Quantifying the effects of lead exposure on children's futures

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Presenters

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Project Partners

Provided data

Provided funding assistance through the Indy East Promise Neighborhood project in support of analyses presented here

Program Partners

Project Goals

1. Understand potential disparities in child lead exposure within the Indianapolis Near Eastside and Martindale Brightwood communities (Indy East Promise Neighborhood) compared to the rest of Marion County.
2. Quantify the potential long-term impacts of child lead exposure in both the Indy East Neighborhood and elsewhere in Marion County.
3. Provide tangible resources and action steps to help reduce child exposure to lead and promote effective strategies and resources to help children already exposed to lead.

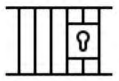
Context

Blood lead levels (BLLs) have declined immensely over the past three decades.

However, many children are still unduly exposed to lead, of which there are no known “safe” levels of exposure.

What does lead do to the human body and what negative effects may it have?

However, as I'll point out later, just because you've been exposed to lead doesn't necessarily mean you will have worse life outcomes.



Juvenile and adult delinquency

Early lead exposure in childhood has been linked to juvenile behavioral issues, as well as incarceration/violent behavior later in life.

Difficulty learning

Lead exposure at an early age can negatively impact a child's ability to pay attention, as well as their academic achievement.

Lost lifetime earnings potential

Due to lead exposure diminishing cognitive ability, this also reduces an individual's lifetime earnings potential relative to no lead exposure.

Damage to brain and nervous system

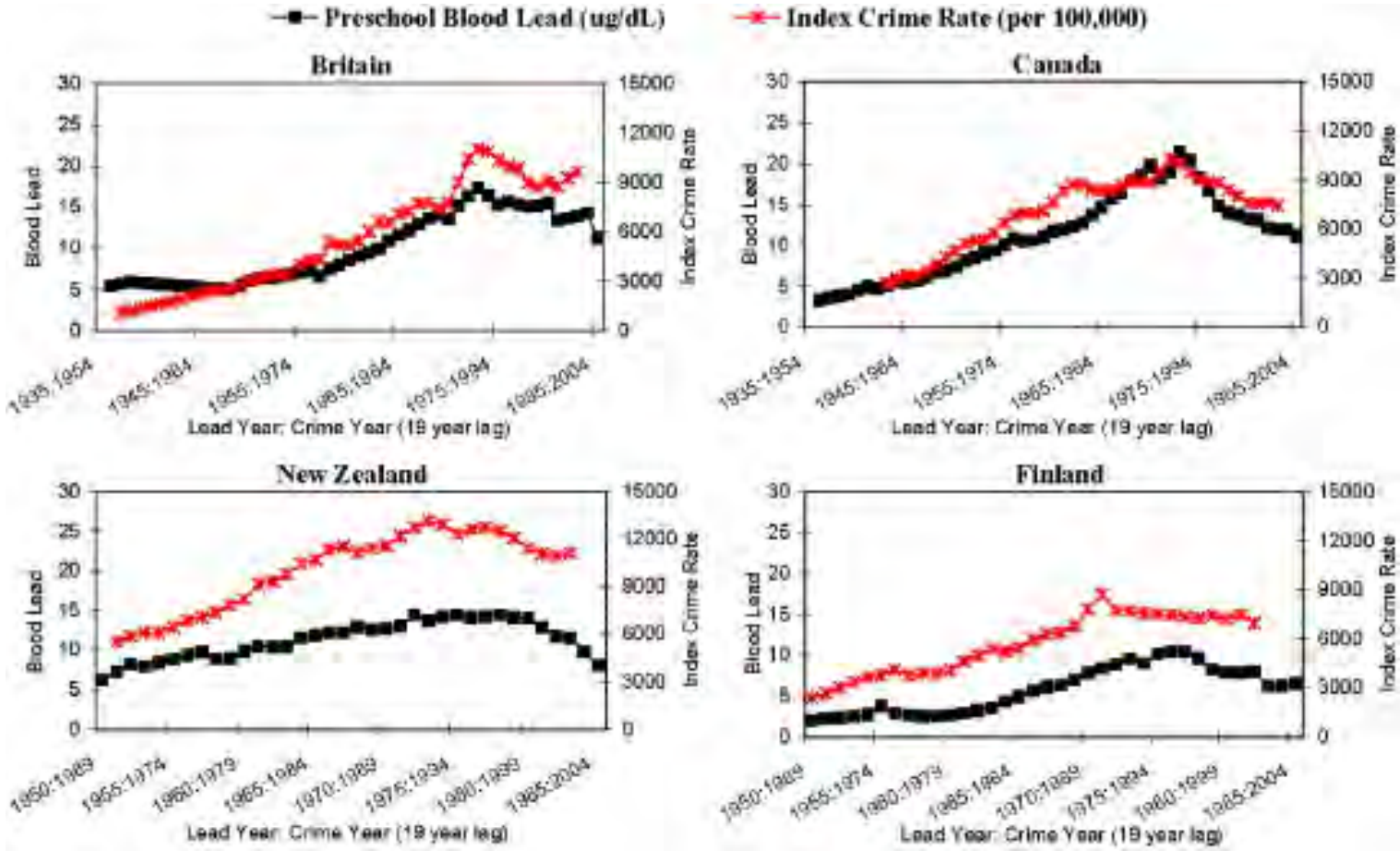
Lead mimics the element calcium in the body, and this can confuse neurons in the brain/nervous system, leading to learning/behavioral issues.

Linkage between lead and crime

Lead-crime hypothesis

Recent research suggests there are additional variables at play, but there is definitely some impact on BLL exposure and crime later in life (Higney et al., 2022).

What may be some confounding variables influencing this relationship?



Higney, A., Hanley, N., & Moro, M. (2022). The lead-crime hypothesis: A meta-analysis. *Regional Science and Urban Economics*, *97*, 103826.

Nevin, R. (2007). Understanding international crime trends: the legacy of preschool lead exposure. *Environmental research*, *104*(3), 315-336.

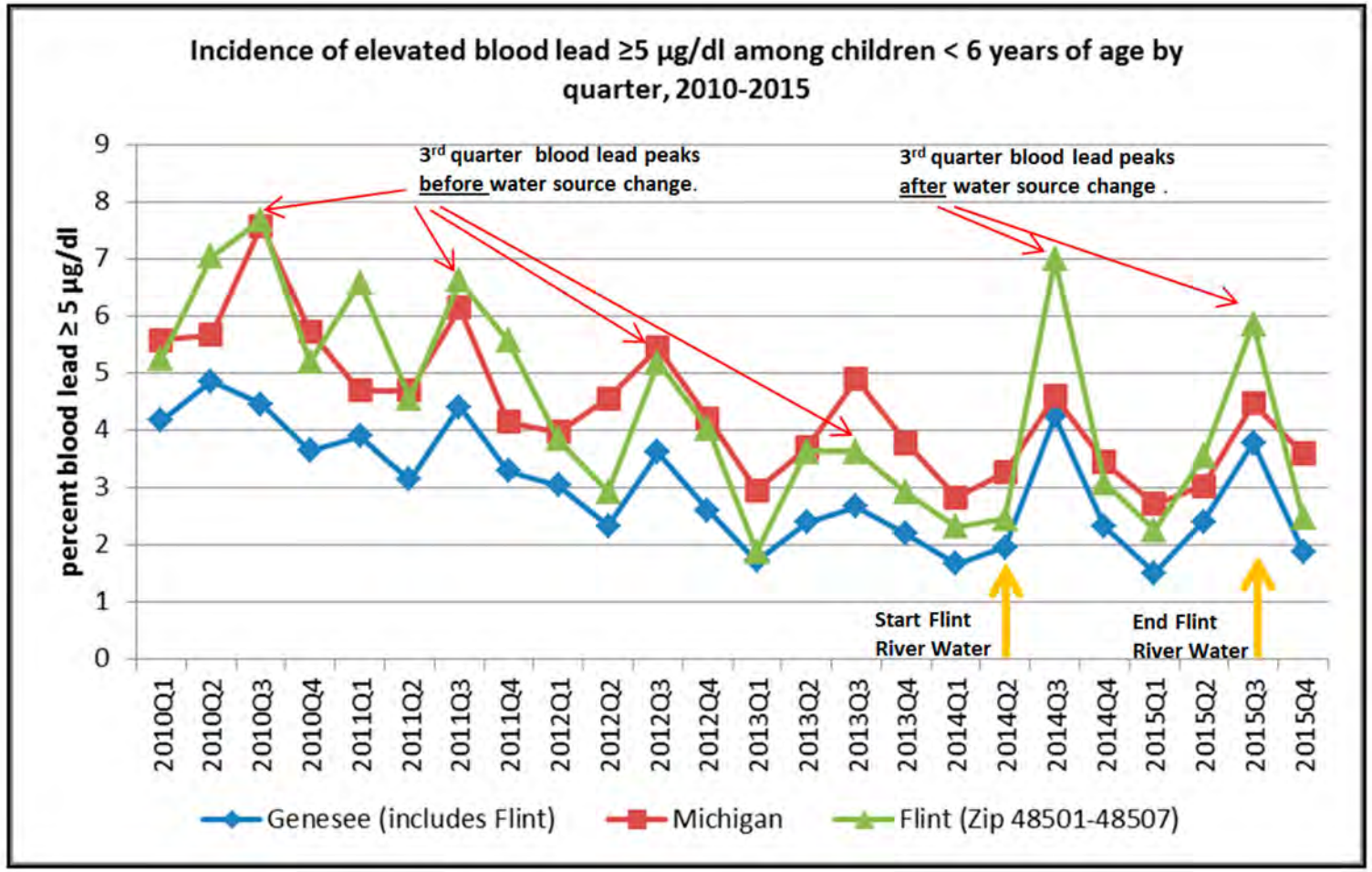
What do you think are the main Pb exposure sources for children?

