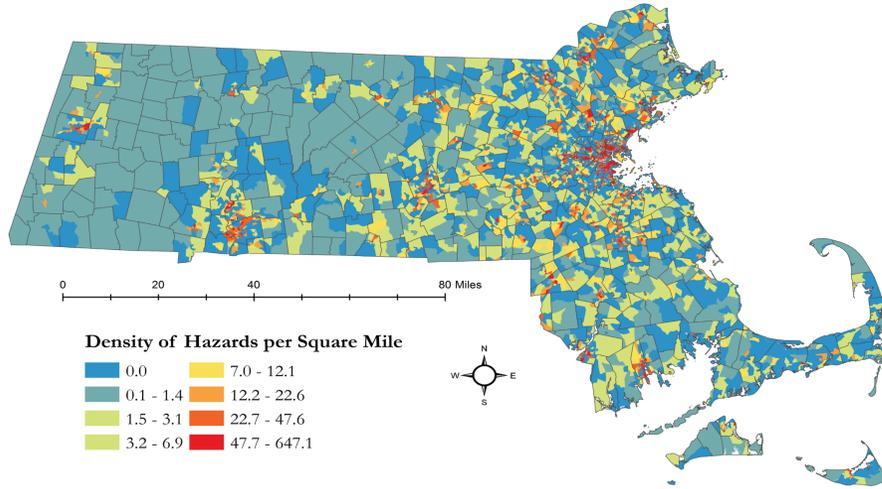


Unequal Exposure in Massachusetts: An Analysis of Environmental Hazards of Towns and Block Groups



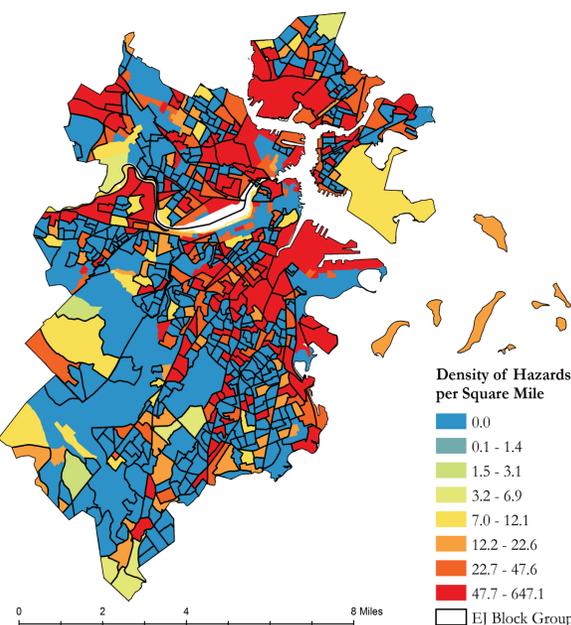
Census Block Groups of Massachusetts: Density of Environmental Hazard Points



METHODOLOGY

The methods used for this project include spatial analyses and calculations. The methodology used for calculating the comparative impact of various types of environmental hazards draws on recommendations from Dr. Faber and Dr. Krieg's forthcoming report, "Unequal Exposure." In addition, federal Superfund sites were added as they are included in other studies of Massachusetts town-by-town hazard exposure (see TAC report). Once the hazard data was added or geocoded to ArcMap, each type of hazard was assigned points to gauge their impact relative to other types of hazards. The points and scale are based on previous Unequal Exposure reports by Dr. Faber and Dr. Krieg as well as conversations with Dr. Faber: Once each hazard layer was given the appropriate points, the hazard layers were spatially joined with the 2010 Census block group level datalayer from MassGIS, and information on the total number of hazards in each block group and their cumulative points were saved. After all hazard layers had been combined with the census block group layer, ArcMap's field calculator was used to add up the cumulative hazard points per census block group for the entire state. Since rural census block groups cover much more area than urban block groups, additional field calculations were done to get the density of hazards within each block group by dividing the block group's area (in acres, which had been converted into miles by the cumulative points to achieve a density measure of hazards points per square mile within each block group. So the same analysis could be performed for Massachusetts' 351 towns, the census block group data was spatially joined with the town layer. Finally, to determine the particular exposure of environmental justice communities to cumulative hazards, the environmental justice block group layer from MassGIS was intersected with the census block group layer. It is clear from the maps that urban areas are disproportionately impacted by environmental hazards and that environmental justice communities in particular are impacted. The maps below show the density of environmental hazard points for the entire state at both the census block group level and the town level. Particular urban areas were further investigated to see the impact of cumulative exposure on populations considered historically marginalized and targeted for waste of all kinds. Certain cities and towns - including Springfield, Worcester, New Bedford, Fall River, Brockton, Chelsea, Everett, Boston, Lowell and Lawrence - have long had the characteristics of environmental justice communities. What is the burden on these communities more recently?

