CITIES, DEMOLITION, HEALTH

Demolitions Across Space and Time in New York and Buffalo

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December 2022

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Best document viewing is as 2-page spread

Foreword

This project intends to render demolitions visible and make clear both the size and scale of their health impacts across a city.

The mapping portion of this project was conducted as part of a class project for CRP 5080, Intro to GIS for Planners. Demolition health and safety is also the focus of my research for my federal work-study at the Susan Christopherson Center for Community Planning (SCCCP). None of the time that I spent working on this project prior to submission to Dr. Stephan Schmidt is being logged as paid hours for work, and those deliverables (including the dust deposition demographic) that were made during work hours are cited as work from a separate project to avoid any self-plagiarism. Work post-submission (largely edits) are being logged as paid hours.

All data visualizations are biased. The visualizations and analyses conducted here have been made for CR0WD, a New York State-based network of partner organizations that advocates for a circular building economy—and thus favors deconstruction. While the sources used in this paper as well as statistics produced are done according to mapping and academic standards, they favor information and data that points to the pitfalls of demolition as a method of building removal. Also the locations and datasets chosen were chosen at my discretion as they include geographic areas that I am highly familiar with.

So What's the Matter with Demolitions?

Go around any city, and whether you see a shiny new building or an empty lot, it's easy to forget what was there before. Often completed within a few days or weeks and obscured from view by fencing, demolitions and the waste they produce are ignored by the general public. Demolition, however, has a widespread impact on the environment and human health. This lack of attention has meant that, unlike other activities that can cause exposure to hazardous materials, there is limited regulation mitigating the impacts of demolition—particularly as they relate to health and safety. A building undergoing demolition isn't just a noisy eyesore and, in many cases, it is a significant health hazard despite existing regulations. Demolitions can have long-lasting and large-scale effects on their surrounding communities, notably in the form of air pollution and water pollution. All sources point to a slower, more tactical strategy for building removal as the best way to reduce the negative health impacts of demolition.

Buildings are often taken down at arm's length with heavy machinery and can create large plumes of dust as they come down. Demolition dust can contain decades-old heavy metals and other contaminants that can travel up to 400 feet from a demolition site and settle on surfaces people—especially children—touch daily.[1] Contaminated demolition dust can travel by blowing or tracking into homes and onto high-touch surfaces. And because children are more likely to put their hands and foreign objects into their mouths and generally much closer to the ground, they are at far higher risk of ingestion.

While most of the research conducted around the health and safety concerns around demolitions has been on lead deposition, numerous heavy metals and other contaminants should be considered among those which can also travel this distance, including arsenic and asbestos. While there are laws on pre-demolition asbestos abatement, they do not apply to emergency demolitions, which is often the case when demolishing abandoned or unsafe housing. Prolonged exposure to these contaminants (especially lead) causes many health problems in children, particularly cognitive and developmental.[2] The Centers for Disease Control estimates that 500,000 children under age six have blood lead levels above the maximum threshold in the United States.[3] Research on demolitions shows that while exposure to the dust from one demolition has an insignificant effect on

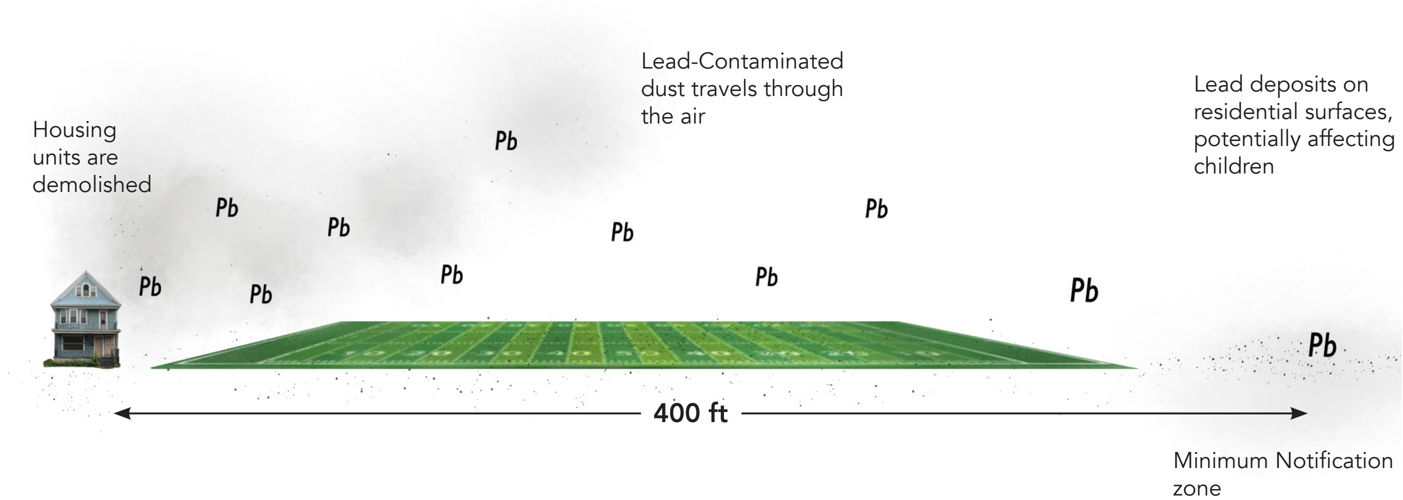


Image source: Emile Bensedrine, Christopherson Center for Community Planning, 2022 childhood blood-lead levels. Repeated exposure to contaminated dust from multiple demolitions within one year raises blood-lead levels above the maximum threshold.[4] While most lead poisoning is due to unhealthy housing conditions, it is also crucial to reduce lead exposure resulting from demolition to lessen community hazards.

Case studies focus mostly on the effects of contaminated demolition dust over localized areas, and there lack visualizations of the size and scale of the problem across urban areas. At the same time, extrapolating the results from localized studies upon different contexts will lead to results that are inaccurate to real-life conditions (limitations). Mapping offers a glimpse at the potential scale and impact of demolition.

This paper examines the demolition histories of two cities in New York State: Buffalo and New York over the past decade. The two cities both saw a long period of post-industrial decline. However, with its larger size and more diversified economy, New York has managed to bounce back from its late 20th-century slump. On the other hand, Buffalo has taken much longer to recover and has yet to rebound from an economic downturn and significant population loss. The two cities also have vastly different demographics and histories and are thus rife for analyzing why demolitions happen and their impact on residents.

For both cities, this study aims to gauge how spatially clustered demolitions are and to see if this clustering can be associated with different factors. Moreover, it aims to see how temporally clustered demolitions are across different geographic areas—and does so by creating animations showing demolitions over time in both cities.

While numerous intersecting factors influence why a building gets demolished, this paper aims to gauge the potential health impacts of demolition on surrounding communities—which research shows is directly related to the clustering of demolitions across space and time. This also study entertains potentially correlated datasets with demolitions to see whether they may be a potential cause of demolitions, such as minority populations. Lastly, I would like to explore demolitions as a cause of environmental injustice by examining their correlation with minority communities specifically living in Potential Environmental Justice Areas (PEJAs) designated by the State of New York. The State of New York defines PEJAs as areas with a high percentage of non-white or a high percentage of low-income households using data from the 2020 census.[5]

While this methodology has limitations, it provides a more concrete and systematic visualization than what current research illustrates. The results of this mapping project explore the potential scale of impact that demolitions can have. The specifics of mapping methodologies are addressed in later sections.

Limitations

There is no data available that can accurately show a building's construction year when it is demolished, thus buildings that may not contain lead are included in this analysis. Buffalo and New York, however, have some of the oldest building stock in the nation. One can assume that many buildings being demolished contain lead—additionally, the studies upon which this project is based focus on single-family homes or small row houses. Limited research exists on the neighborhood effects of large building demolition. Demolitions of larger buildings, being more high-profile, may be subject to more rigorous enforcement and dust-mitigation techniques or alternately produce more dust relative to their size. An additional limitation of this research is the assumption of a 400-ft buffer zone of contamination around each demolition. This zone must be interpreted as an area of potential contamination, not an area that for certain has higher ambient lead levels. For practical reasons, however, the 400-foot precautionary zone should be implemented across the board.

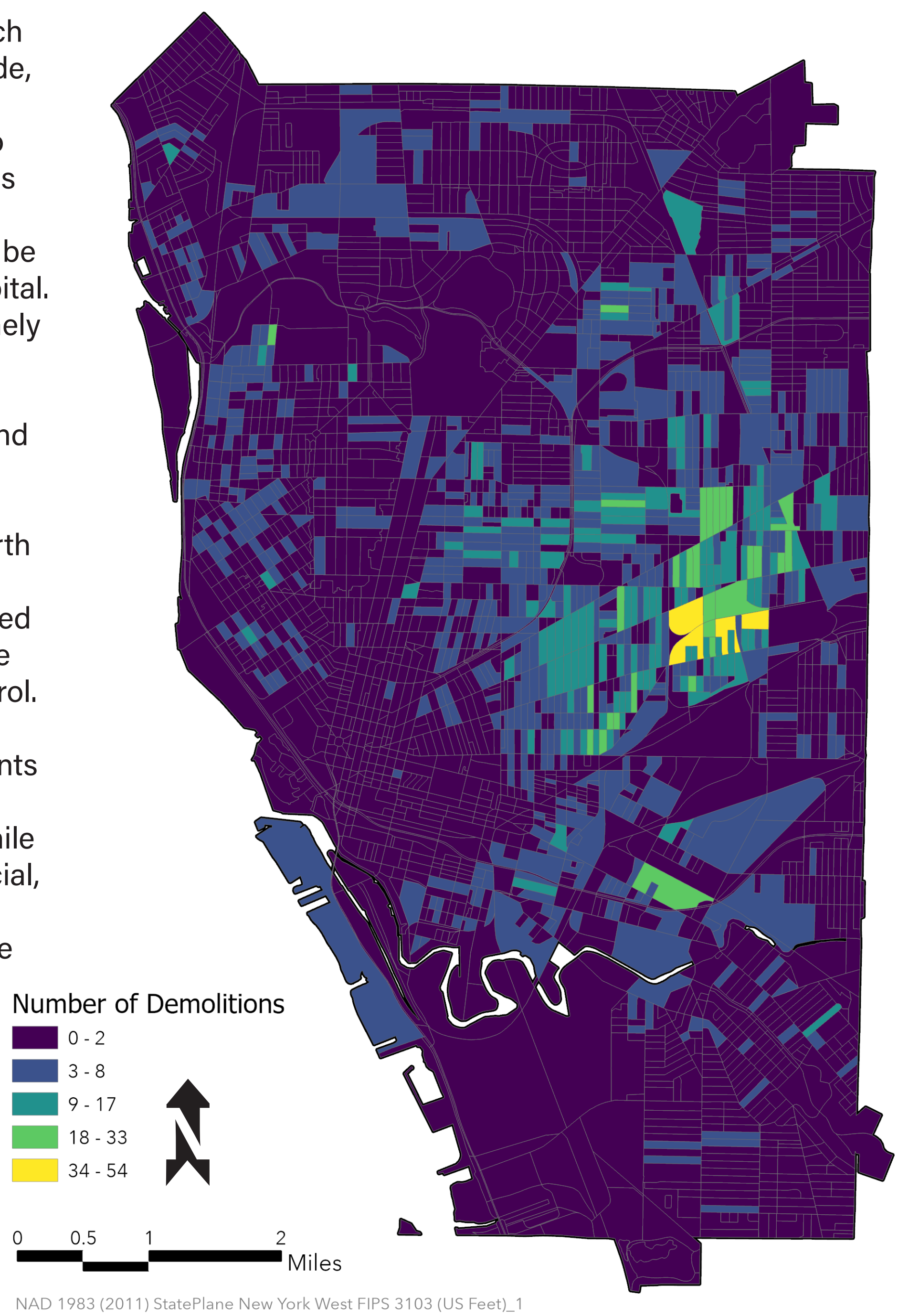
Map 1: Demolitions per Census Block in Buffalo

The map to the right was created by doing a spatial join of census blocks with demolitions, georeferenced according to their latitude and longitude in the city of Buffalo from the years 2007 to 2022. Census blocks are then symbolized according to the number of demolitions within each census block.