Where does it come from?

https://www.in.gov/health/lead/

While water can be a source, soil/dust/paint often contribute as the primary sources

Flint, MI



Laidlaw MAS, Filippelli GM, Sadler RC, Gonzales CR, Ball AS, Mielke HW. Children's Blood Lead Seasonality in Flint, Michigan (USA), and Soil-Sourced Lead Hazard Risks. *International Journal of Environmental Research and Public Health*. 2016; 13(4):358. https://doi.org/10.3390/ijerph13040358

The good

- Lead emissions from new, primary pollution sources have decreased immensely
  - This includes leaded gasoline, leaded paint, lead solder for cans, etc.
- As a direct result, childhood BLLs have decreased drastically over the last three decades
- A lot of resources today to help prevent exposure and educate those dealing with exposure

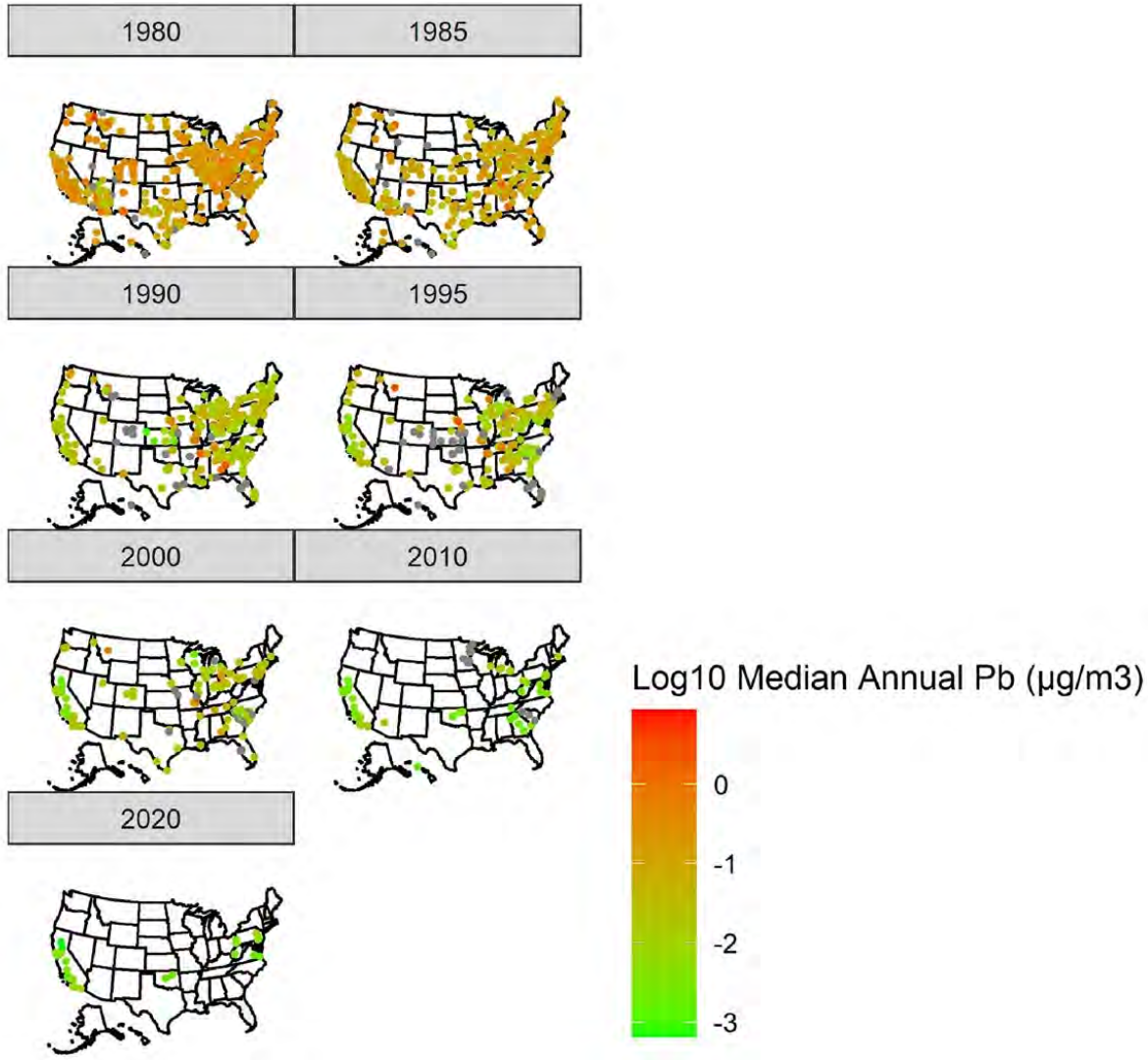
The bad

- About half a million children likely still have EBLLs (> 3.5 µg/dL) in the U.S.
- “Legacy” sources of lead persist in the environment and still pose an exposure risk
- People today are still paying for past exposure
  - In 2015, over 170 million people (>53%) had BLLs above 5 µg/dL in early life (McFarland et al., 2022)
  - The average lead-linked loss in cognitive ability was 2.6 IQ points per person as of 2015. (McFarland et al., 2022)

McFarland, M. J., Hauer, M. E., & Reuben, A. (2022). Half of US population exposed to adverse lead levels in early childhood. *Proceedings of the National Academy of Sciences*, *119*(11), e2118631119.

Decline in lead over time

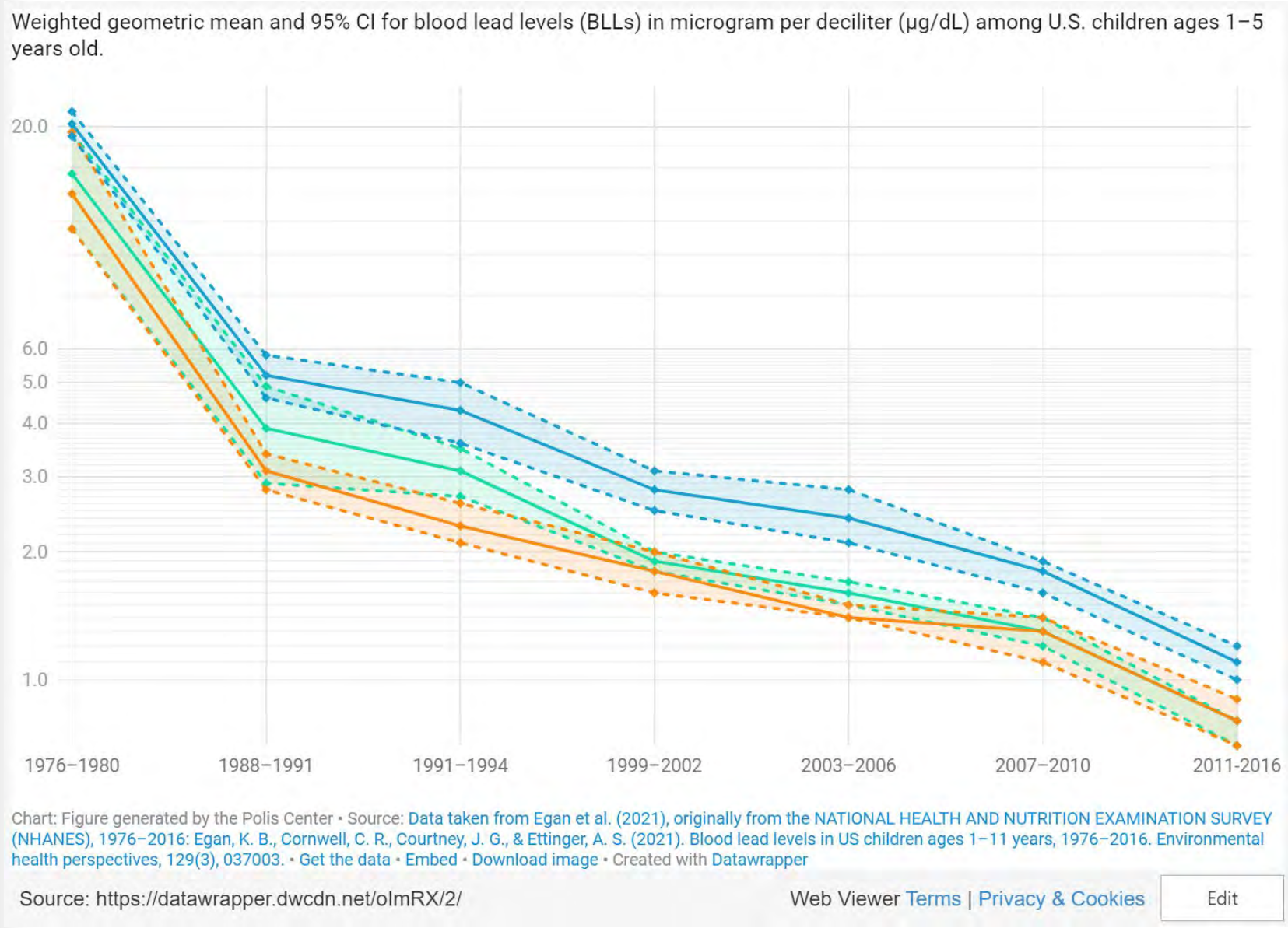
McFarland, M. J., Hauer, M. E., & Reuben, A. (2022). Half of US population exposed to adverse lead levels in early childhood. *Proceedings of the National Academy of Sciences*, *119*(11), e2118631119.



Dietrich, M., Filippelli, G.M. Positive outcomes from U.S. lead regulations, continued challenges, and lessons learned for regulating emerging contaminants. *Environ Sci Pollut Res* 30, 57178–57187 (2023). https://doi.org/10.1007/s11356-023-26319-4

Racial disparities persist

- Non-Hispanic Black children are disproportionally impacted by lead exposure in the U.S.
- Children in poverty more likely to have higher lead exposure as well.



Our Analysis in Marion County

Analyzing childhood blood lead data (<6 yrs old) from the Marion County Public Health Department

Initial tests, integer value BLLS in µg/dL

2009-2021

By census tract

Our Core Dataset – What's Included

Initial tests for blood lead levels in children under 6 years old within Marion County.

Blood lead levels are in µg/dL.

From 2009-2021.

*Values provided are only integer values (nearest whole number).

135,756 total samples, 125,883 initial tests.

Key Fields Included

- age_years
- SAMPLE_YEAR
- BLL
- test_details
- Tract2010
- Tract2020

Our Core Dataset – What's Not Included

The conclusions we can draw are limited by the scope of the dataset.

