Soil Lead and Redlining at The Conscious Connect Houses of Knowledge

Sam Bennett

Environmental Science, Wittenberg University

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Dr. Fortner

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Introduction

Soil lead is an issue that does not affect everybody equally. Soil lead concentrations are often higher in poor neighborhoods and cities than in wealthy areas. This inequality has roots that go back very far, and some of these roots can be traced directly back to the actions of the Home Owners' Loan Corporation (HOLC) between 1935 and 1940. (Nelson, *Mapping Inequality*) During this time, the HOLC rated neighborhoods in cities for risk of paying back loans. There were four ratings: green (least risky), blue, yellow, and red (most risky). Given the language they use, it is clear that these zones are based largely on the racial makeup of these neighborhoods. This assessment system created what is now referred to as "redlining": making it nearly impossible to take out a loan for a residence in a red zone. It also led to "neighborhood disinvestment," which is where a city essentially decides that a neighborhood or zone isn't worth the money to maintain, and just leaves it as it is and lets it go to waste. The assessments by the HOLC and the injustices that were created by it eventually led to housing deterioration responsible for higher soil concentrations of soil lead in poor neighborhoods.

Lead is a toxic heavy metal that is unsafe in the body at any concentration. It is particularly unsafe in children. Because children are still developing, any negative effect lead has on their body, and particularly their brain, will affect how they continue to develop. Lead damages children's vulnerable brains and nervous systems, causing delayed growth and development, and learning and behavior issues. (Whitehead & Buchanan, *Childhood Lead Poisoning* 2019) Families that live in poor neighborhoods, often black families, are forced to raise their children around lead. They are still feeling the effects of the HOLC redlining to this day and due to many factors cannot escape the lower class they live in. It is possible that these families are not even aware that they live around soil lead. This is why research needs to be done on where soil lead concentrations are highest. Public research will increase awareness instead of the issue being swept under the rug.

One way to decrease the impacts of soil lead is by growing gardens. When gardens are grown, soil is usually amended with compost, mulch, and other organic matter. An increase in organic matter in soil makes lead immobile in the soil, and also dilutes the lead. (Schwarz et al., *Growing Gardens in Shrinking Cities: A Solution to the Soil Lead Problem?* 2016) Although gardening can combat the effects of soil lead, it does not solve the problem, and if lead concentration is above 200 PPM, that location is not safe to garden in. Another factor that affects gardening is soil carbon content. Carbon is the most necessary nutrient for plants to grow. A high carbon content means that plants will grow well in that soil. Unfortunately, urbanization decreases carbon content in growing spaces. Construction involves digging deep and moving a lot of soil, which ends up homogenizing the soil. Soil is naturally layered, with different depths of soil having different carbon content. Mixing it all up homogenizes the layers, meaning that there is much less carbon in the growing space that plants need. (Herrmann et al., *Urbanization drives convergence in soil profile texture and carbon content* 2020)

Our group's main goal in this research project was to work with the Conscious Connect to seek out locations near their "Houses of Knowledge" that could grow gardens. Growing food in gardens brings together communities, reduces the impact of soil lead, can provide some amount of nutritious food for people that may not be able to afford it otherwise, and can provide enrichment for children involved in the growing process. To determine whether a location is viable for a potential garden, we are testing two things: carbon and lead. High lead concentrations indicate that a location is unsafe for gardening, and high carbon content indicates that plants will grow well in that soil.