Unsurprisingly, demolitions are much more prevalent on Buffalo's East Side, which, throughout its history was deliberately disinvested from due to racist policies such as redlining. This caused property owners to failed to maintain their buildings, which can be attributed to a lack of access to capital. Abandoned properties were extremely common, and became hotbeds for criminal activity. Moreover, arsons were common and put the public and firefighters at risk.

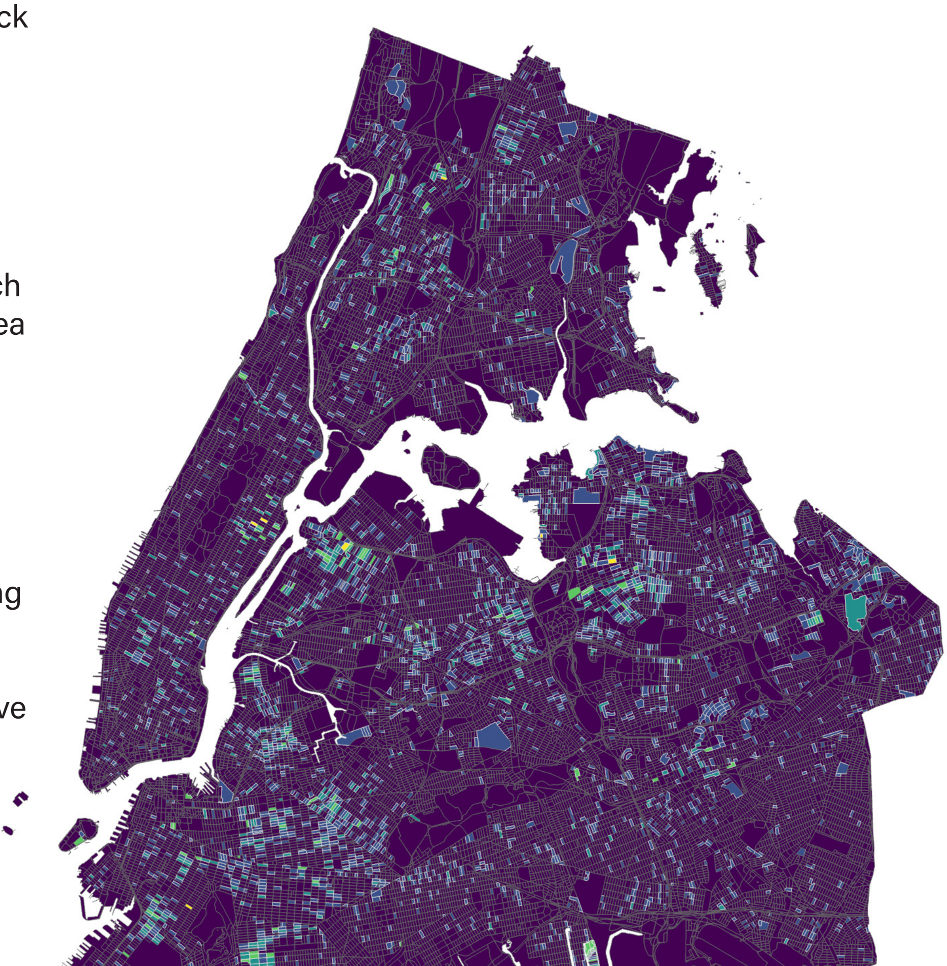
In 2006, mayor Byron Brown put forth the "5 in 5" Demolition Plan in 2007 which set out to demolish abandoned properties at an unprecedented rate and bring them into municipal control. Emergency demolitions became widespread and salvage requirements were scarce. Sarah Lyons from the University at Buffalo argues that while removal of unsafe structures is crucial, it does solve the problem of blight or crime. It is also crucial to evaluate the potential health impacts these demolitions have had over time.[6]

To evaluate public health impacts on the city, it is crucial to normalize based on the area of different census blocks to understand the density of demolitions across different census blocks and also to account for the varying sizes of different blocks.



Map 2: Demolitions Per Census Block in New York

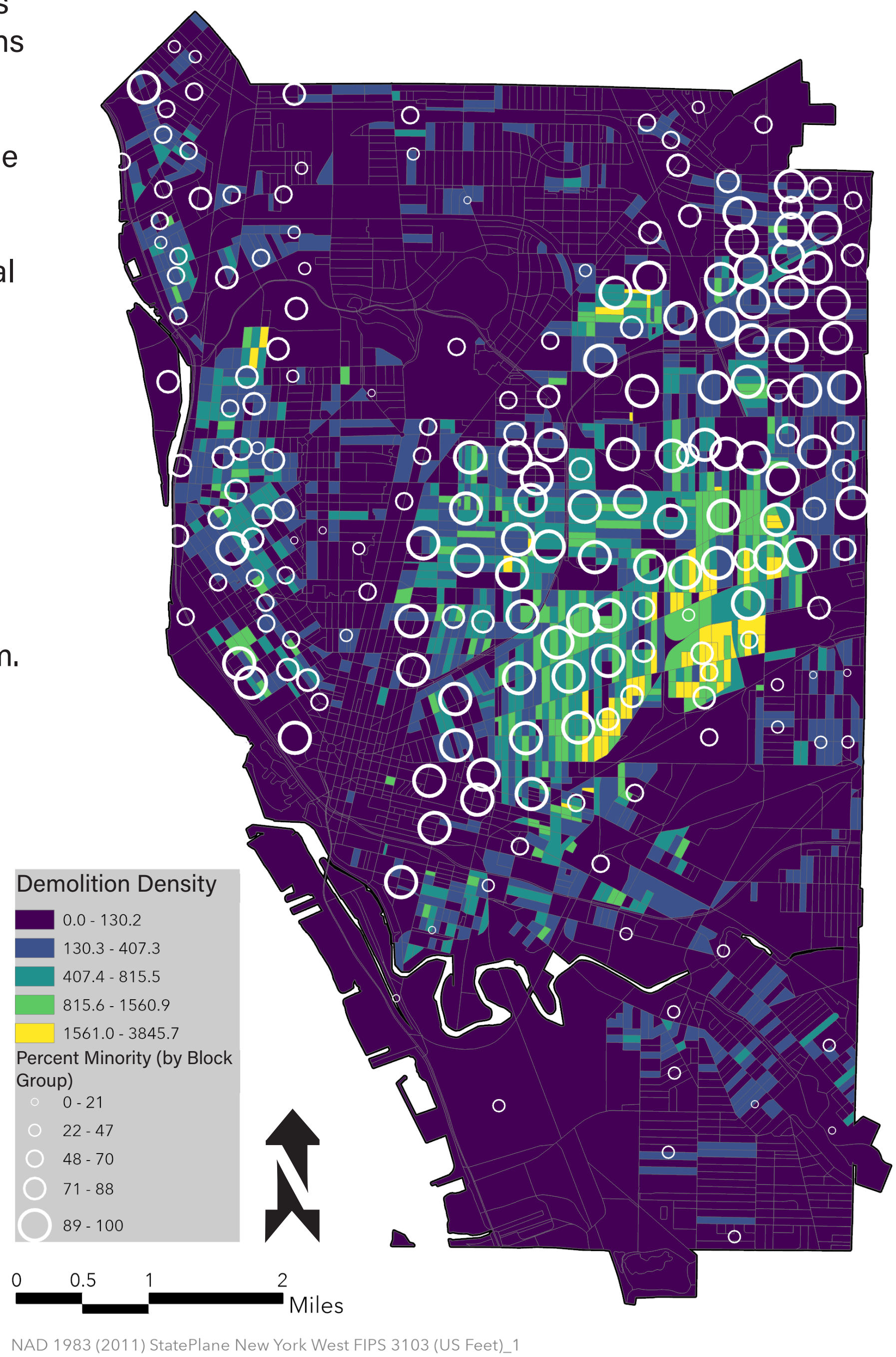
Using the same methods as Map 1, the number of demolitions per census block was calculated for the City of New York. The data shows a much broader distribution of census blocks with a high number of demolitions, making it much harder to draw conclusions. Because census blocks are such a granular measure for New York, a much larger and more densely populated area than Buffalo, it is more difficult to see trends in the data at this scale. Map 2 also includes an inset (see lower-center), that shows an area of Staten Island where multiple demolitions have taken place. These areas include Oakwood Beach among other low-lying areas that were affected by Hurricane Sandy. These areas were subject to buyouts from the government, and have since been completely depopulated. Again, the size of census blocks in New York City varies greatly, and thus normalization based on tract size is crucial.



Map 3: Demolition Density and Minorities per PEJA block Group in Buffalo

As we can see in this map, the density of demolitions per census block, measured in demolitions per square mile, is distributed roughly the same way as the raw number of demolitions per census block with a few exceptions in the case of very large blocks.