Key Data Not Currently Available

- Demographic information of individuals tested
- Why an individual was tested
- Home conditions of the child tested
- Source of the lead
- More precise values of BLLs

Other Limitations

- The data from initial tests by the county to flag for elevated blood lead levels is not as precise as follow-up testing

How we aggregated the variables

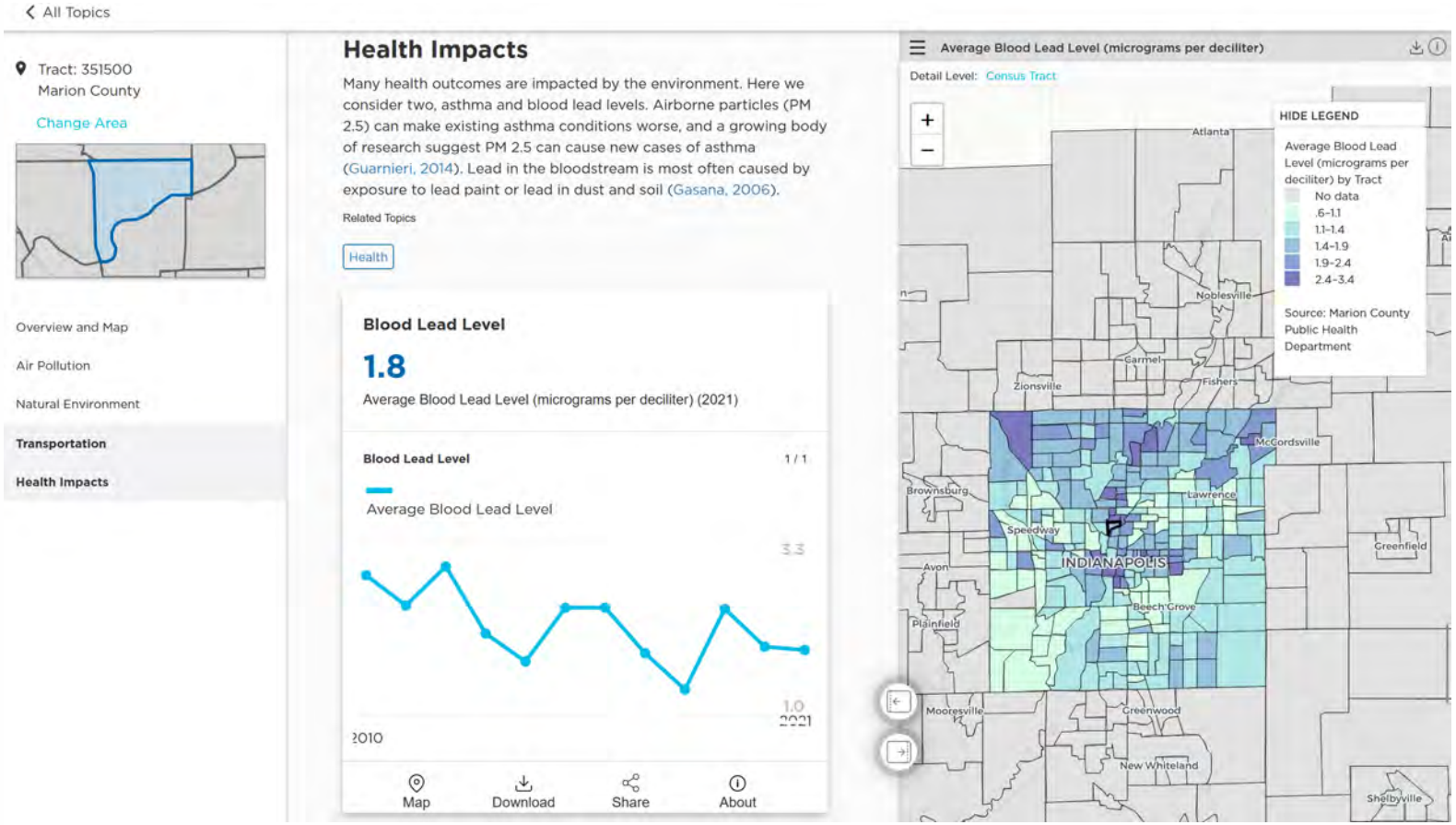
The Polis Center aggregated (averaged) initial tests by census tract (2020 tracts) and by year of testing.

Calculations made by the Polis Center

- Number of children tested per year by tract
- Mean/Median age of child tested by year and tract
- Mean/Median BLL by year and tract
- Mean/Median age of child tested by year and tract
- Separation of Near Eastside and Martindale Brightwood communities (Indy East Promise Neighborhood) from the rest of Marion County

Available on SAVI at tract level geographies

Working on some updates to fix a few bugs.



https://profiles.savi.org/topics/dashboard.html?TOPICID=1000078&geoid=348&geolocid=18097351500

Our Secondary Dataset

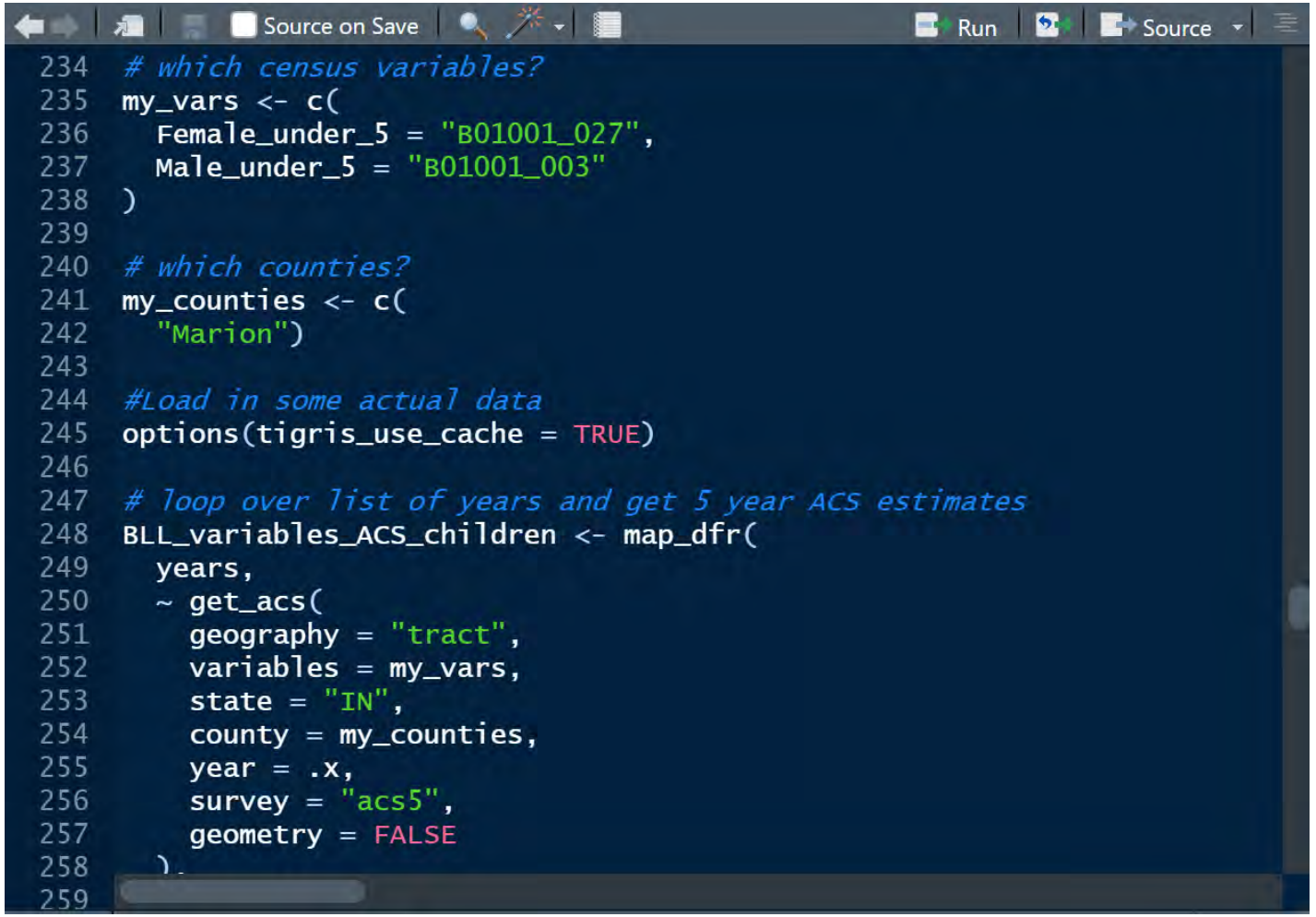
We also evaluated data from the American Community Survey (ACS) 5-YR estimates to estimate the number of children under five years old living in each tract and the percentage of housing built before 1980 per tract.

Utilized the R package: “tidycensus.”

Used to help estimate risk/impact.

ACS resource: https://www.census.gov/programs-surveys/acs

tidycensus: https://walker-data.com/tidycensus/



Change over time

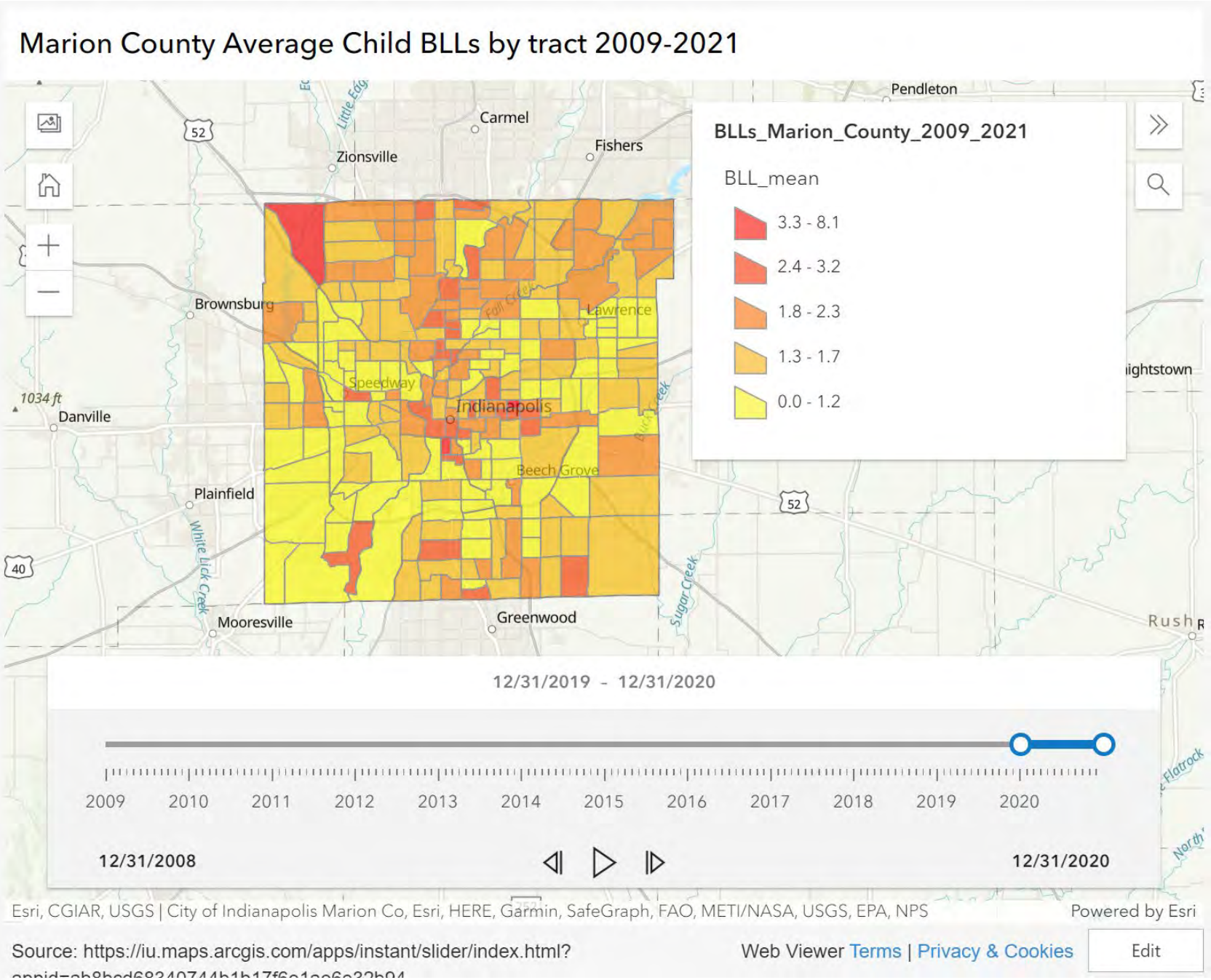
Mean BLLs by census tract decline over time.