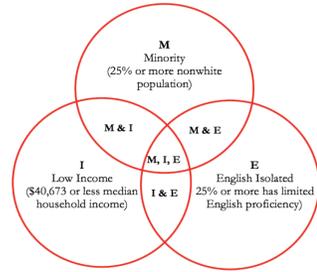
Boston Area Hazard Points Density by Block Group
 (includes Chelsea, Everett, Somerville, Cambridge Boston, Brookline)



PROJECT OVERVIEW

We live in a polluted state. This research examines the level and intensity of environmental hazards to which everyday residents of Massachusetts are exposed to on a daily basis. Notwithstanding increased topic visibility, the issue of unjust exposure still affects many within the state, particularly what the state defines as environmental justice communities - populations that are low-income, high minority and/or have limited English proficiency. These communities have historically been targeted for the siting of polluting facilities due to their decreased ability to resist these facilities being sited in their communities due to corporate, financial, legal and political pressure. Do these trends still exist today? How extensive (sum of hazards) and intensive (density of hazards) is the exposure of populations across the state, and are environmental justice communities among the most overburdened populations? The maps show both cumulative (total point) hazard exposure for each census block and town in the state, as well as intensity of hazard exposure for each town and census block group. Intensity is measured by calculating the density of hazard points per square mile averaged across a census block or town. Through spatial analysis, it is clear that the most intensively overburdened communities and census block groups in the state are also considered environmental justice communities.

Environmental Justice Communities Defined



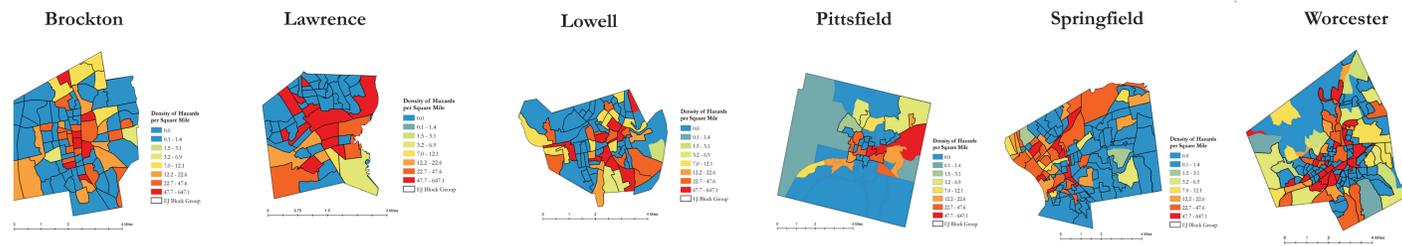
Points for Types of Environmental Hazards

Type of Hazard	Points
EPA Superfund Sites	25
Active Combustion Facilities	25
Chapter 21E Tier 1 Sites	10
Unlined/Unknown liner Landfills	6
Large Transfer Stations	6
Historic Combustion Facilities	5
Large Quantity Toxic Users (TURA Facilities)	5
Hazardous Waste Recyclers	5
Chapter 21E Tier 1D and Tier 2 Sites	3
Lined Landfills	3
Small Transfer Stations	3
RAO Sites	1