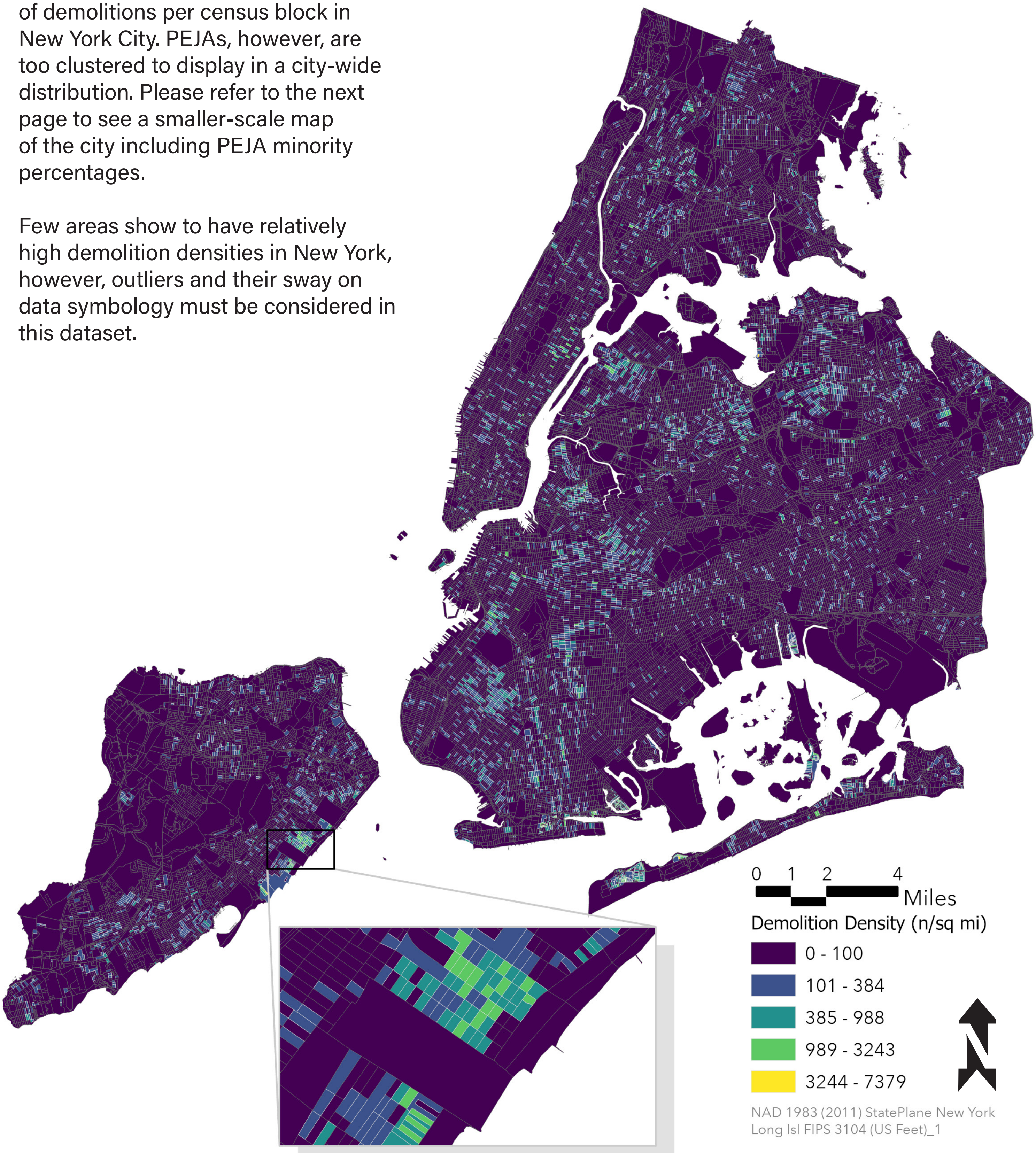
Overlaid on this map is the percentage of the population that is of a racial minority in census block groups designated as Potential Environmental Justice Areas (PEJAs). As we can see, there seems to be an association between PEJA-designated areas with a high percentage of minorities and areas with high demolition densities. It seems that census blocks with a high demolition density are almost exclusively in areas with a high percentage of minorities. Raising questions about environmental racism.



Map 4: Demolition Density in New York

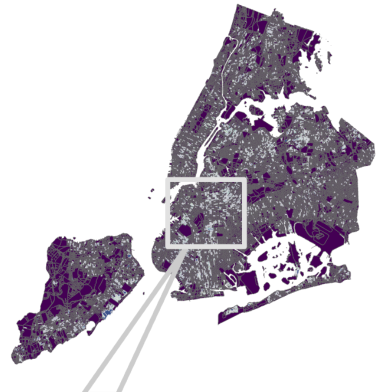
This map, like map 3, shows the density of demolitions per census block in New York City. PEJAs, however, are too clustered to display in a city-wide distribution. Please refer to the next page to see a smaller-scale map of the city including PEJA minority percentages.

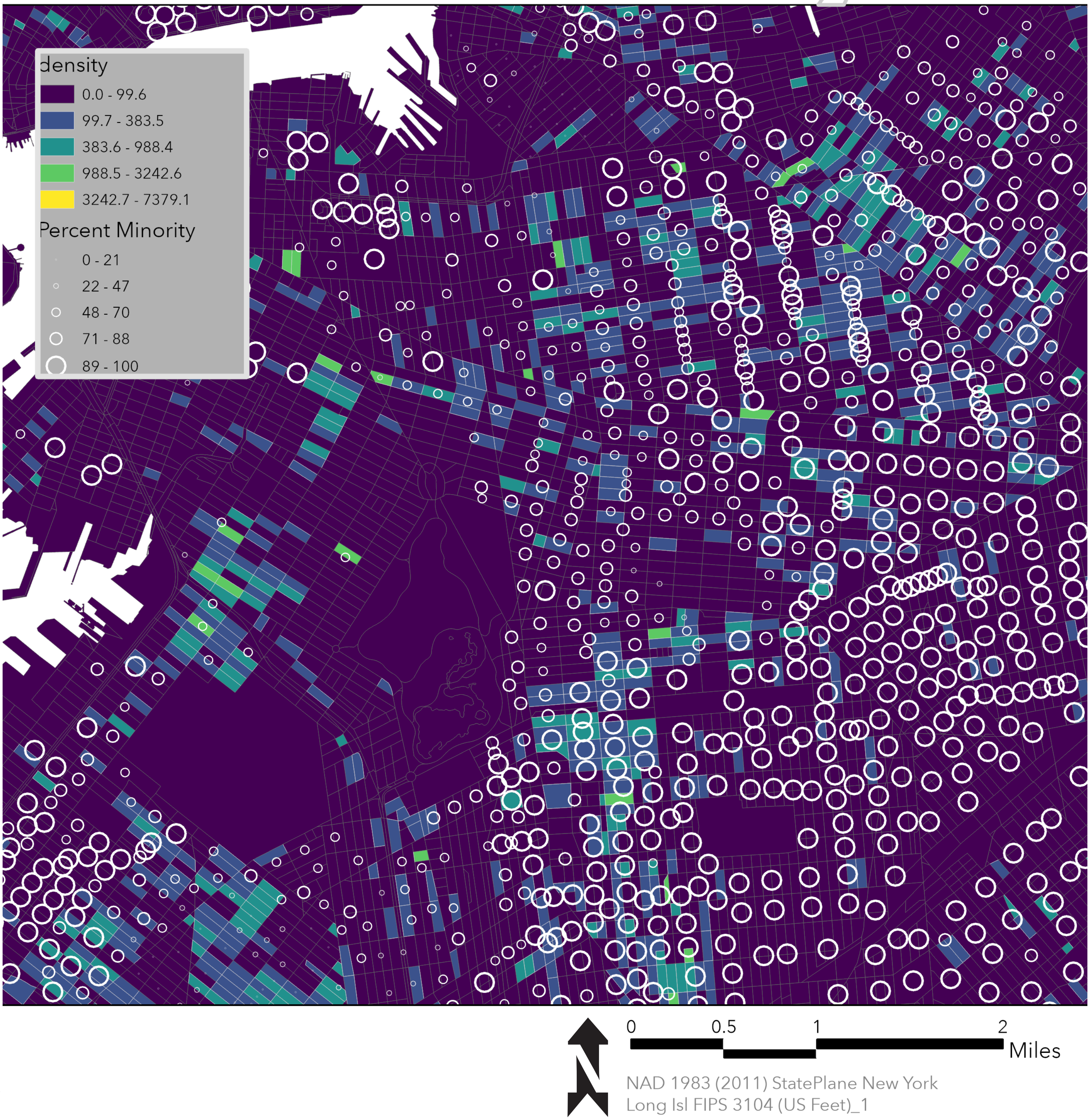
Few areas show to have relatively high demolition densities in New York, however, outliers and their sway on data symbology must be considered in this dataset.



Map 5: Demolition Density and Minorities Per PEJA Block Group in New York

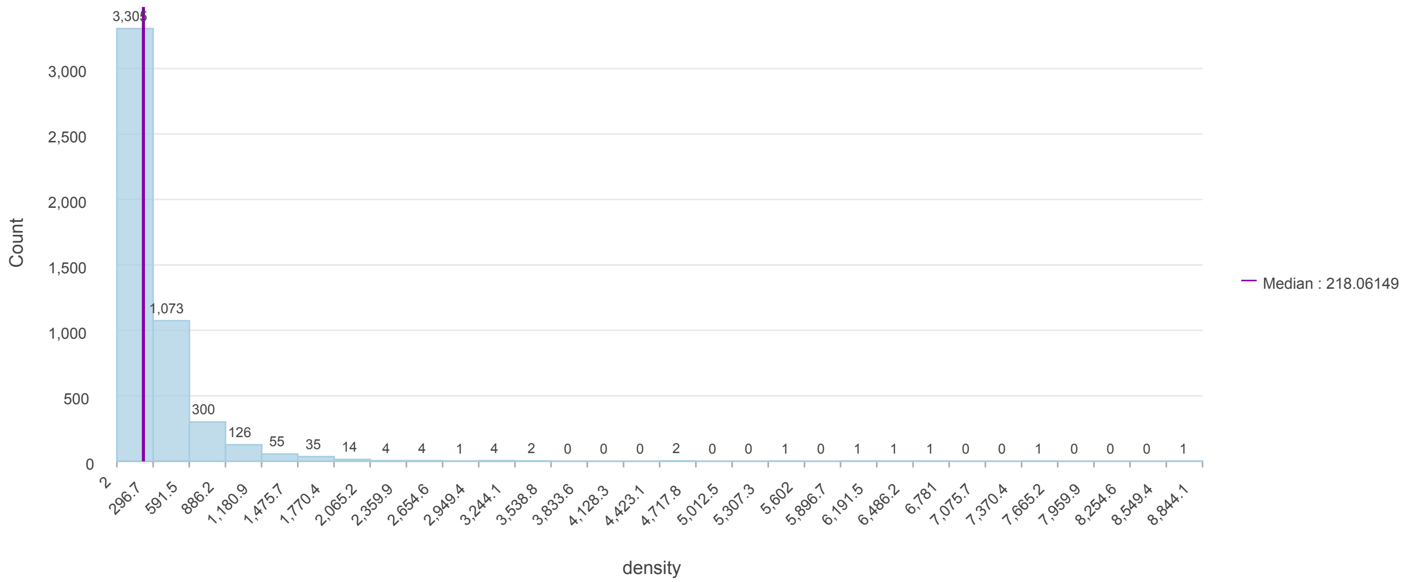
Here we zoom into an area of North Brooklyn and Lower Manhattan that exhibits a wide range of demolition densities and PEJA minority populations. Unlike the City of Buffalo, there is little apparent correlation between PEJA areas with high minority populations and census blocks with high demolition densities. This indicates that the factors that lead to their correlation in Buffalo have likely not been as heavily at play in New York from 2010 - 2020.