Remain elevated though in certain areas.

Particularly Near Eastside and Martindale Brightwood areas.

Do any areas stand out to you?

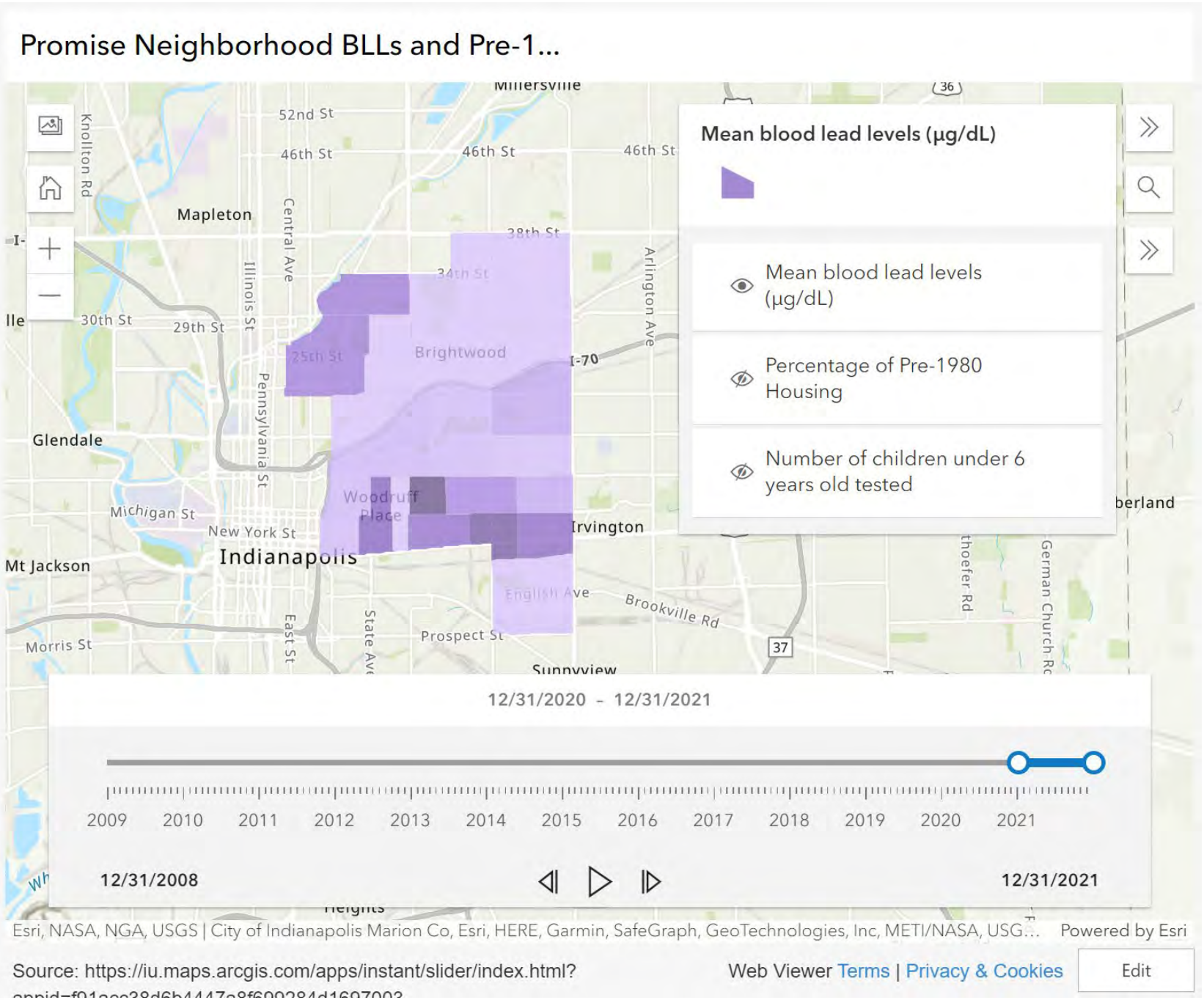
MCPHD, analysis by the Polis Center



How have average BLLs shifted over time in a specific community—the Promise Neighborhood?

While BLLs have also declined over time here, they remain higher on average compared to the rest of Marion County, particularly in the Near Eastside.

MCPHD, analysis by the Polis Center



What is the Indy East Promise Neighborhood?

The IndyEast Promise Neighborhood is both a place and a strategy led by John Boner Neighborhood Center and Edna Martin Christian Center. The IndyEast Promise Neighborhood promises all students on the Near Eastside and in Martindale-Brightwood access to great schools and whole family support to ensure a successful transition from birth to adulthood.

https://indyeastpromise.org/

INDY EAST PROMISE NEIGHBORHOOD

A PLACE AND A STRATEGY

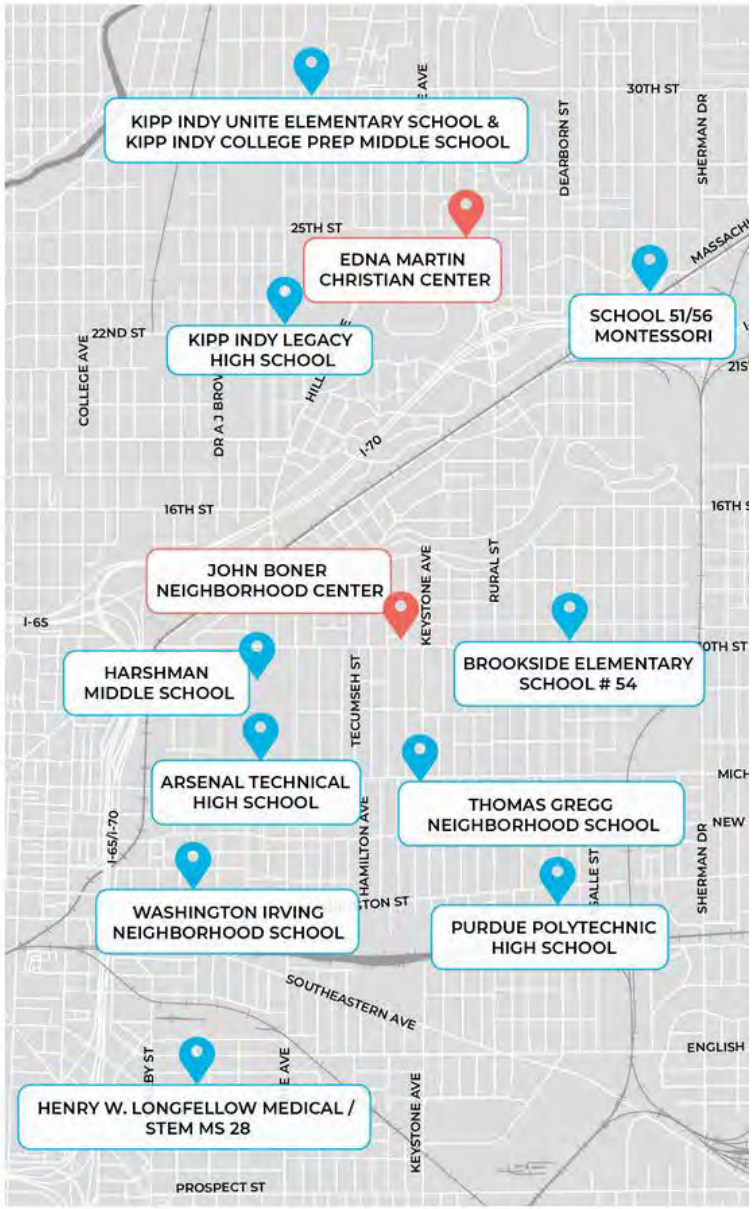
The IndyEast Promise Neighborhood is both a place and a strategy. Located in Near East and Martindale Brightwood neighborhoods, the initiative is led by John Boner Neighborhood Centers and Edna Martin Christian Center.

JOHN BONER NEIGHBORHOOD CENTERS

EDNA MARTIN CHRISTIAN CENTER

OUR PROMISE

We promise ALL students on the Near Eastside and in Martindale-Brightwood access to great schools and whole family support to ensure a successful transition from birth to adulthood.