Methods

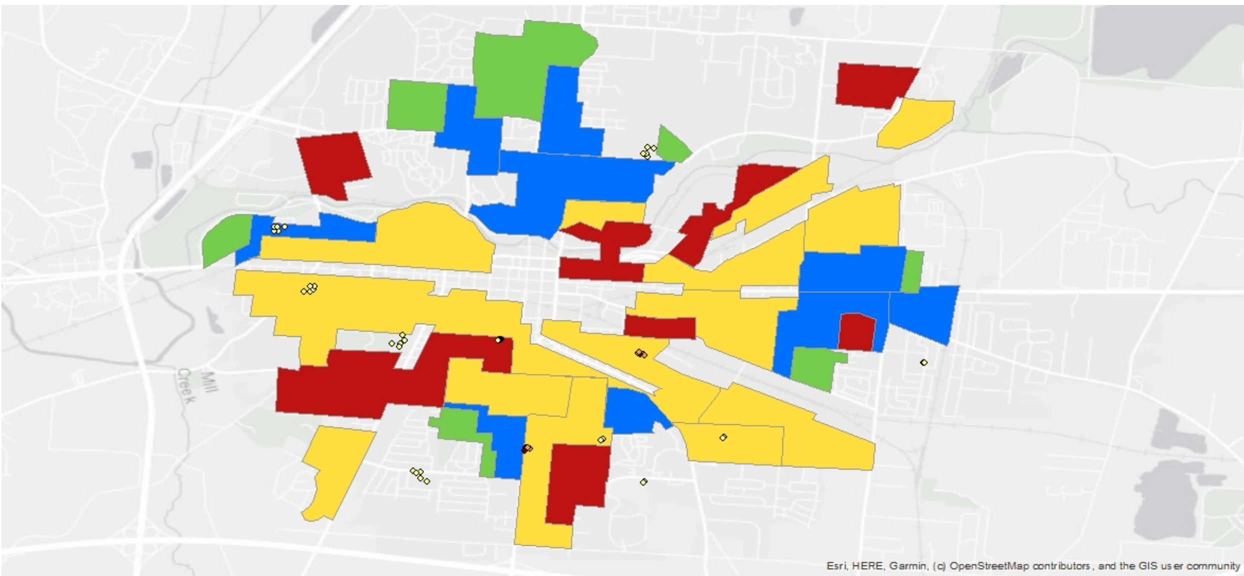
To collect soil samples, we went to five locations which had a House of Knowledge (HoK) and collected five samples from around the area. In four cases, the HoK was by an elementary school, so we collected samples around the buildings. We chose locations that were relatively flat and appeared to receive some amount of sunlight each day. We dug 10 cm deep in the soil to get an accurate estimate of lead. At the location of each sample, the latitude and longitude were recorded.

After each sample was collected, we went back to the lab and left the soil samples exposed to open air to dry out. After the samples were relatively dry, we tested the carbon content using the burning procedure. Burning the sample draws out the carbon, so the volume of carbon can be determined by the difference of its weight before and after burning. Then each (unburned) sample was tested for lead using XRF. (Kalnicky & Singhvi, *Field portable XRF analysis of environmental samples* 2001) We did not measure replicate data, so this is a limitation in our research and should be done in further projects. Replicate data would have given us a more confident measure of lead content.

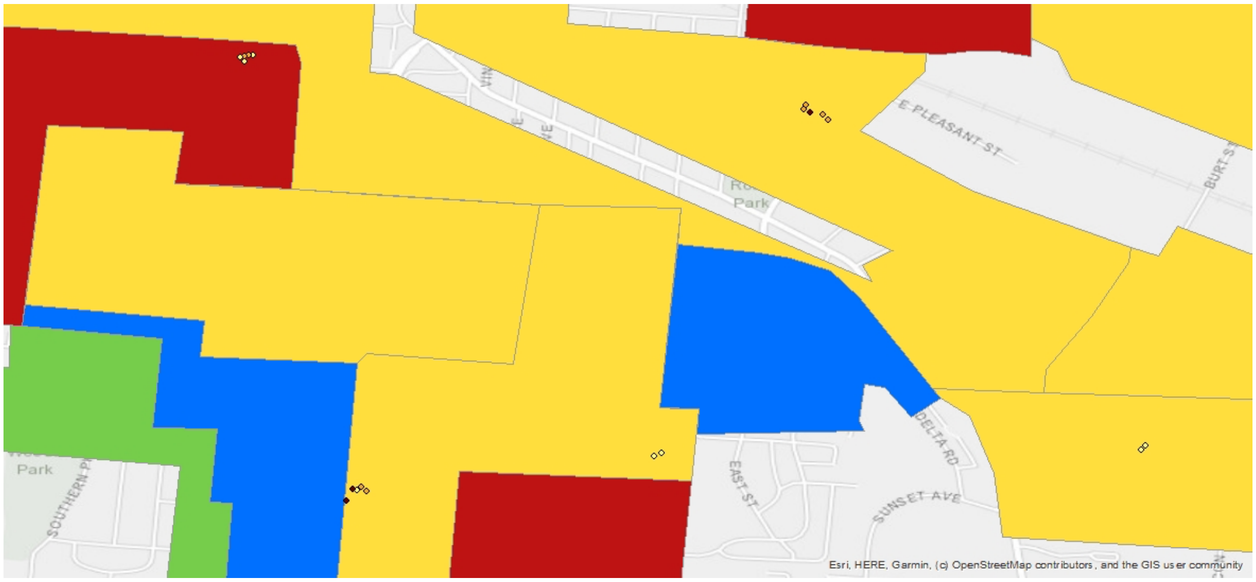
The two other groups we were working with also tested for carbon and lead, but may have done slightly different procedures.