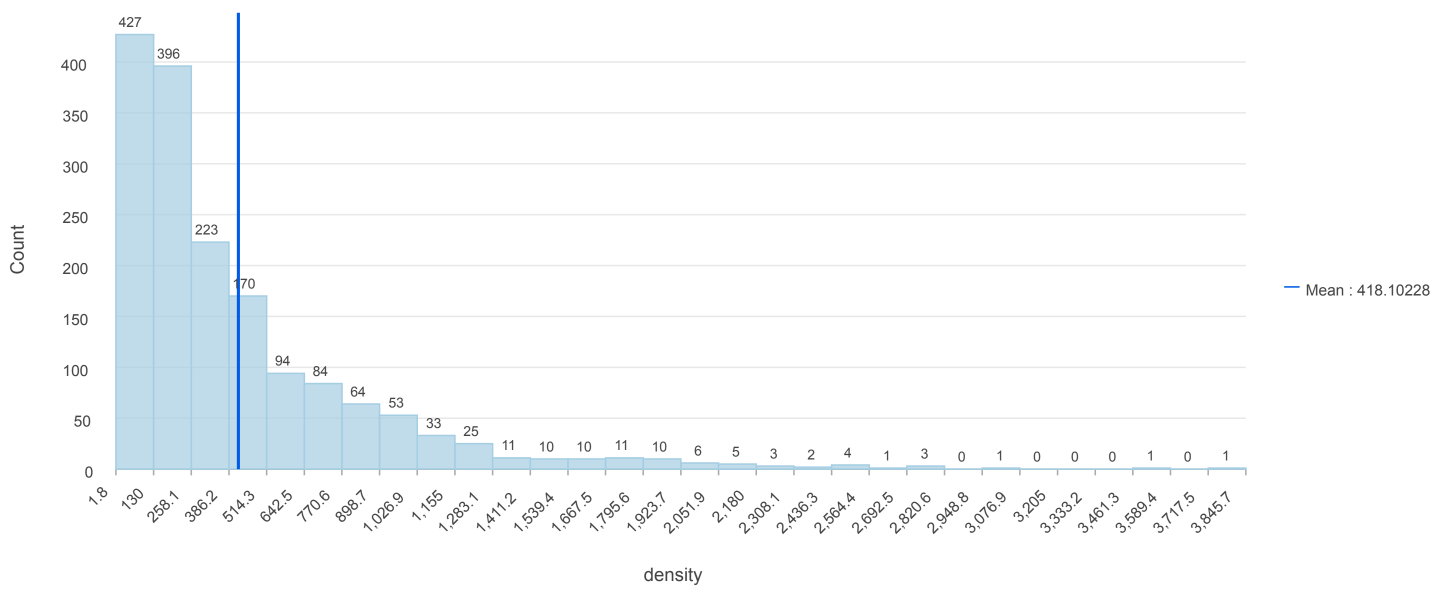


Distribution of Demolition Density in New York and Buffalo, compared

Looking at the statistical breakdowns of census blocks where demolitions have occurred in each city (filtering out for census blocks where no demolitions have occurred) we can draw several conclusions about the distribution of demolitions in both cities.



The above shows demolitions for New York. The data is highly skewed right, with a handful of outliers with a very high demolition density. The data is highly peaked on the lower end of densities, with a kurtosis of 124.0, confirming the peaked nature of this data. The median demolition density in New York is 218 demolitions per square mile.

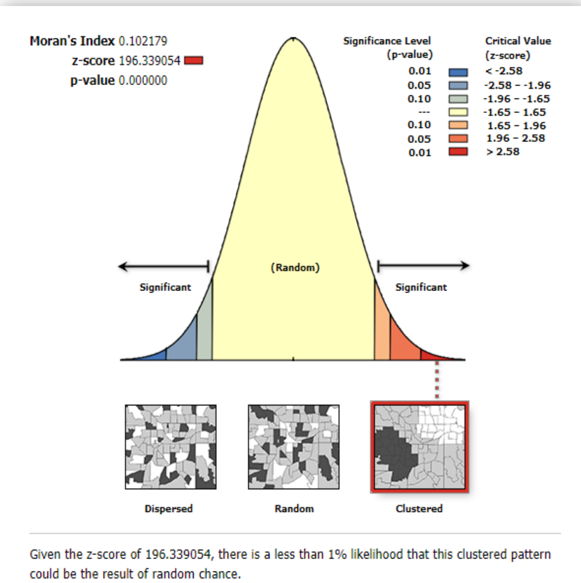


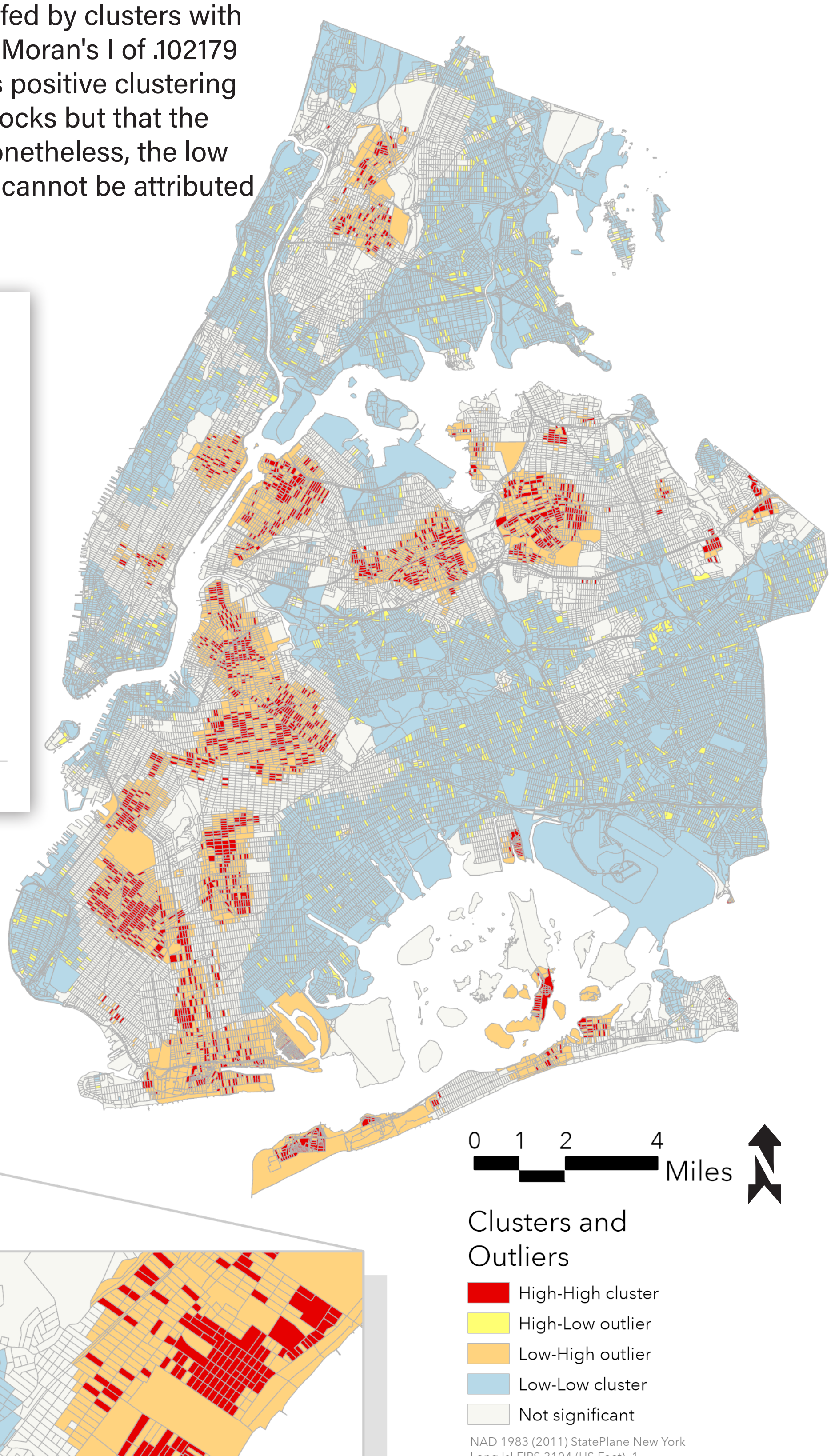
On the other hand, Buffalo has a much smaller demolition density range. The data—while still skewed right— is more evenly distributed across the data range than New York City's. Moreover, the data is far less peaked, with a kurtosis of only 11.5. In Buffalo, the median number of demolitions per square mile in census blocks where demolitions have occurred is 259.0, nearly twice that of New York City.

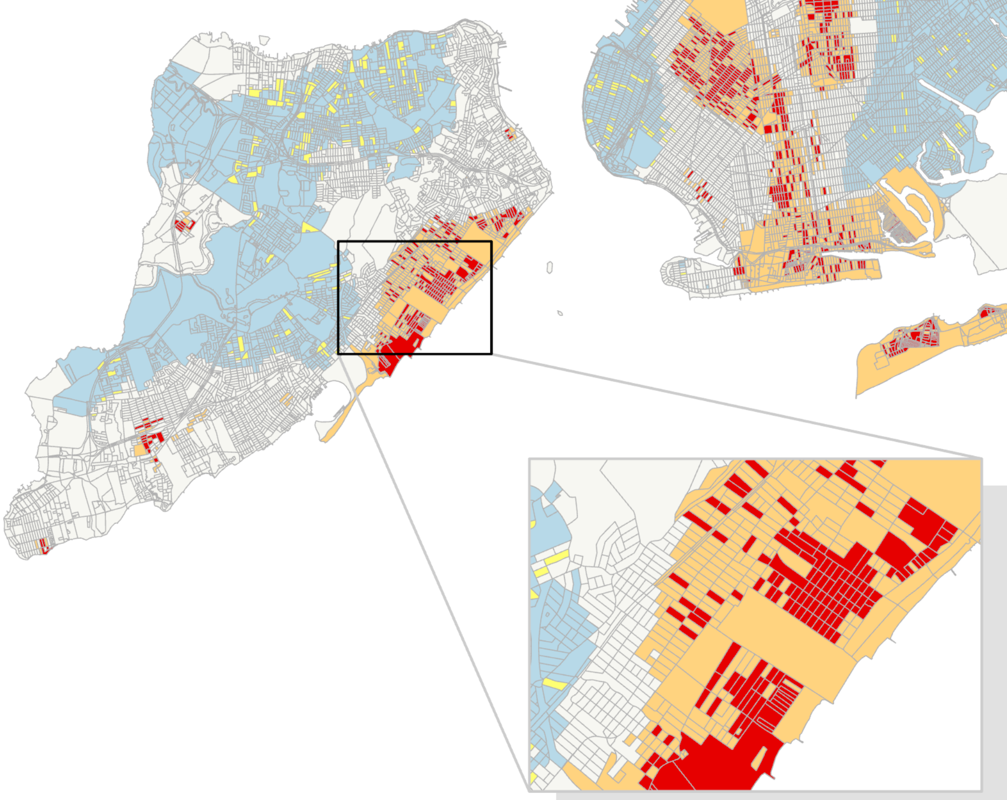
Overall, by cross-comparing this data, we can see that the density of demolitions in Buffalo is higher than in Yew York. However, there are outlier census blocks where the demolition density is far higher in New York than in Buffalo.

Map 6: Demolition Clustering in New York

In New York City, there are over a dozen discernible clusters of census blocks with high demolition densities spanning the entire neighborhoods. These clusters of high-density census blocks are dwarfed by clusters with low demolition densities. The Global Moran's I of .102179 and a p-value of 0 tell us that there is positive clustering of high-demolition-density census blocks but that the data is only moderately clustered. Nonetheless, the low p-value indicates that this clustering cannot be attributed to random chance.