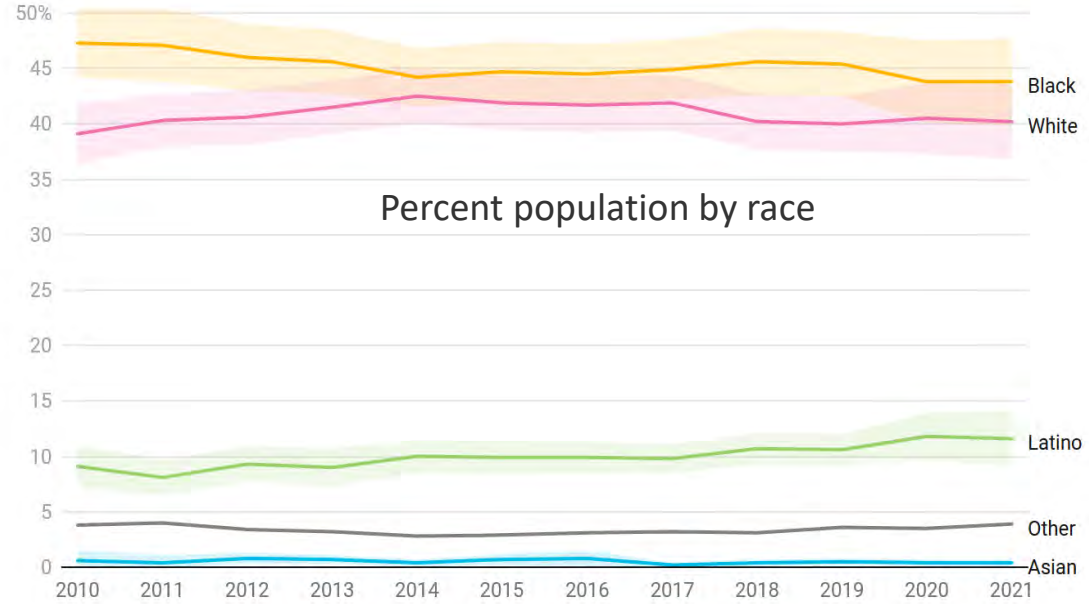


Promise Neighborhood is predominantly Black, high poverty rates

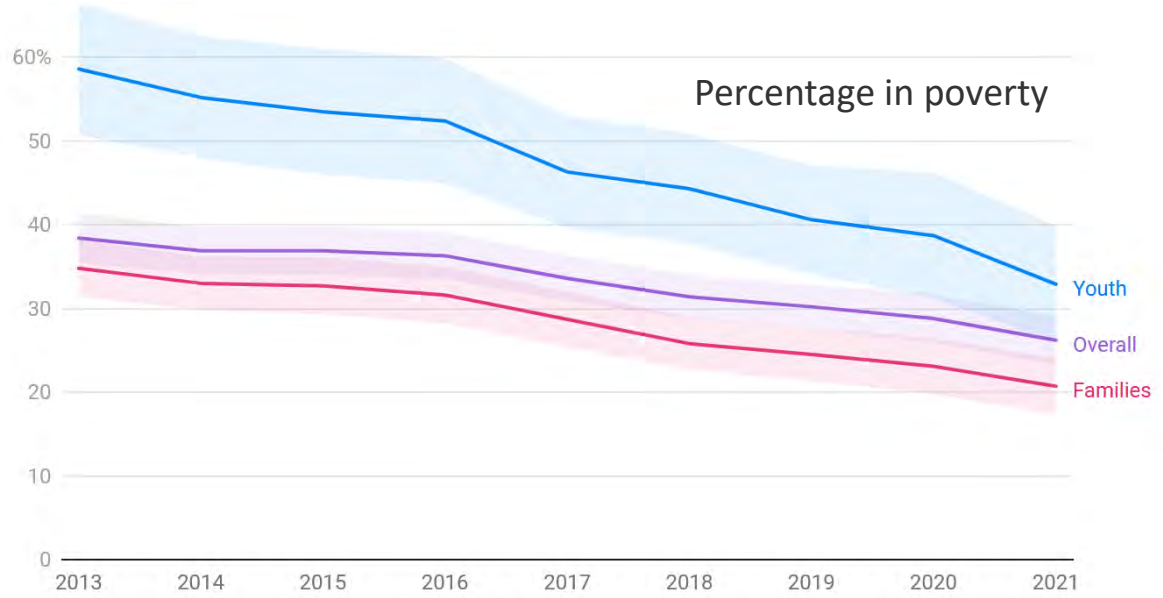
Poverty rate has been declining though across the board over the last decade.

Still, potential **environmental justice** issue at hand.

ACS-5YR Survey

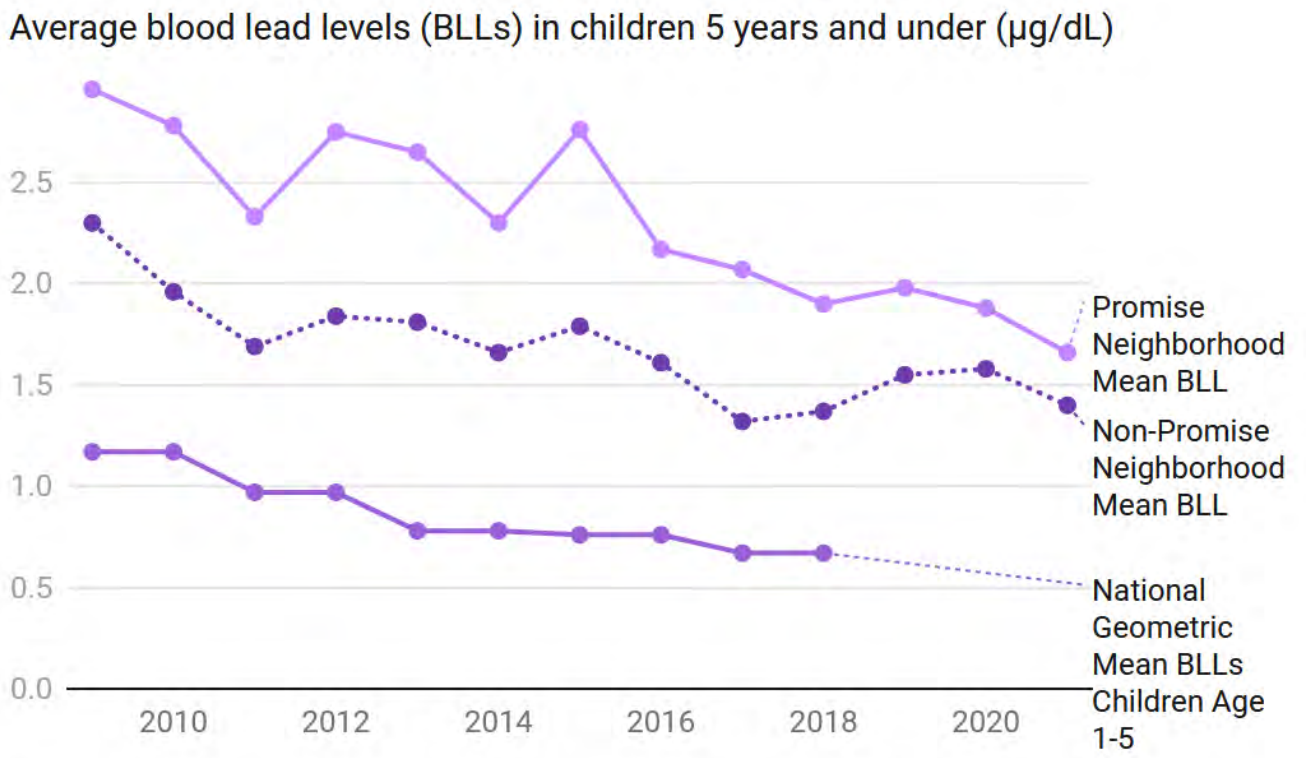


Source: Polis Center analysis of data from American Community Survey Five-Year Average • Get the data • Created with Datawrapper



Source: Polis Center analysis of data from American Community Survey Five-Year Average • Get the data • Created with Datawrapper

Decline over time, but disparities persist



Mean values based on census tracts within the Promise Neighborhood compared to those outside the Promise Neighborhood in Marion County. Note that the national data was taken in two year cycles from the NHANES survey, and are geometric mean, not arithmetic mean like the MCPHD data.

Source: Marion County Public Health Department, NHANES • Get the data • Embed • Download image • Created with Datawrapper

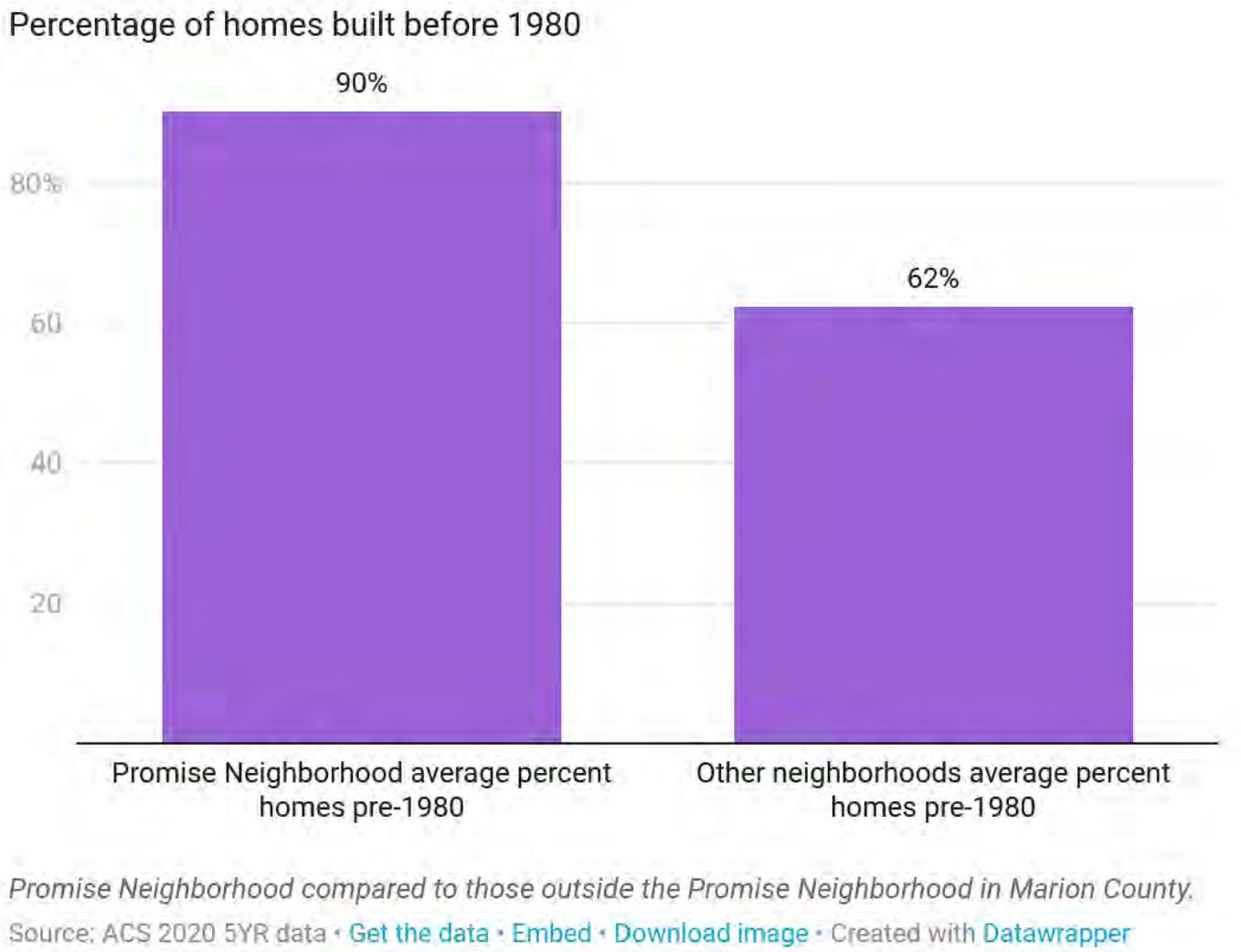
Age of home is a major risk factor

Homes built prior to 1978 are more likely to contain lead paint.

Deteriorates over time in dust and soil.

Remains in soil for decades and potentially hundreds of years.

Does condition and cleanliness of the home matter?



Promise Neighborhood compared to those outside the Promise Neighborhood in Marion County.