RESULTS

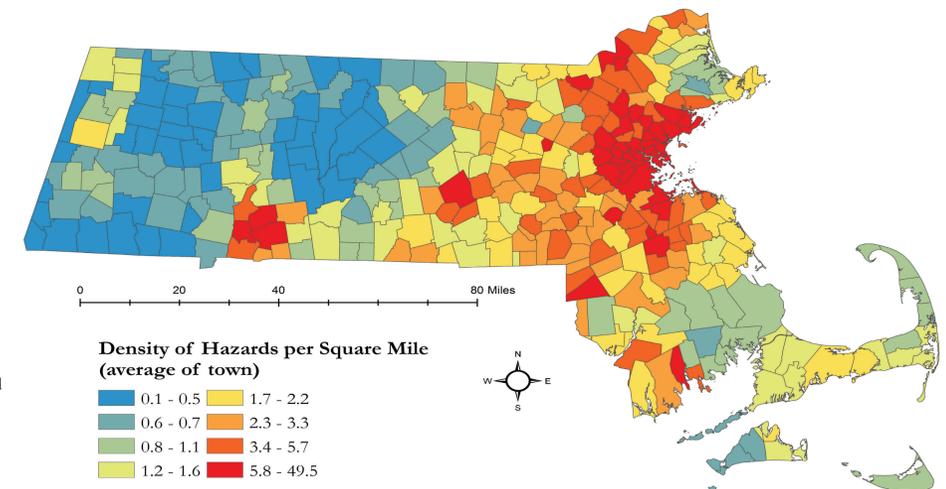
Through this analysis, it is evident that environmental justice communities remain among the most overburdened in the state when it comes to a whole host of hazards. At the city and town level the burden of environmental justice communities is somewhat muted because it is averaged across the town, meaning that very high block groups with high levels of hazards are averaged with block groups with relatively little hazard exposure. When it comes to the top twenty most overburdened towns by intensity of exposure, eleven of the twenty are considered environmental justice cities or towns on the basis of minority (25% or more of the population is non-white): Chelsea, Everett, Cambridge, Somerville, Lawrence, Malden, Boston, Revere, Springfield, New Bedford and Waltham. Four out of twenty are considered low-income (the median median household income is at or below \$40,673): Chelsea, Lawrence, Springfield and New Bedford. Intensity of exposure is calculated by taking the total sum of environmental hazard points for each city or town and dividing it by the square mileage, giving a density measure of environmental hazard points per square mile. By simply summing the total hazard points for the top twenty most overburdened cities and towns in the state, we find that eight out of twenty can be considered environmental justice communities based on minority criteria: Boston, Springfield, Cambridge, New Bedford, Lawrence, Lowell, Brockton and Somerville. Four out of twenty are considered environmental justice cities or towns based on median household income: Springfield, New Bedford, Lawrence and Fall River. However, if we drill down to the census block group level, we find that there are great disparities between census block groups within cities and towns. Out of the top twenty most overburdened census block groups in the state when it comes to cumulative hazard points, six were environmental justice communities: Springfield, Everett, Somerville, Agawam, Boston and Medford (see map for (EJ) marker), while many of the remaining census block groups were located in cities and towns that are considered environmental justice communities overall, including Pittsfield, Woburn and Somerville. Most surprising by far was analyzing the top twenty most polluted census block groups by density of hazards per square mile (calculated for the census block group area). This measure of hazard exposure intensity showed that out of the top twenty census block groups in the state, almost all (18) are considered environmental justice communities. These 18 census block groups are located in New Bedford, Somerville, Boston, Lowell, Chelsea, Cambridge, Lynn, Lawrence, Springfield, Medford. The remaining two block groups did not themselves fit the definition of an environmental justice community, but they are located in New Bedford, which is considered an environmental justice town overall.

Below is a selection of Massachusetts towns which show the visual disparities in terms of exposure to environmental hazards. The maps are calculated for density of environmental hazards per square mile within each census block group. Census block groups outlined in black are considered environmental justice communities. Note that in some cities, such as Springfield and Boston, the overwhelming majority of census block groups fit at least one environmental justice category