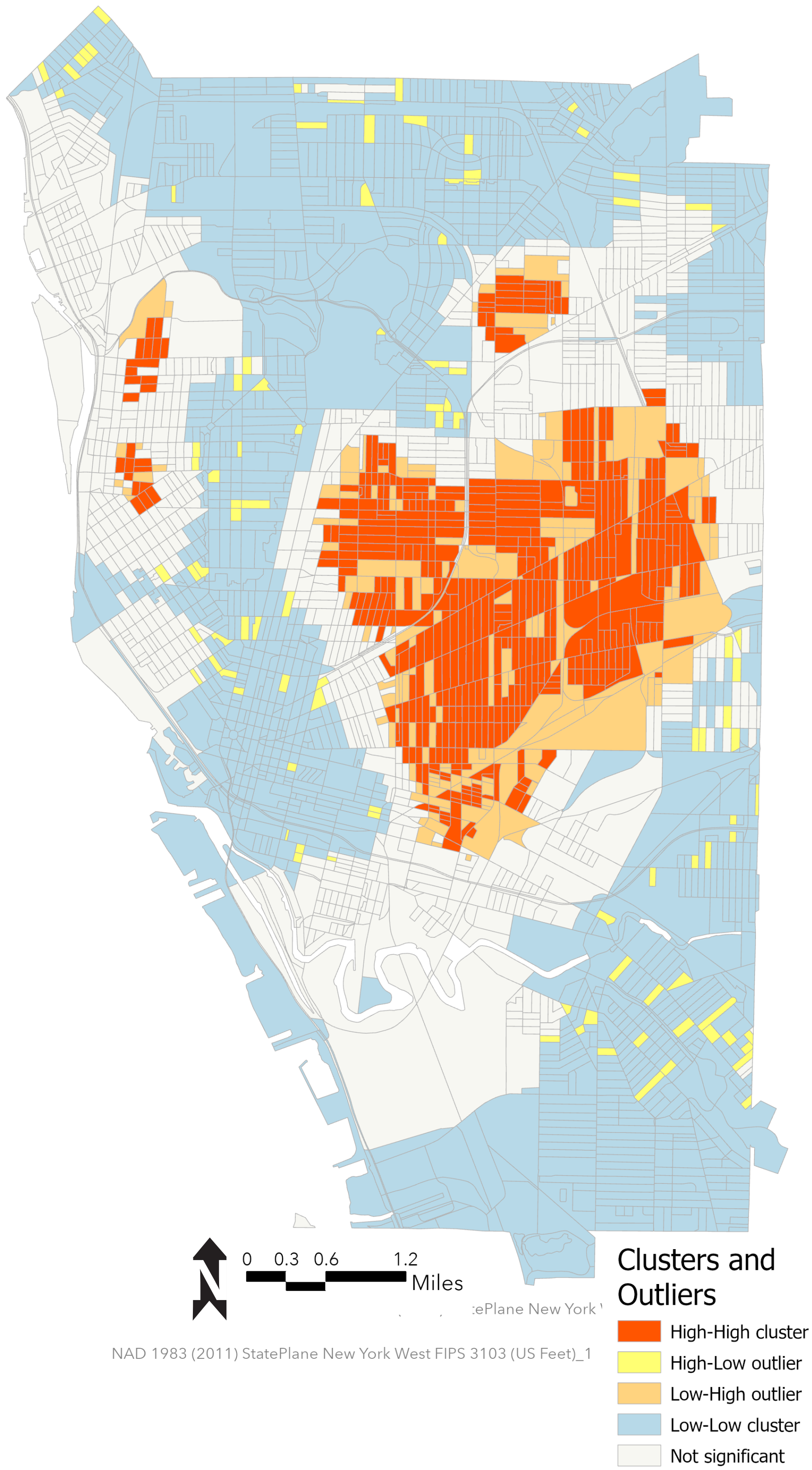


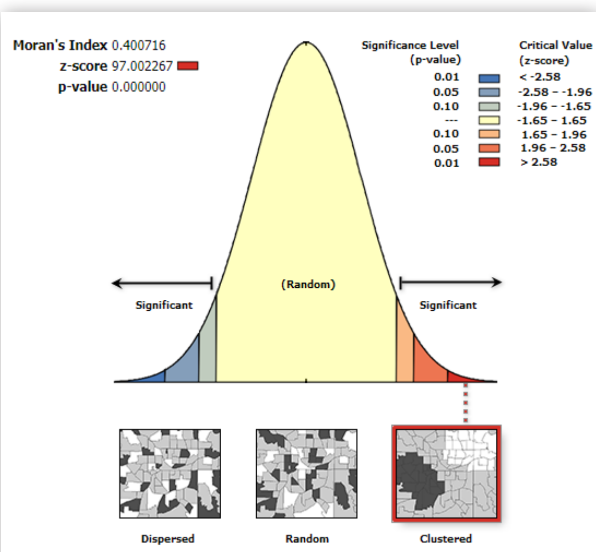


Map 7: Demolition Clustering in Buffalo

Buffalo, on the other hand, expectedly, has one large cluster in East Buffalo and some small clusters in other areas. Consequently, tracts with high-demolition-densities are highly clustered with a Moran's I value of .400716 and a p-value of 0. The low p-value indicates that this clustering cannot be attributed to random chance.

The drastically higher clustering of high-density census tracts in Buffalo vs. New York City may be due to their sample size differences. More research would need to be done comparing similarly-sized areas of New York city to Buffalo.





Given the z-score of 97.002267, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Maps 8 and 9: Demolitions Across Time

Children are most likely to be harmed by contaminated demolition dust when they are exposed more than one time within one year of each subsequent exposure.[7] The data on demolition permits in both cities was stamped with a time, meaning that they could not only be visualized across physical space but also across time.

To do this, I enabled the time viewer in ArcGIS, then mapped all the demolitions in each city based on their completion date. This time data was converted to keyframes in ArcGIS's animation function to produce mp4 files showing the temporally referenced data. These were then uploaded onto youtube for the world's viewing pleasure (or horror). The animations to the right (scan the QR code or type the link into your browser) show demolitions in New York and Buffalo, respectively over time. Each frame is a new 12-month timespan, toggling forward month-by-month, thus giving an idea of the areas that have been exposed to dust from more than one demolition over 12 months.

Scan or copy link to watch a video showing demolitions in New York City

https://youtu.be/oU4cCDIHhx4

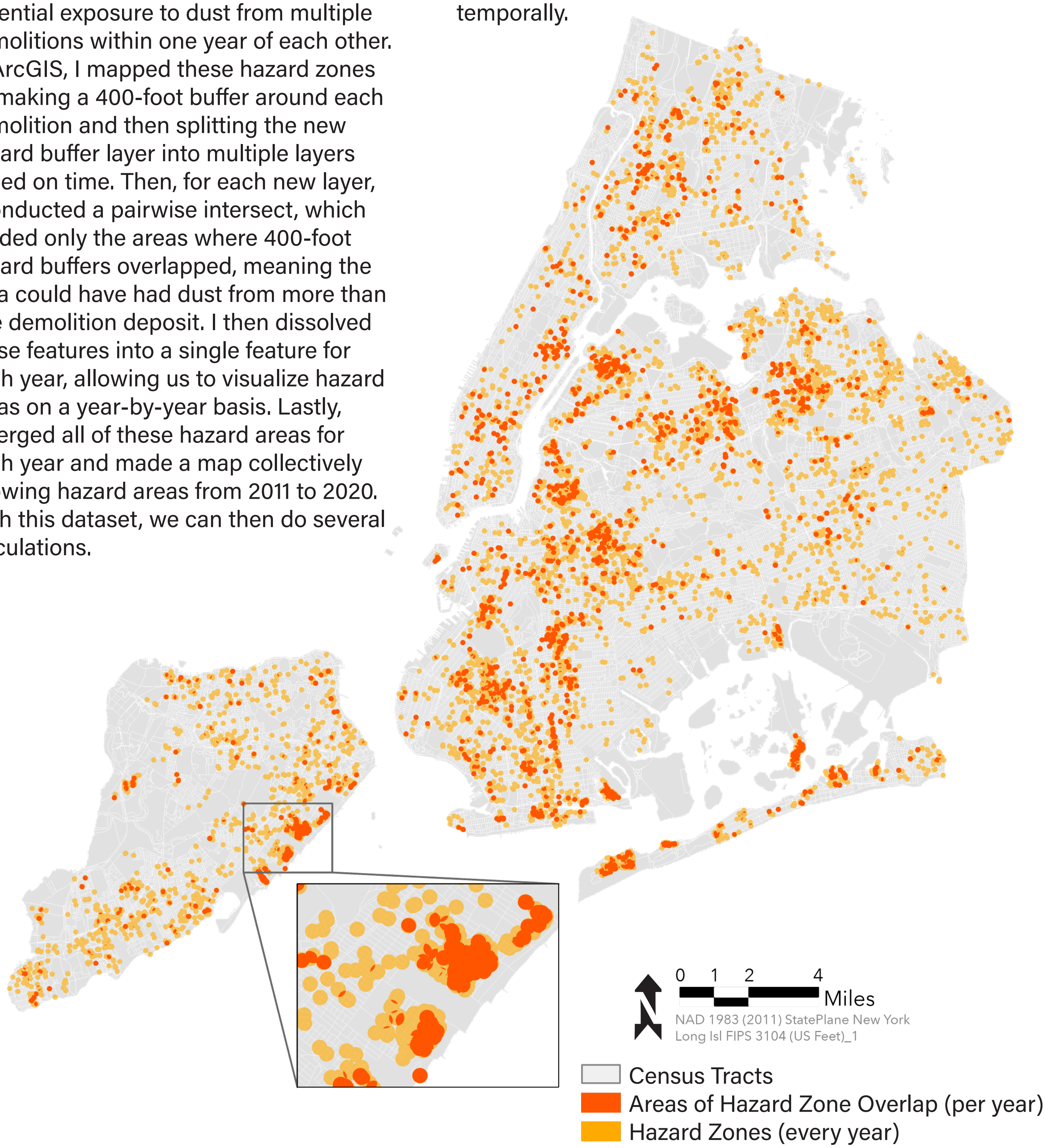
Scan or copy link to watch a video showing demolitions in Buffalo

https://youtu.be/928VTDYU9RA

Map 10: Where are people exposed to the most hazard?

In addition to research on the effects of repeated exposure on childhood blood-lead levels, researchers suggest a 400-foot hazard zone around any demolition site. I thus wanted to see what the areas of the city were that experienced potential exposure to dust from multiple demolitions within one year of each other. In ArcGIS, I mapped these hazard zones by making a 400-foot buffer around each demolition and then splitting the new hazard buffer layer into multiple layers based on time. Then, for each new layer, I conducted a pairwise intersect, which yielded only the areas where 400-foot hazard buffers overlapped, meaning the area could have had dust from more than one demolition deposit. I then dissolved these features into a single feature for each year, allowing us to visualize hazard areas on a year-by-year basis. Lastly, I merged all of these hazard areas for each year and made a map collectively showing hazard areas from 2011 to 2020. With this dataset, we can then do several calculations.

This map overlays areas of greatest hazard, in red (areas potentially exposed to demolition dust in one-year intervals), with areas that were potentially exposed to the dust from a single demolition over a given 1-year period. This map helps visualize where demolitions have been clustered both spatially and temporally.



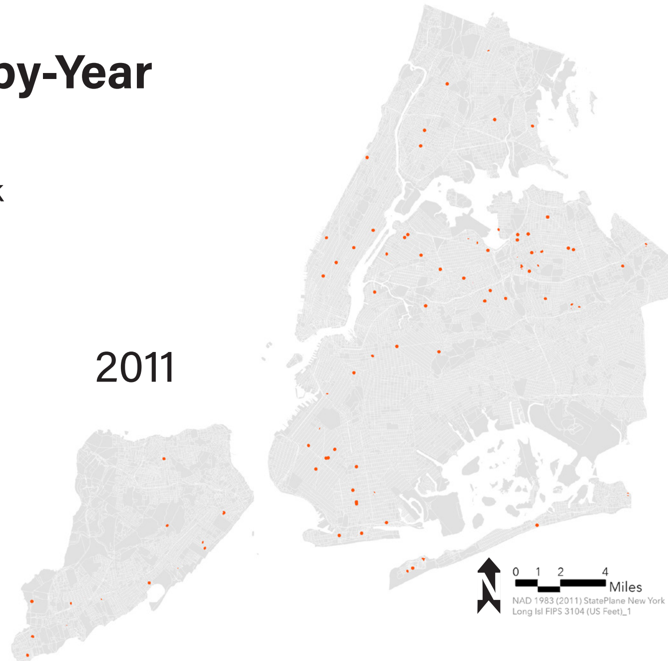
Maps 11-21: Greatest Hazard Year-by-Year

The following maps show the areas of greatest hazard on a year-by-year basis. Note the increase in Bushwick and Flatbush in the mid-2010s as these areas have, anecdotally, become increasingly gentrified. More research should be conducted on the role demographic shifts and economic development play on demolitions.