Analyses/Figures

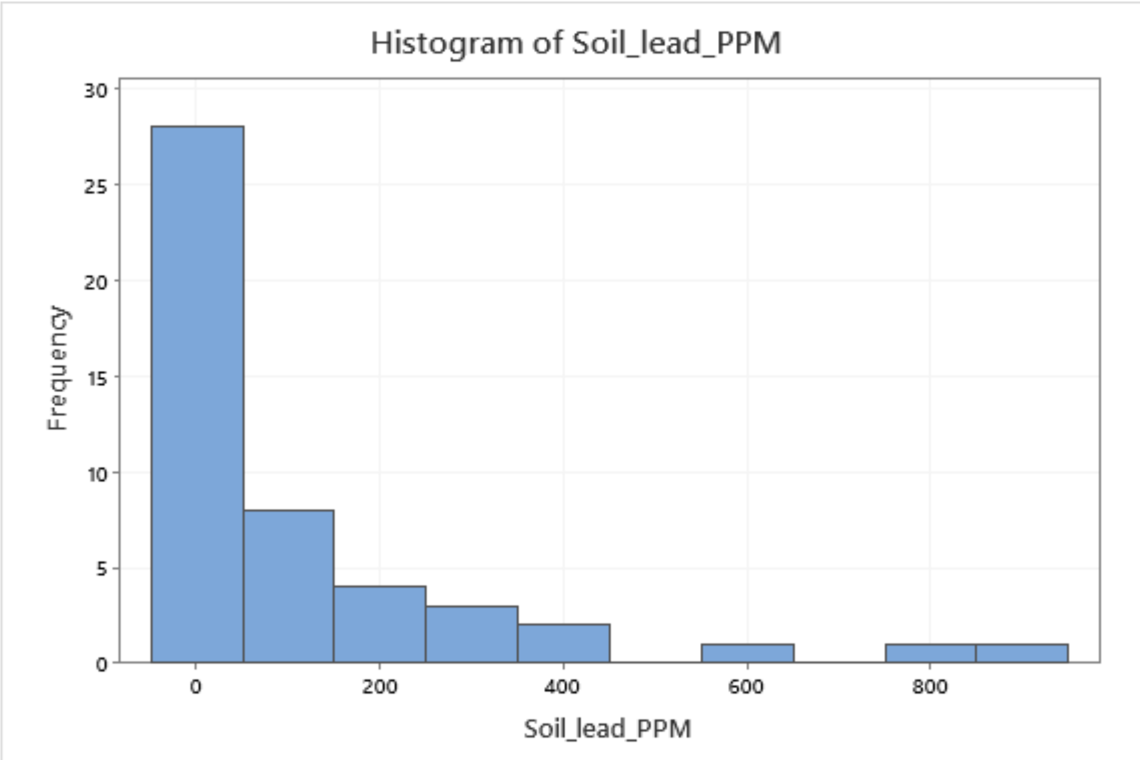
This is a map with all the class data points superimposed onto a redlining map of Springfield. The red zones were marked as “hazardous,” yellow as “declining,” blue as “still desirable,” and green as “best.” The colors of the points line up with the EPA’s soil lead concentration guidelines: yellow points are under 200 PPM (safe for gardening and bare soil), orange points are between 200 and 400 PPM (safe for covered soil), and dark points are over 400 (not safe).