Source: ACS 2020 5YR data · Get the data · Embed · Download image · Created with Datawrapper

This impacts children and their futures

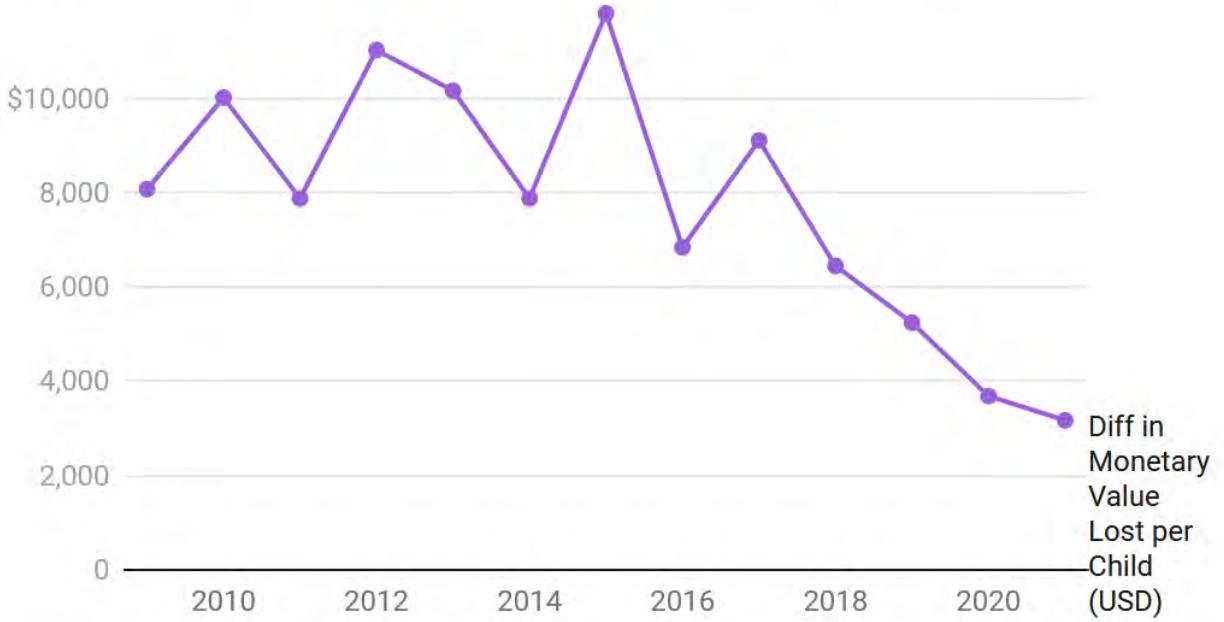
Lost income potential due to neurologic damage from even small levels of lead exposure as a child.

Just an estimate based on the literature—new research shows how early intervention can offset damage from lead.

Dietrich, M., Barlow, C. F., Entwistle, J. A., Meza-Figueroa, D., Dong, C., Gunkel-Grillon, P., ... & Filippelli, G. M. (2023). Predictive modeling of indoor dust lead concentrations: Sources, risks, and benefits of intervention. *Environmental Pollution*, *319*, 121039.

Children in the Neighborhood lose out on lifetime earnings potential due to lead exposure, more so than their peers in Marion County.

Additional money (USD) lost per child five years and under due to lead exposure in the Promise Neighborhood versus anywhere else in Marion County



Based on loss from total life earnings, calculated based on 0.54 IQ points lost per drop in blood lead level (BLL, µg/dL) and $22,611 lost per IQ point drop. Mean BLLs based on census tracts within the Promise Neighborhood compared to those outside the Promise Neighborhood in Marion County.

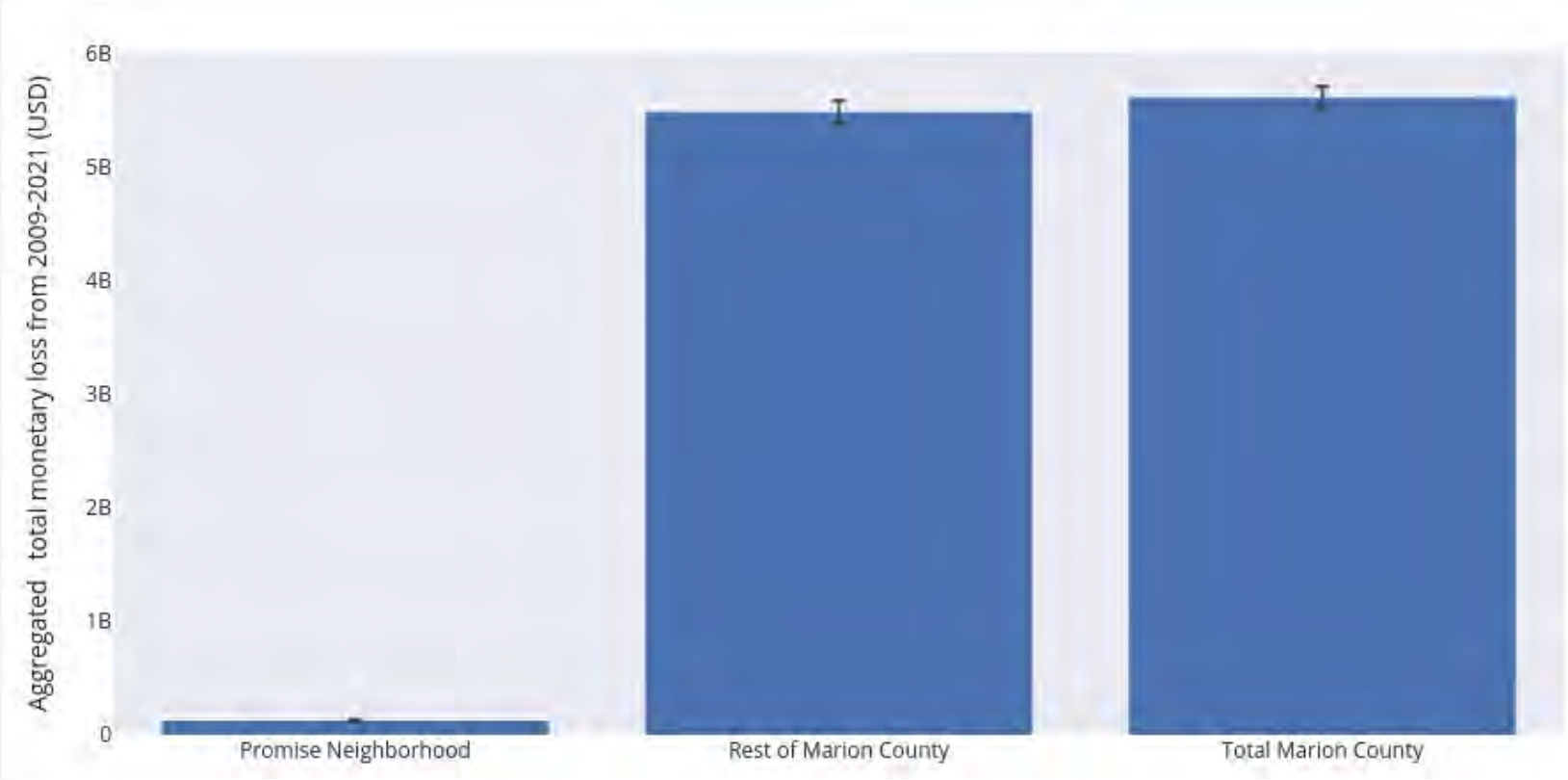
Source: SAVI analysis of data from the MCPHD · Get the data · Embed · Download image · Created with Datawrapper

In total, billions of dollars have likely been lost to blood lead exposure in Indianapolis

Just **one way** to quantify long-term effects.

Used to articulate the potential “value” of funding for intervention both before (primary prevention) and after (secondary intervention) exposure.

Estimated lost earnings potential from blood lead exposure (2009-2021)



What can be done?

Action steps that people can take at the individual level

both before and after lead exposure to give children the best opportunities possible

Primary Prevention

Leave your shoes at the door

Take your shoes off when indoors! Shoes can track in lead that may be residing in soils around the perimeter of your home.

Keep bare soil covered

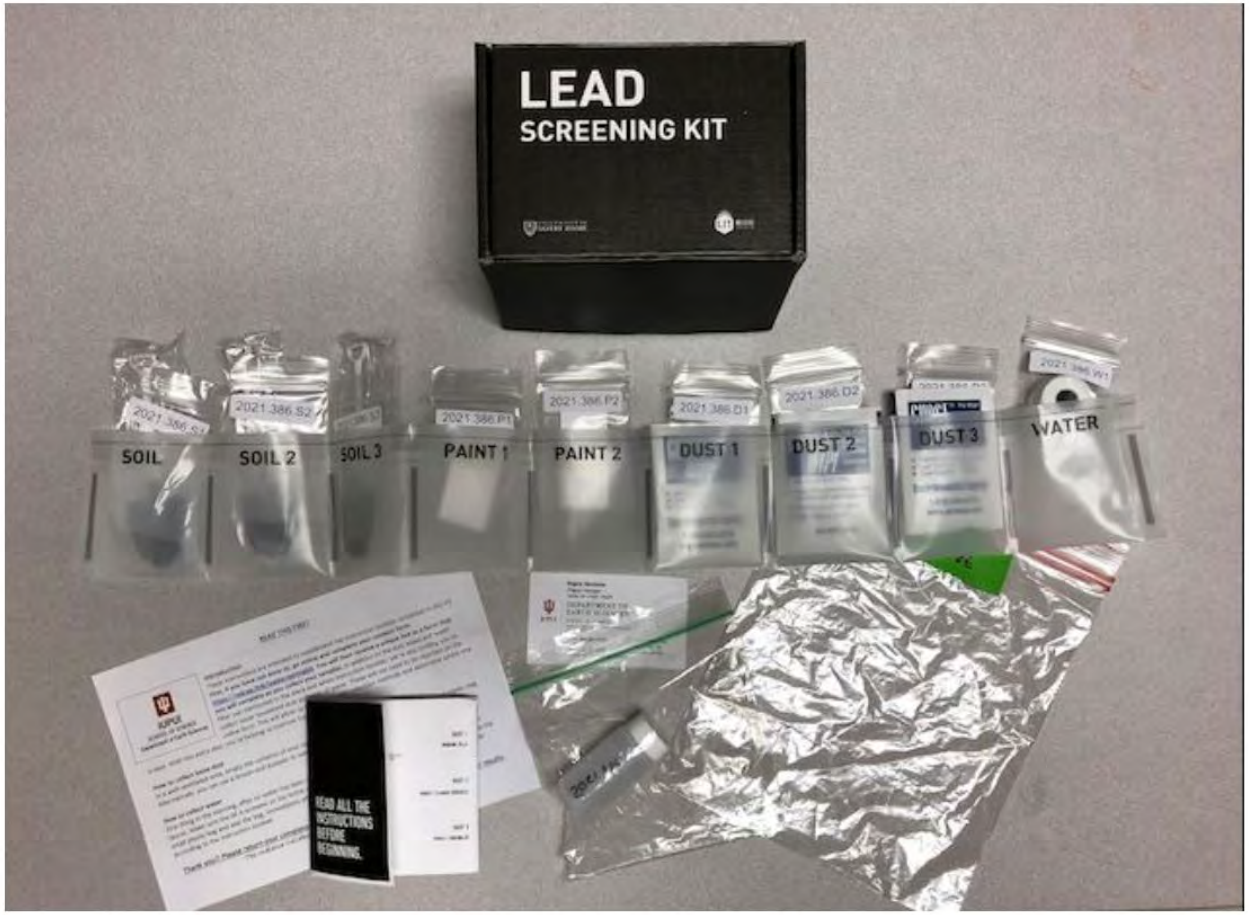
Lead is often greatest around the "dripline" or immediate perimeter alongside a home. If soil is left uncovered, it's easier for children playing to get it on their hands or inadvertently breathe it in or swallow. Planting grass or covering bare soil with mulch or tarp can reduce this exposure risk.