Also note the increased demolitions in coastal parts of Brooklyn, Queens, and Staten Island following Hurricane Sandy (2011).

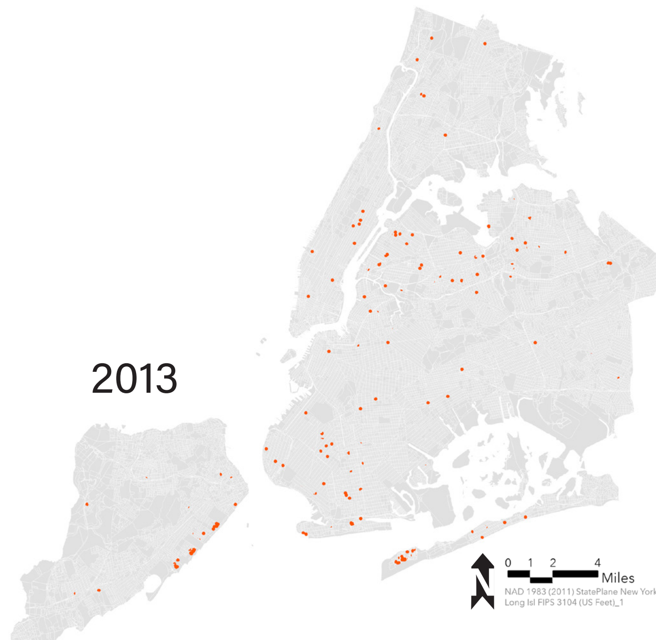
Census Tracts
Hazard Zone Overlap

2011

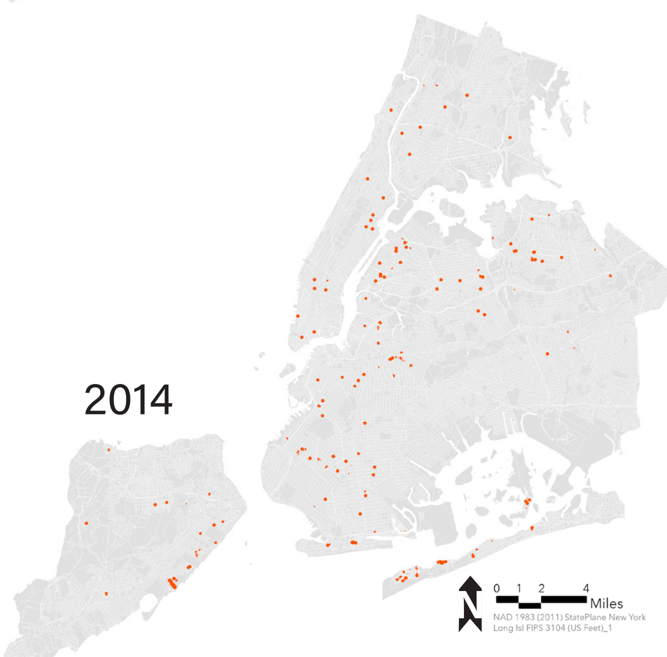


2012

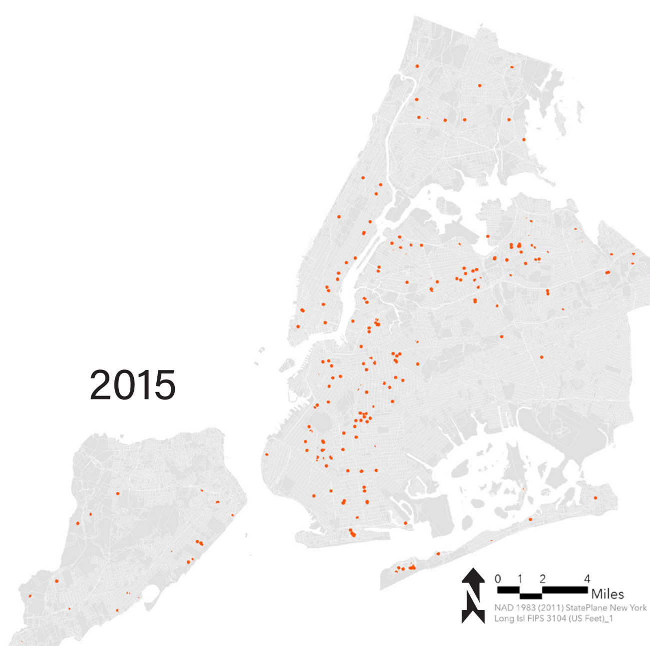
2013

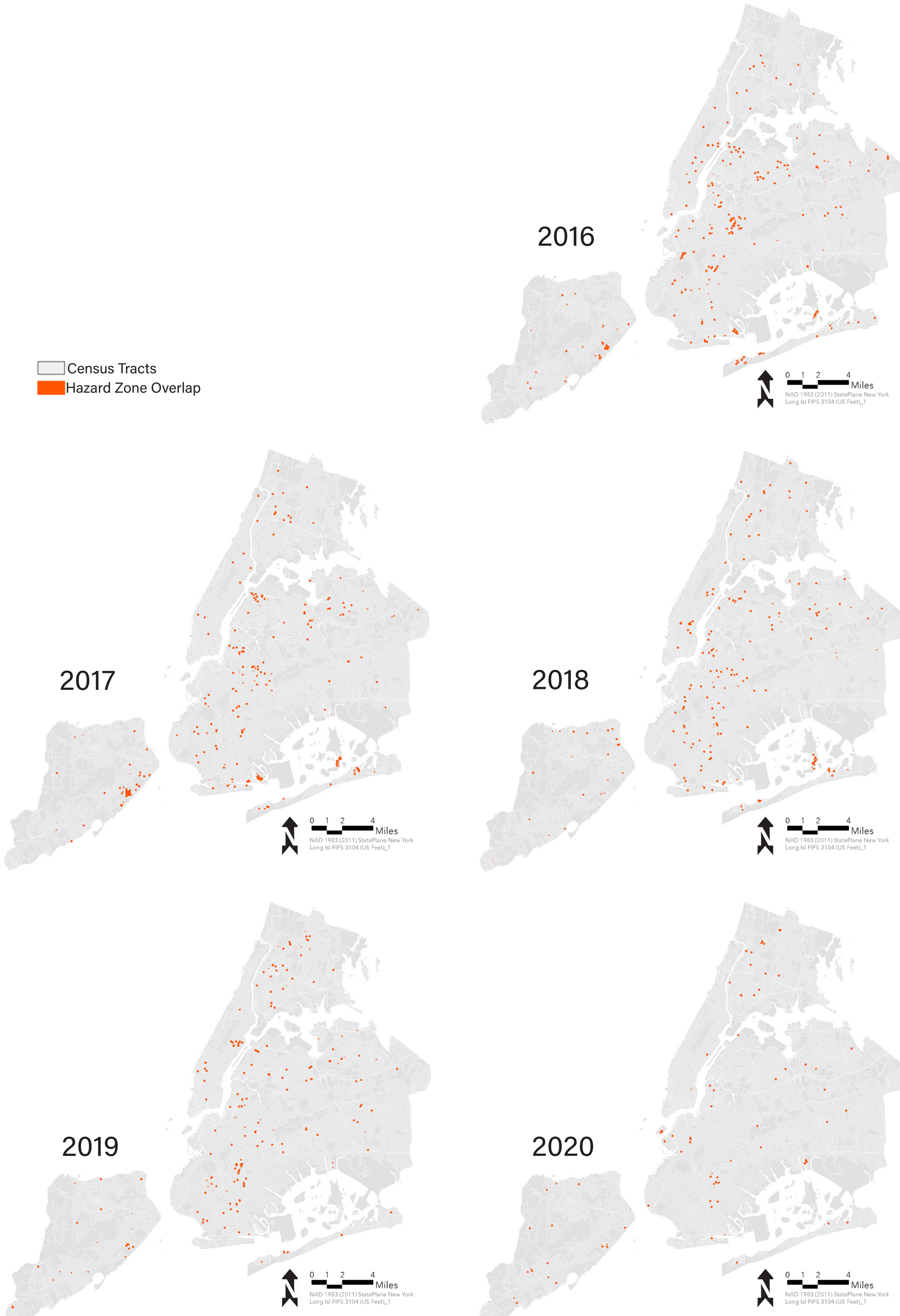


2014



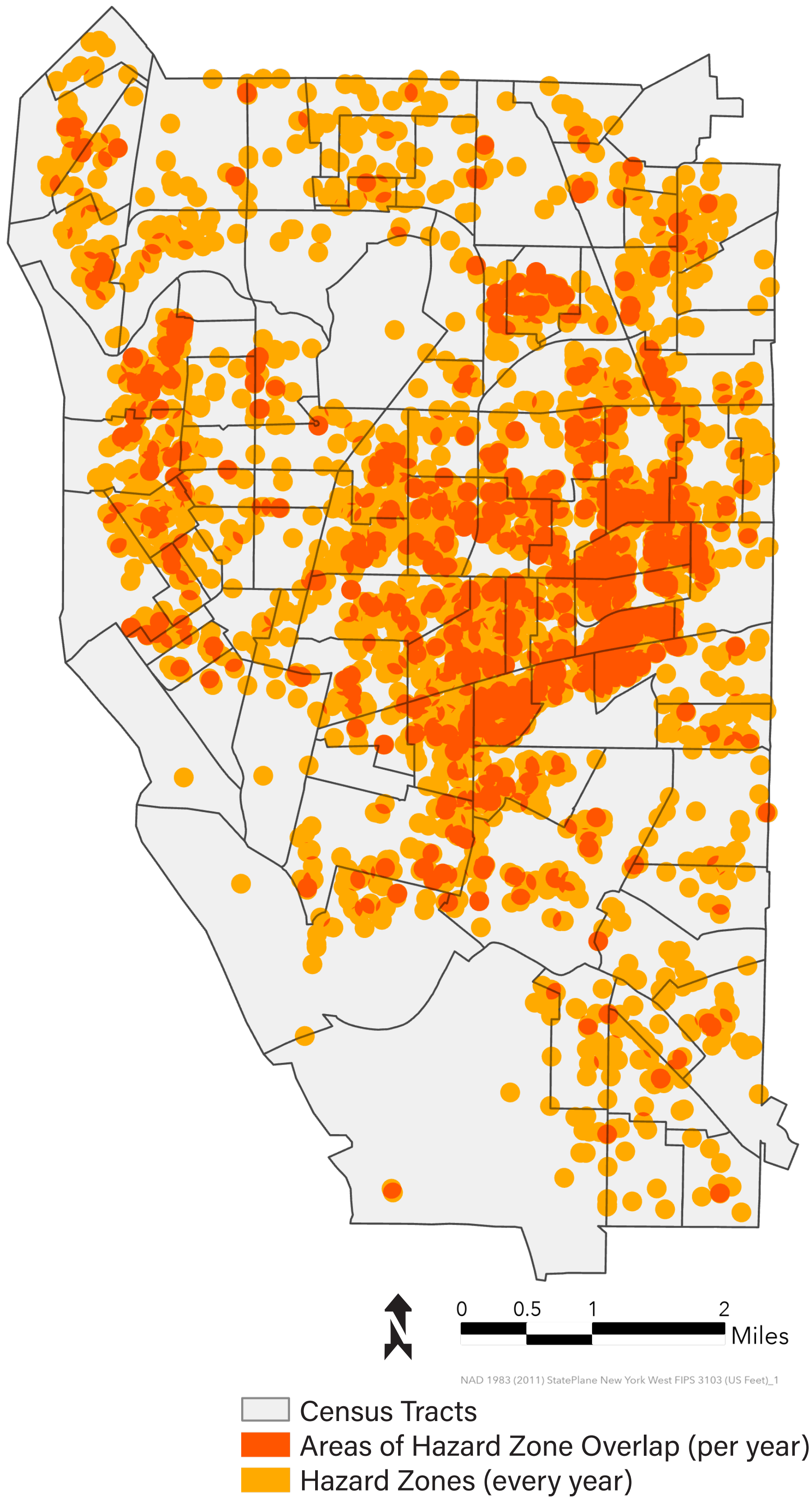
2015




Census Tracts
Hazard Zone Overlap
2016
2017
2018
2019
2020
0 1 2 4
Miles
NAD 1983 (2011) StatePlane New York Long Isl FIPS 3104 (US Feet)_1