PROJECT OVERVIEW

Towns of Massachusetts: Density of Environmental Hazard Points

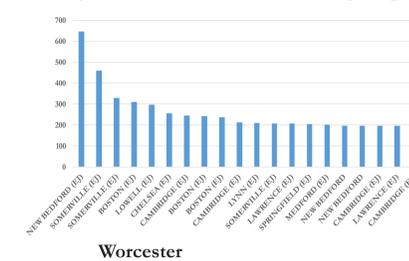


LIMITATIONS & POLICY IMPLICATIONS

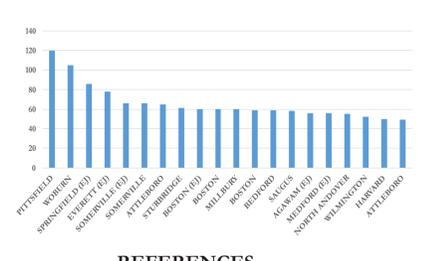
Most environmental hazard data is from MassGIS, and updated with periodic frequency. However, the state does not publicly provide data on Federal (EPA) Superfund sites, this layer had to be created manually using addresses from the EPA's website and google earth to corroborate location. The datalayer created was points, however the majority of Superfund sites are many acres, therefore polygons would have provided more accurate boundaries for these hazards but creating polygons is beyond the scope of this analysis. Data collected from MassGIS on which block groups in the state are considered environmental justice communities comes from data calculated from the 2010 Census. There have been numerous demographic changes since then, not the least of which is the pressure of gentrification. This means that the race and income characteristics of certain block groups and towns will inevitably have changed. There likely sources of spatial error in this analysis relate to the boundaries used for the analysis - namely town and census block boundaries. If a hazard was located close to the boundary of a census block, it would be counted in that town or census block's cumulative hazard points, but not in its neighboring town or census block. Using census block analysis is standard in environmental justice research. By comparing both census blocks and entire towns, this study provides two points of reference. The use of a buffer for hazards might be appropriate for policy and planning considerations, but it is unclear at what distance any hazard stops becoming a hazard. Additionally, there is always the potential for spatial error when performing spatial analysis on tables and layers within GIS. While the output of each analysis was sampled, this does not remove all error from the results. The analyses conducted for this project form part of a larger body of research set to be completed in 2017, therefore the methodology and final spatial and statistical analysis used are likely to change.

What does this mean for policy and planning today? This research is far from complete, and indeed the methodology on how each hazard is weighted will likely change and new hazards may be added to future analyses. But as this preliminary study shows, there are clear correlations between communities that are low-income, high minority and/or have a high percentage of residents that are limited English proficient and higher exposure to hazards harmful to human health and wellbeing. Exposure is an ongoing problem, but armed with this data, city officials and communities alike can make the case that their community is environmentally overburdened. There are two ways in which this information could be used: to pressure the operators of noxious facilities, state or federal regulators and city officials to take a closer look at the cumulative impact these hazards are having on the population. Evidence like this might help communities make the legal case for hazard remediation or even against future hazardous facilities looking to site in these same communities. In 2014, outgoing Governor Deval Patrick signed an Executive Order on Environmental Justice, which states that, "Environmental justice means that all people have a right to be protected from environmental pollution and to live in and enjoy a clean and healthy environment regardless of race, income, national origin or English language proficiency." The Executive Order calls for an Environmental Justice Policy that would ensure equal compliance and enforcement in environmental justice communities for facilities subject to environmental regulatory programs and/or permitting requirements which seek to locate in these same communities. Armed with information on the extent and intensity of environmental burdens across the state, it should be clear to policymakers and planners that the issue of unequal exposure - indeed the issue of having any exposure whatsoever - remains a concern, particularly to historically marginalized communities, that needs to be addressed more proactively at every level of government so that the language and vision of this Order on Environmental Justice can be met, and furthermore that every resident of Massachusetts has the opportunity to live, work and play in a safe and healthy environment.

The Top 20 Most Polluted Census Block Groups: Density of Environmental Hazard Points per Square Mile



The Top 20 Most Polluted Census Block Groups: Total Environmental Hazard Points



REFERENCES

- Eric Krieg and Daniel Faber. "Unequal Exposure to Ecological Hazards 2017: Environmental Injustices in the Commonwealth of Massachusetts." Northeastern Environmental Justice Research Collaborative. Forthcoming 2017.
- Massachusetts Department of Environmental Protection <http://www.mass.gov/eca/agencies/massdep/cleanup/programs/>
- Massachusetts Office of Geographic Information Systems <http://www.mass.gov/anf/research-and-tech/tt-srv-and-support/application-srv/office-of-geographic-information-massgis/datalayers/layerlist.html>
- Environmental Protection Agency Superfund Sites <https://www.epa.gov/superfund/search-superfund-sites-where-you-live>
- Sylvia Broude. "Toxics in Massachusetts: A Town-by-Town Profile." Toxics Action Center. April 2010. www.toxicsaction.org/sites/default/files/tac/.../TAC-toxics-in-massachusetts.pdf.