Vacuum and wet-mop regularly

Lead can easily accumulate in dusts within a home, particularly if it's slowly flaking off paint in the walls or brought inside from soil. Vacuuming and wet mopping floors regularly can reduce exposure for children crawling on the ground.

Keep children away from places with old, peeling paint

Old, leaded paint oftentimes has a sweet flavor, and young children may be drawn to it, particularly around low-access points such as windowsills. Check around your home for peeling paint and try and create a barrier for your child to prevent them from reaching the paint.



Marion County Residents

- Pick up your Lead Screening Kit from one of the 18 Indianapolis Public Library locations on this map.

All Hoosiers

- Free lead screening projects: https://urbanhealth.iupui.edu/projects

Safe Gardening Practices

[Safe Gardening Guide Link]

[Simplified, Updated Gardening Guide Link]

Why Should I Be Careful When I Garden In The City?

Gardening is fun, healthy, and can be extremely safe, even in cities. Soil in urban areas is like soil in the countryside in that it is full of nutrients and is the foundation of any garden. However, urban soils often contain high amounts of lead and other heavy metals. These contaminants are harmful to human development and are especially dangerous to children. For example, lead can cause permanent decreases in intelligence and increases the likelihood of attention deficit disorder and aggressive behavior, especially in children.

You should test your soil to learn if you are at risk for lead exposure. Then, you can take the appropriate and simple steps to safely garden. Although lead is not the only contaminant of concern in urban soils, it is one that is most closely linked to wide-scale human health impacts. When you garden, you are working the soil, your produce is in the soil, and your kids may be playing in that soil. All of these activities increase exposure to potentially harmful amounts of lead.

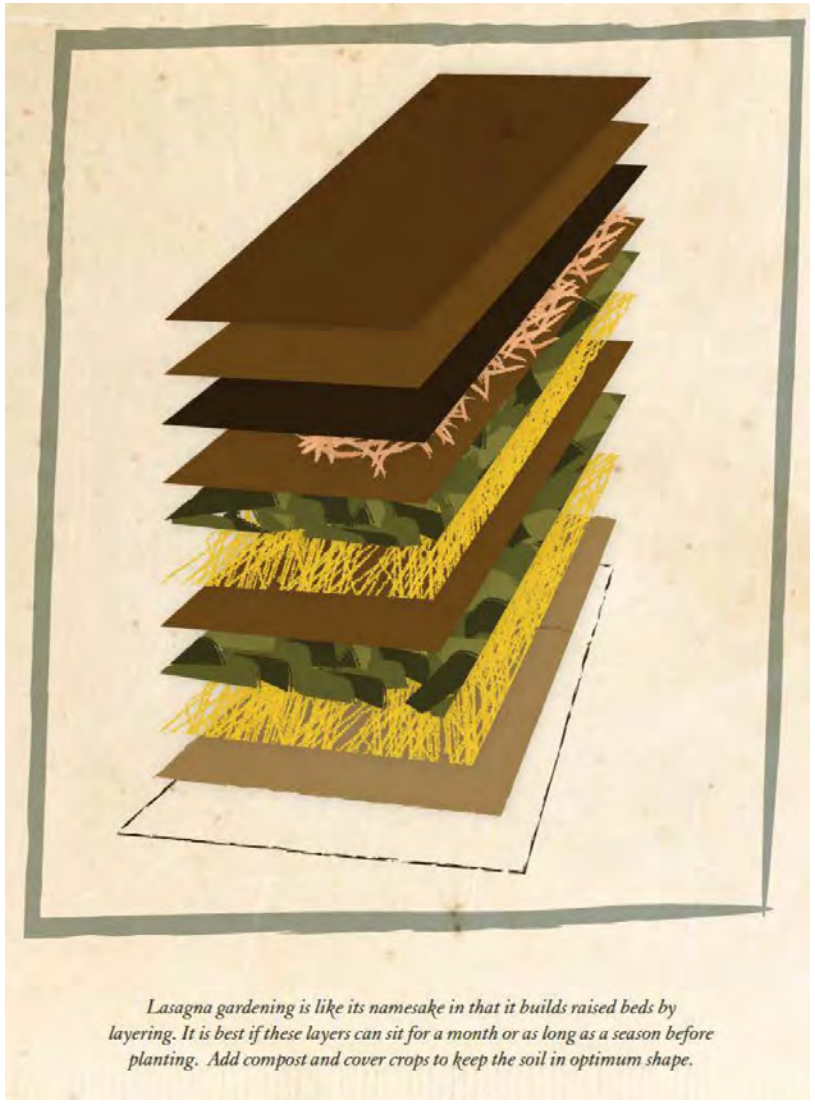
Why Is There Lead In The Soil?

Emissions from industrial activities, lead-based paint from older homes and commercial buildings, and lead from combustion of leaded gasoline all put lead into the atmosphere. The soil then acts like a sponge, absorbing and accumulating decades of harmful lead in the surface layers—typically, the top 4-6 inches of soil. The lead then stays in the soil. So, even though lead-based paint and leaded gasoline are no longer used, the lead released long ago is still in the upper soil layers. This is especially dangerous because gardening utilizes this very portion of the soil.

So, Is It Dangerous To Garden?

No! Although it may seem scary and intimidating, lead in your soil is no reason to stop gardening. In fact, with the proper steps not only will your garden be safe, but also your entire backyard will become a healthier environment. There are two simple steps for safe gardening – test your soil and then take the proper action if necessary.

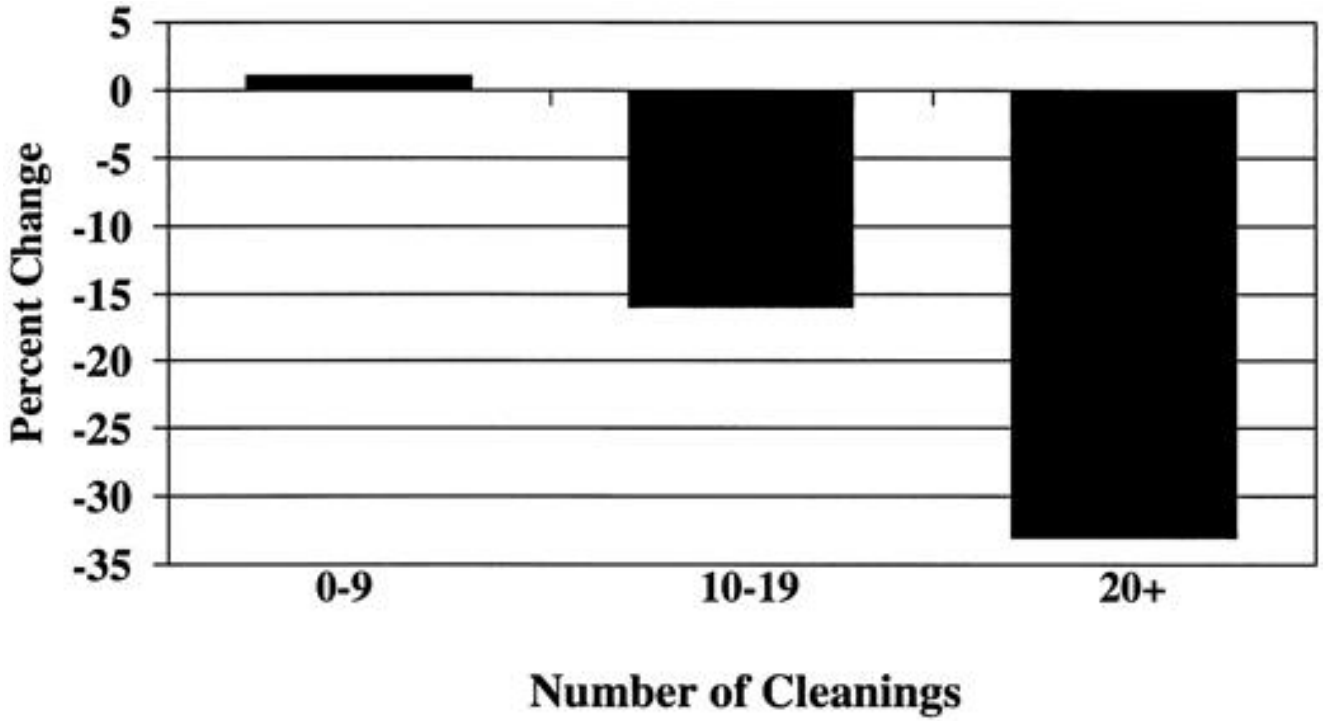
What are some safe gardening practices?



Lasagna gardening is like its namesake in that it builds raised beds by layering. It is best if these layers can sit for a month or as long as a season before planting. Add compost and cover crops to keep the soil in optimum shape.

Secondary interventions

- Household cleaning shown to reduce child BLLs up to 34%
- More cleaning (i.e., vacuuming, wet mopping, etc.) resulted in greater drops in BLLs



Rhoads, G. G., Ettinger, A. S., Weisel, C. P., Buckley, T. J., Goldman, K. D., Adgate, J., & Lioy, P. J. (1999). The effect of dust lead control on blood lead in toddlers: a randomized trial. *Pediatrics*, *103*(3), 551-555.