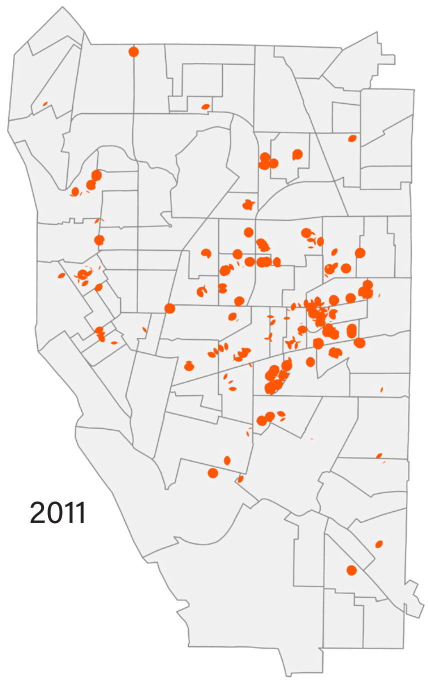
Map 22: Where are people exposed to the greatest hazard?

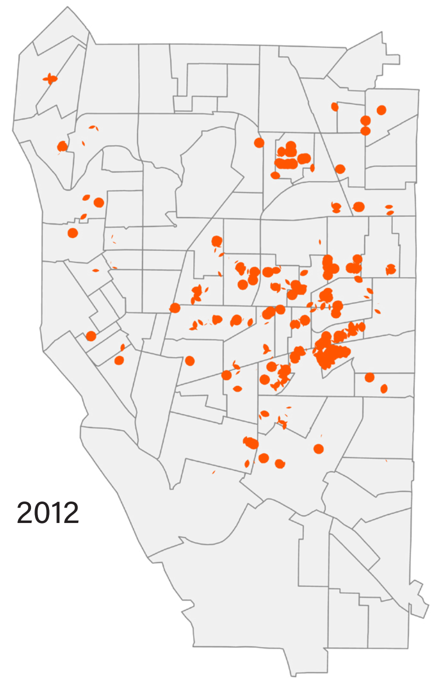
The map to the right shows hazard buffers for the City of Buffalo over 10 years from 2011-2020. A much more sizeable proportion of the city is located within the hazard zone than New York.

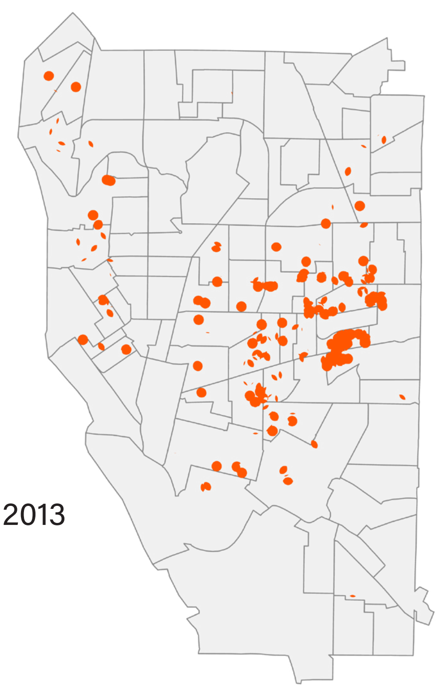


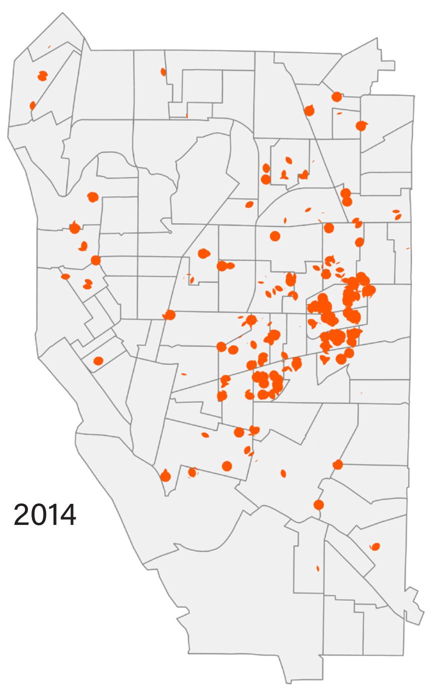
Maps 23-33: Greatest Hazard Year-by-Year

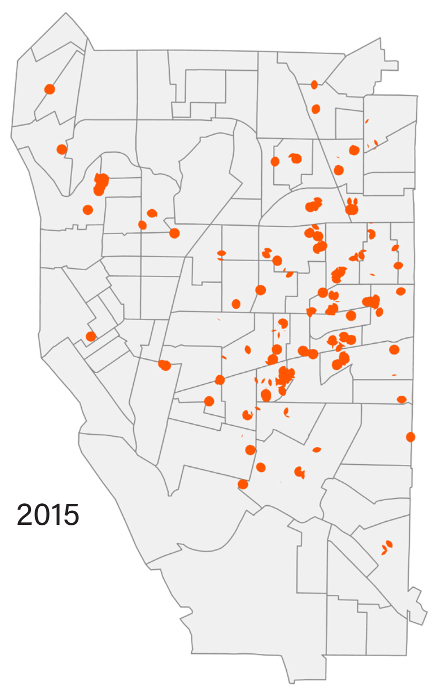
The following map series shows hazard zones on a year-by-year basis. Notice how the size of the hazard zone decreases drastically from 2014 up to 2020.

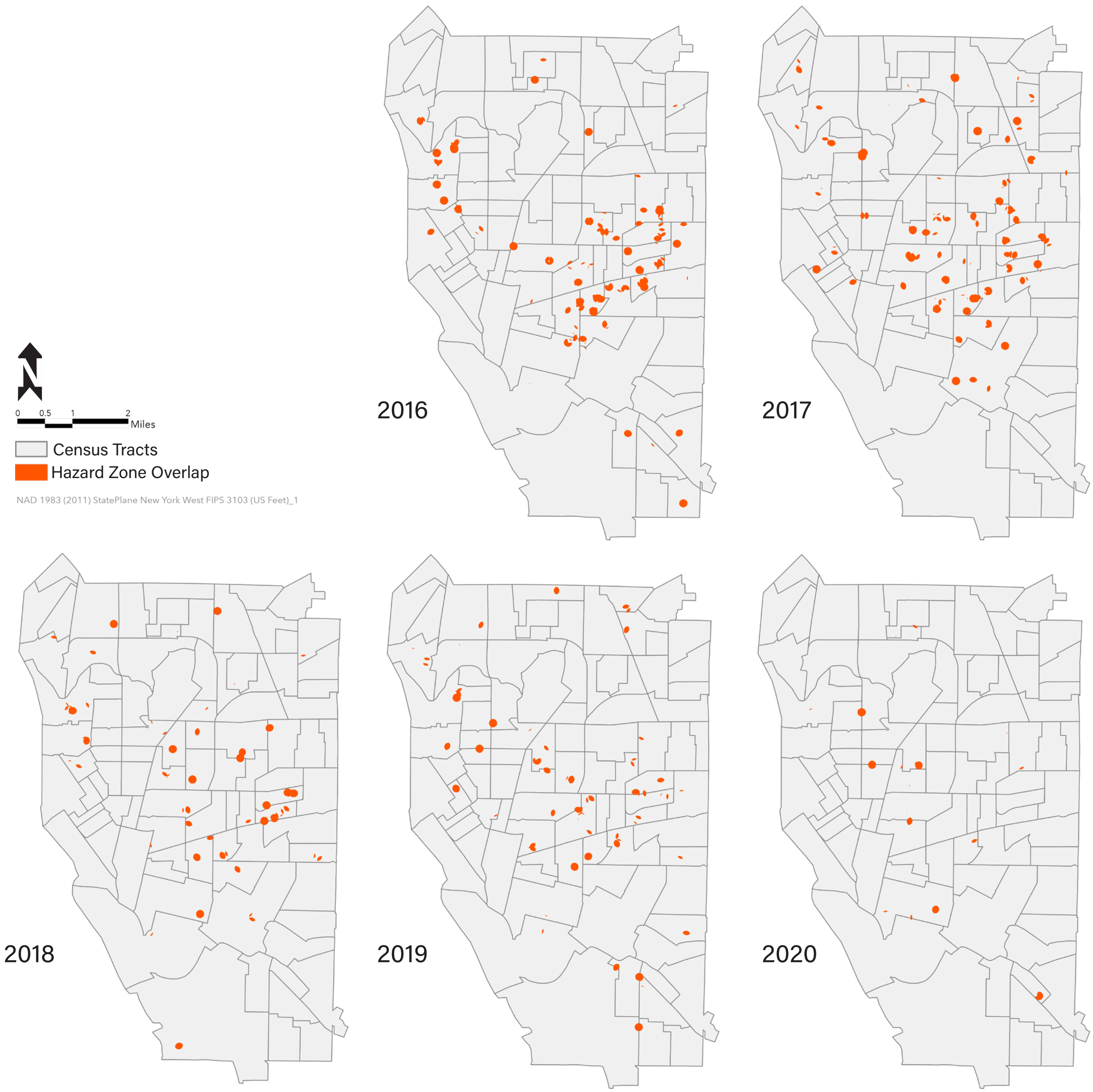

2011


2012


2013


2014


2015


2016
2017
2018
2019
2020
0 0.5 1 2 Miles
Census Tracts
Hazard Zone Overlap
NAD 1983 (2011) StatePlane New York West FIPS 3103 (US Feet)_1