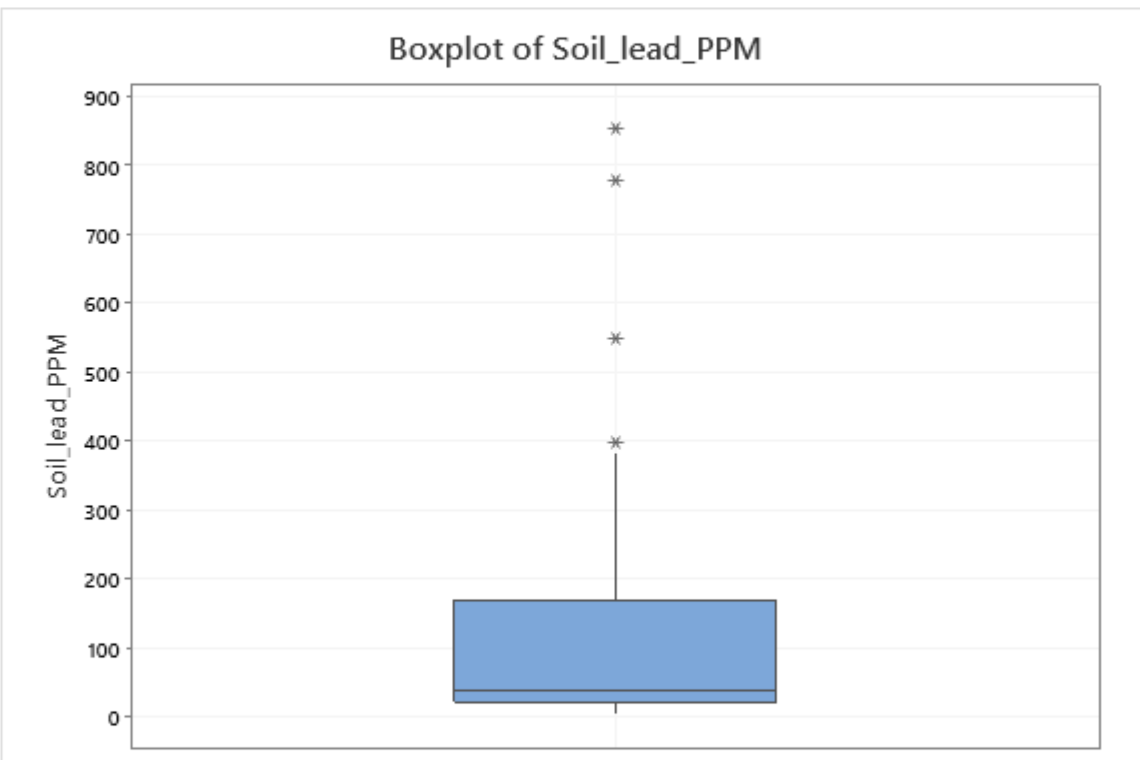


Because the points are so close on the whole map, they overlap and are difficult to distinguish. Because of this, I zoomed in on a portion in the lower center, which contains some areas of interest. This portion has the only orange and dark points that were tested. These do line up with the redlining: the samples with elevated soil lead concentrations are all located on yellow or red zones. All other locations, which tested only under 200 PPM, were near blue and green zones.



The histogram of the data shows that the vast majority of all samples tested are under the limit of 200 PPM for safe gardening. The boxplot also shows this clearly: the three lower quartiles of data are entirely under 200 PPM, and only the highest quartile exceeds 200. The four highest points of data registered as outliers according to the program that generated the boxplot.





Synthesis/Discussion

In general, most of the sites that were tested are safe for gardening in terms of soil lead. The EPA requires soil lead concentration to be under 200 PPM for gardens, and the majority of the sites tested well below that guideline. A measurement that we tested, but I did not include in the figures section of this paper, was carbon content. This is because most samples tested fairly close in carbon, and the difference would likely be unnoticeable in a practical setting. Any garden should be amended with a carbon-rich material such as compost and mulch regularly. In the long term, maintenance and amendment of the soil is much more important than the quality of the native soil for gardens.

For future study and research, I would recommend hypothesizing locations that might be high in lead concentration around the city and testing those locations. Bringing the community together to maintain gardens is a good thing, but to solve the issue of lead poisoning, it is essential to find the locations with the highest concentrations and bringing that information to government officials and build understanding to deal with it properly.

References

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