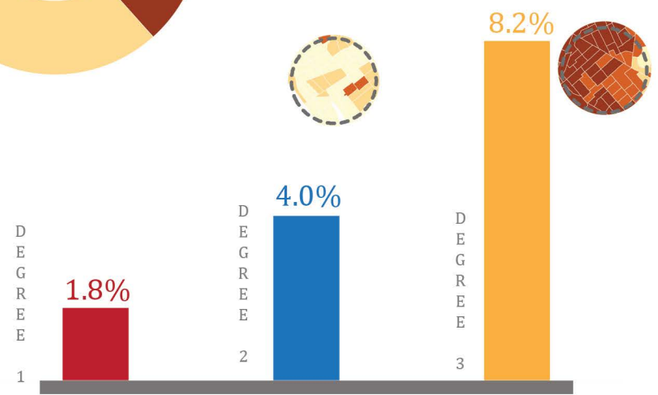
Concentration of Children





Concentration of Racially Minor Population





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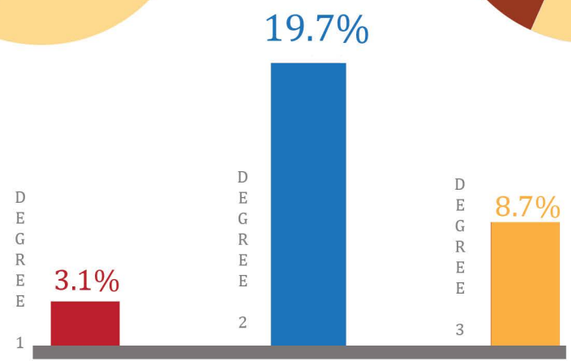
Percentage of Affected Schools



20 The Way Forward
Thankful Schools | Healthy Youth

Since I took this study up with a perspective of using GIS for its methodology and drawing results from mapping only, I think the conclusions are not very significant. If this study were to be done as a full-fledged research study, which I think it has a potential for, it would be interesting to draw the numbers for students attending these schools. Also strengthening this data with the hospital records for the diseases seen commonly for children will be a good support argument leading to more conclusions.

Since there are already organizations in the western part of the country who are doing similar studies, this could be added to that database and should be considered as a criterion while choosing land for public schools as public schools are funded by government organisations or trusts. Also as they cater to the masses of the country, these criterion become all the more critical.

If similar studies are done at a more intensive scale decisions to relocate some schools which are in dire problem, will be a good option and will benefit many lives.