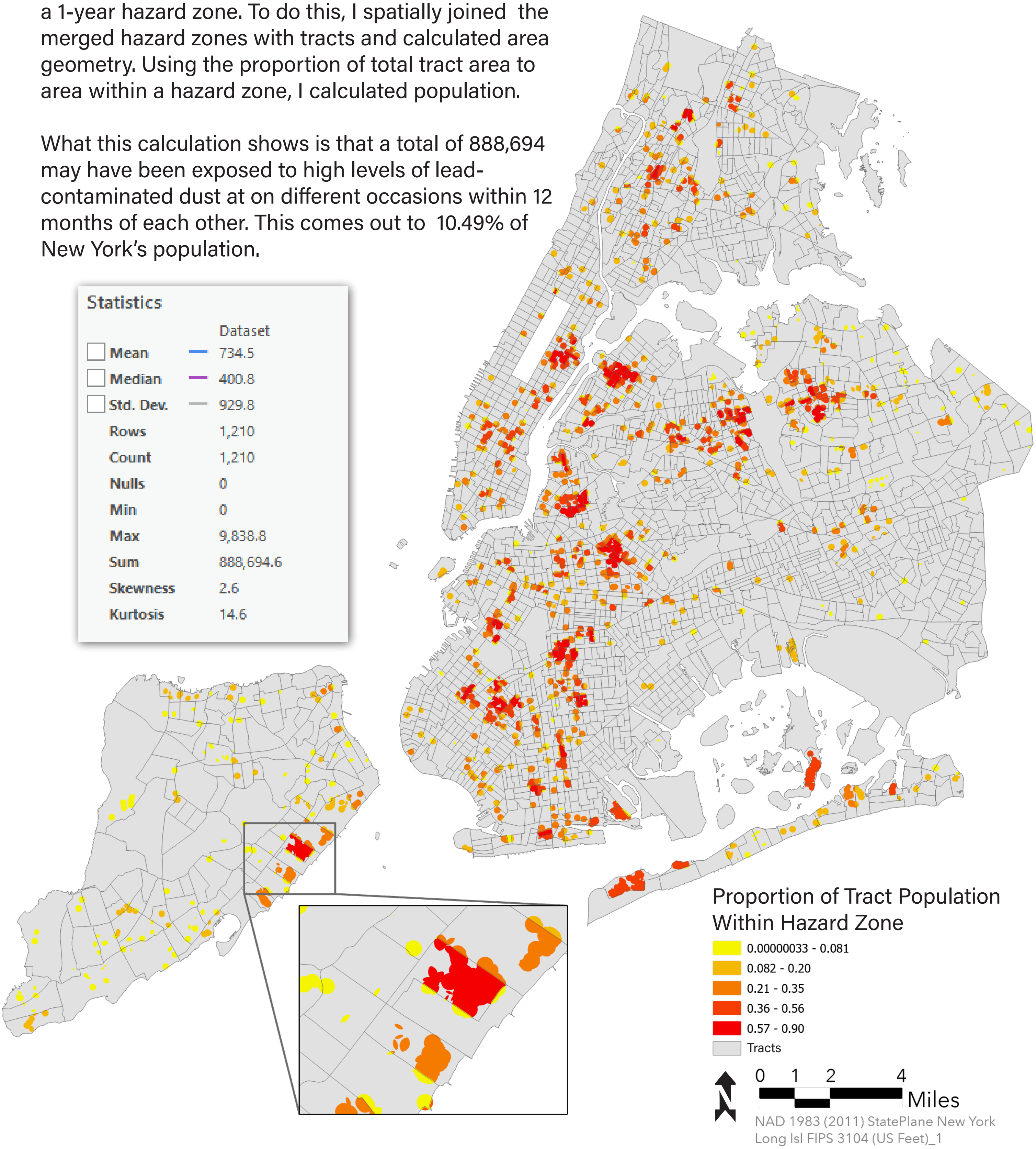
Map 34: How many people were potentially exposed?

Making the assumption that population is distributed evenly across each census tract (because there is no block-level data from the 2020 census yet), I calculated the population of each census tract that lives within a 1-year hazard zone. To do this, I spatially joined the merged hazard zones with tracts and calculated area geometry. Using the proportion of total tract area to area within a hazard zone, I calculated population.

What this calculation shows is that a total of 888,694 may have been exposed to high levels of lead-contaminated dust at on different occasions within 12 months of each other. This comes out to 10.49% of New York's population.

Statistics

		Dataset
Mean	—	734.5
Median	—	400.8
Std. Dev.	—	929.8
Rows		1,210
Count		1,210
Nulls		0
Min		0
Max		9,838.8
Sum		888,694.6
Skewness		2.6
Kurtosis		14.6



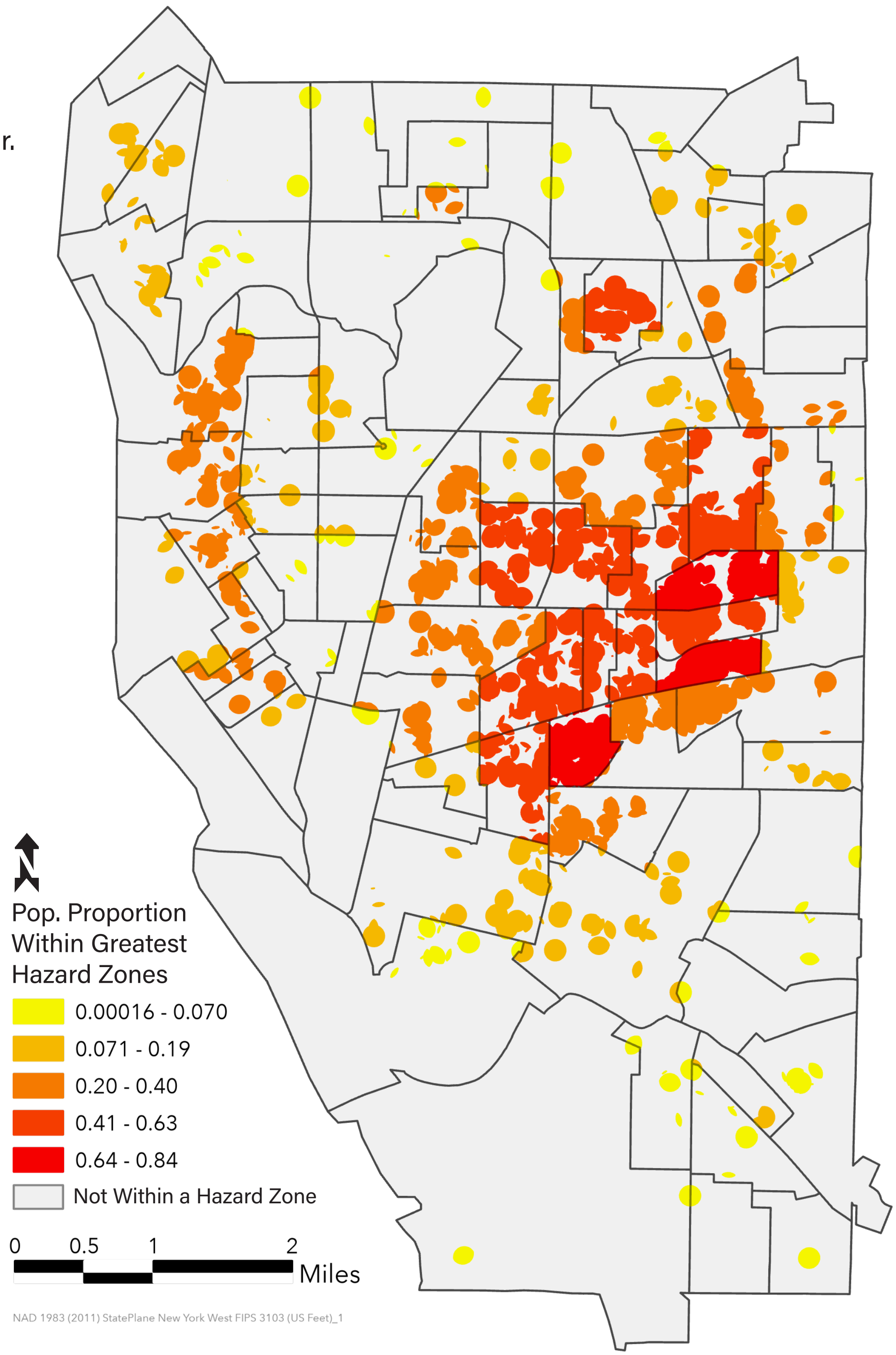
Map : How many people were potentially exposed?

Using the same methodology as was applied to the data from New York, the map below shows hazard areas joined with tracts. These hazard areas are symbolized based on the proportion of the tract population that lives within that area. Again, we see strong clusterin on the East Side as well as on the city's Upper West Side and Black Rock Neighborhoods.

Overall, 45,874 people in the City of Buffalo were potentially exposed to contaminated demolition dust at more than one instance within a given year. This amounts to 16.57% of the city's population of 276,807.

Statistics

	Dataset
☑ Mean	509.7
☐ Median	356.7
☐ Std. Dev.	509.0
Rows	90
Count	90
Nulls	0
Min	0.25
Max	2,368.3
Sum	45,874.0
Skewness	1.32
Kurtosis	4.3



Discussion

Demolitions are widespread, clustered, and have the potential to affect a large proportion of A given city's population. While they are significantly clustered in both Buffalo and New York, they are far more clustered in Buffalo by a factor of nearly four. The percentage of the population that lives within an area exposed to multiple demolitions within a year is also significantly greater in Buffalo compared to New York (16% compared to 10%. Moreover, The city of Buffalo, compared to New York, has a much higher proportion of demolitions in areas that are majority-minority, raising serious environmental racism concerns around the practice and its inequitable effects. Ultimately, demolitions are the result of numerous compounding factors ranging from racist housing policies to the fluctuating market. One must look at demolition practice as it is today as the result of a domino effect triggered by these root problems that have tangible widespread harms on thousands of residents today.

Like many research projects, I am coming out of this with more questions than I have answers. Other issues related to this not discussed nor mapped are the cost of demolitions and where the money is going, is it staying on the East Side? Who is buying up the abandoned land after the houses are demolished on it? Are East Side Residents really reaping the benefits of fewer abandoned houses in their neighborhoods if they are continuously exposed to demolition dust?

More analysis should be done to quantify a hazard factor for areas that were exposed to dust from, say, two demolitions and from six within a year, for example. Moreover, because years are discrete values, I was not able to compare overlapping dust hazards for demolitions that happened in different years. Perhaps more appropriate would be an animated timed dataset of buffers and the areas where they overlap over one-year intervals much like the animations of demolitions.

More research, thus, is needed to spatially and temporally compare these factors and different demographic statistics and shifts with demolition to better understand the inequitable causes and effects of the health externalities explored in this report. First of all, more data on census block demographics, building ages, and lead-testing results needs to be made more publicly available. Many more spatial and temporal questions could be answered through more detailed and diligent data-taking from contractors and municipal agencies, as datasets from both cities contained manu null values for crucial fields such as date. In addition to more data, more research needs to be conducted on dust deposition resulting from demolitions of buildings of varying sizes and in different urban settings. The 400-foot buffers come from researchers' policy recommendations based on the demolition of single-family and rowhouses in Baltimore and Chicago—which is unlikely to be applicable in New York City, where larger building typologies are more common.

In conclusion, this study shows that demolition could be a potential source of high lead exposure for over 10% of the population going off of prior research. With this as a revelation, it would be negligent for public health researchers and policymakers to ignore the potential severe detriment demolition poses to public health. While more research is needed to determine the real-life effect of demolition on health across cities, **why wait to change something?**

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