Following exposure, environmental stimulation and reading can offset negative effects

- “Our work demonstrates that by providing an enriched early life environment, the adverse effects of lead on the brain may be minimized or potentially reversed, emphasizing how important early childhood interventions may be.”-Jay Schneider, PhD

https://www.jefferson.edu/about/news-and-events/2022/07/lead-poisoning-may-be-reversible-with-childhood-enrichment.html

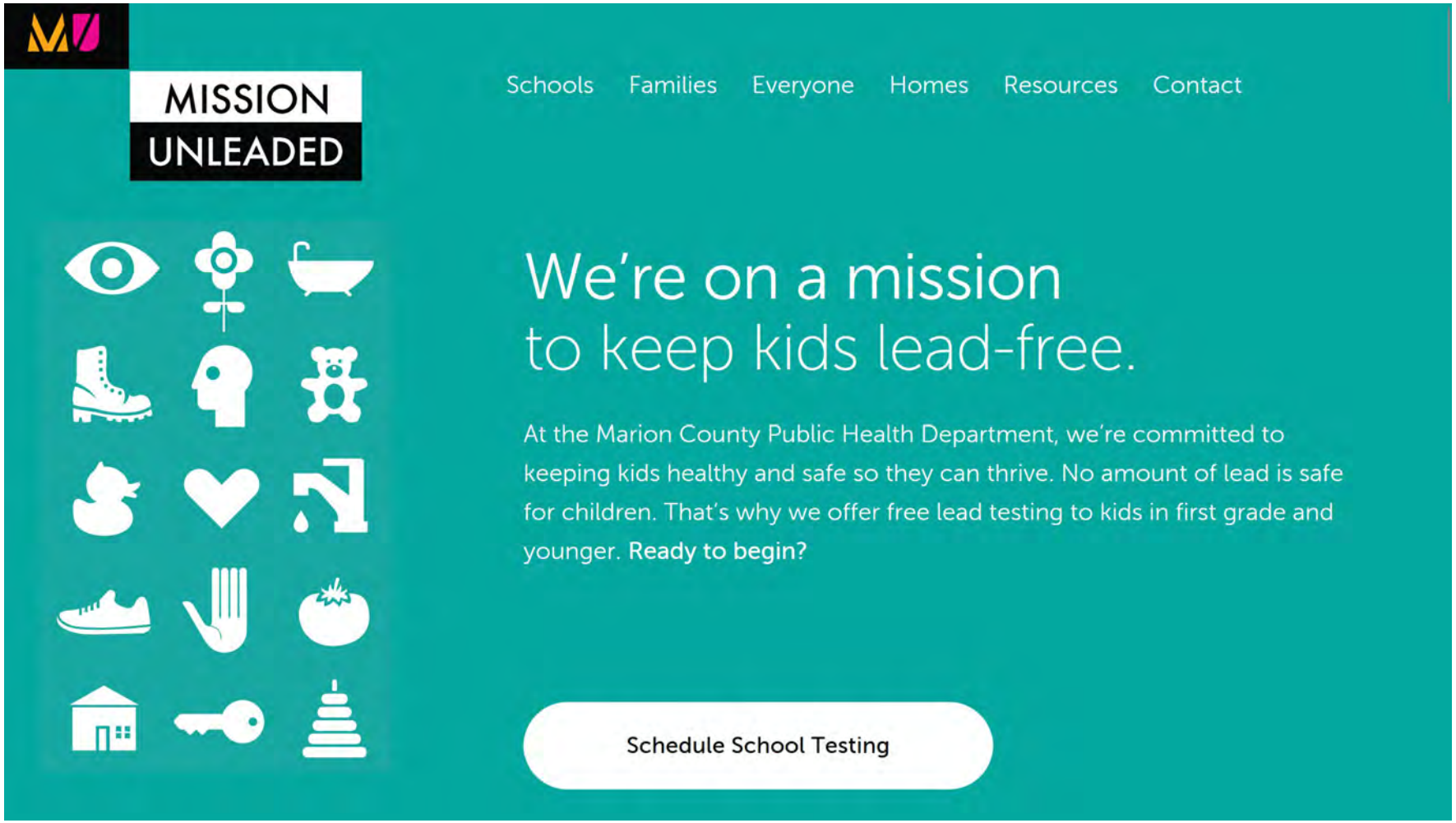
Singh, G., Singh, V., Kim, T. *et al.* Altered genome-wide hippocampal gene expression profiles following early life lead exposure and their potential for reversal by environmental enrichment. *Sci Rep* **12**, 11937 (2022). https://doi.org/10.1038/s41598-022-15861-9

Educational activities and supportive home environment

- Detailed working group summarizing educational interventions for children affected by lead (CDC)
  - Provides multiple resources and information

  https://www.cdc.gov/nceh/lead/publications/educational_interventions_children_affected_by_lead.pdf

Community Resources-MCPHD



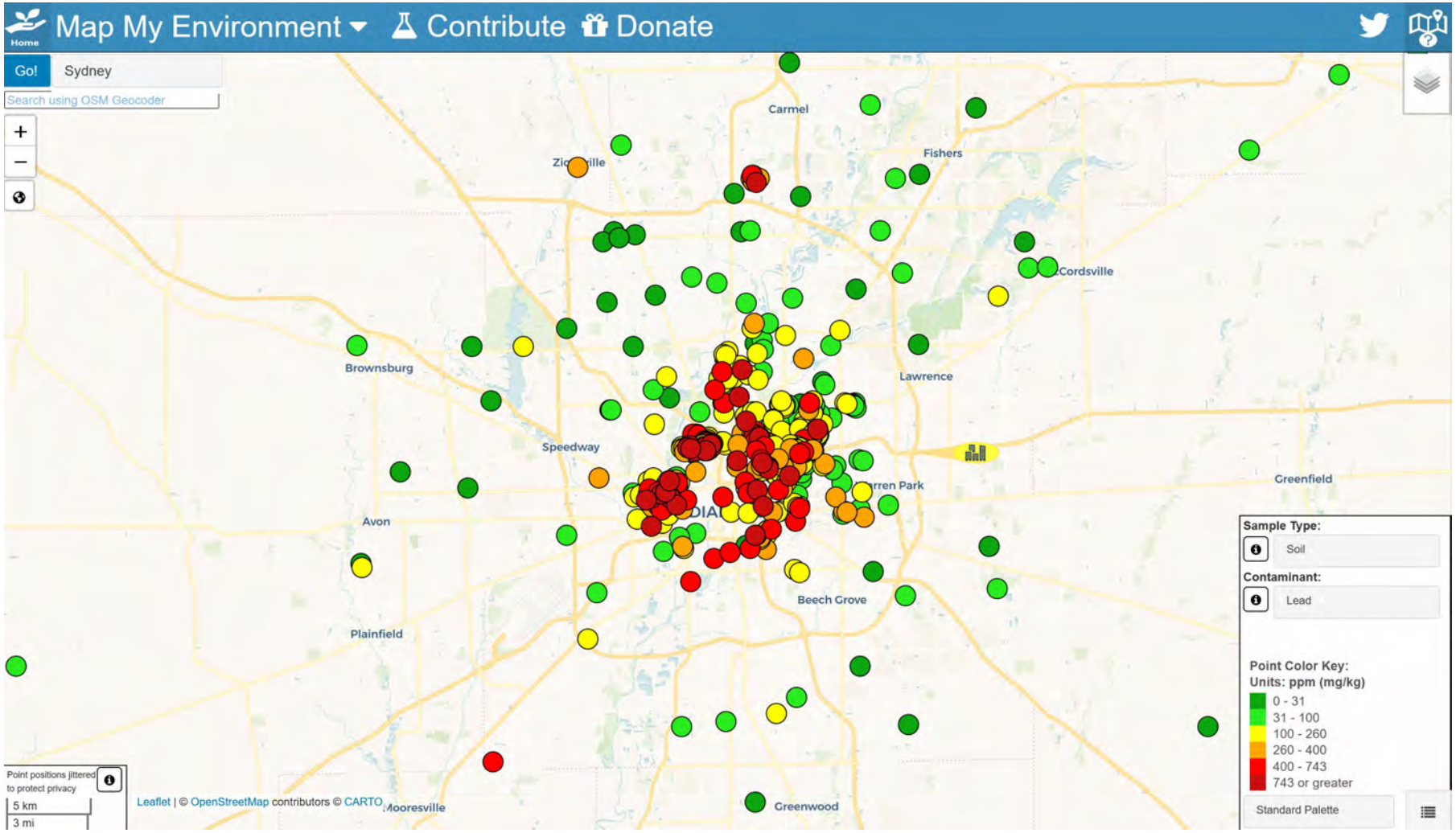
https://missionunleaded.org/

National Resources

- Environmental Justice Toolkit for Lead Paint Enforcement Programs (U.S. EPA)
- “The Toolkit includes strategies for developing partnerships, conducting community engagement, and maintaining ongoing communication with the communities where enforcement activities are planned or ongoing; it provides methods for how to target inspections in overburdened communities; and information and examples on remedies available that enhance environmental justice.”

Data resources

- Map My Environment
- https://iupui-earth-science.shinyapps.io/MME_Global/



Justification for more programming/resources in certain areas

- Areas/individuals most impacted by lead exposure often have the least number of resources available for assistance
- Why data can be a powerful tool to justify greater funding/assistance

Thank you!

Questions?

Get in Touch

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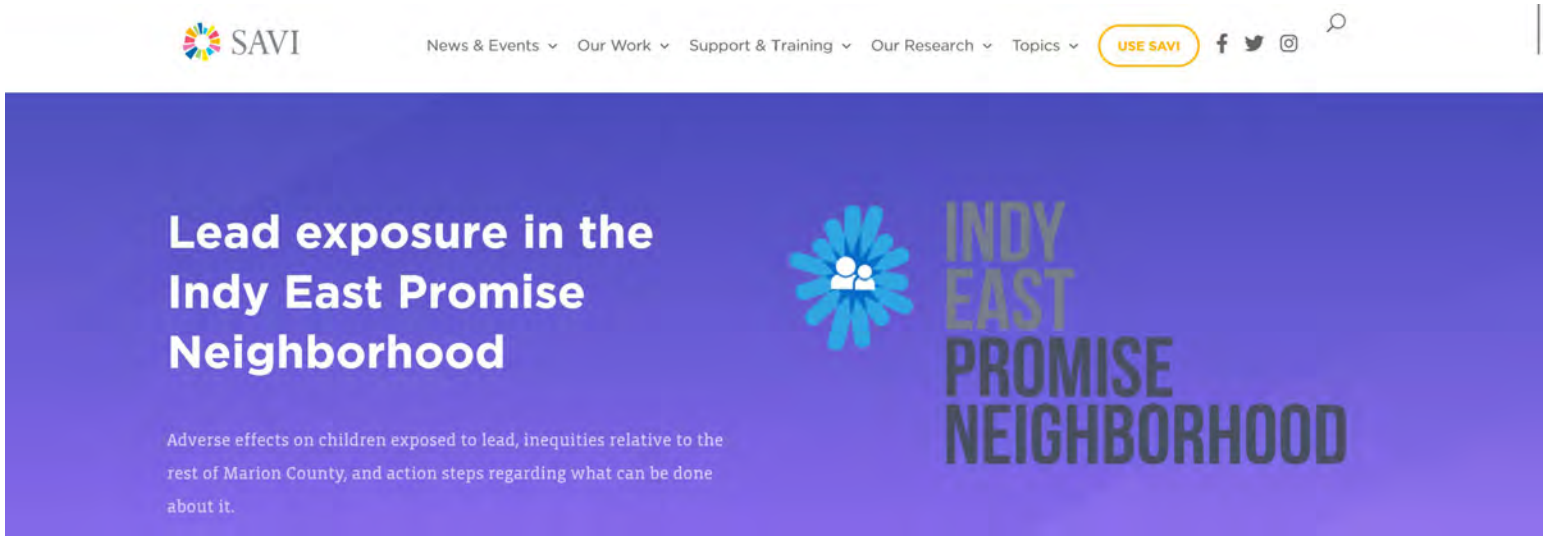
https://www.savi.org/



https://www.savi.org/promise-neighborhood-child-blood-lead-analysis/