

# Update on EPA Lead Mapping Efforts to Identify Locations at Higher Risk of Lead Exposure

Lead Exposure and Prevention Advisory Committee (LEPAC) Meeting  
December 3, 2021

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# Disclaimer

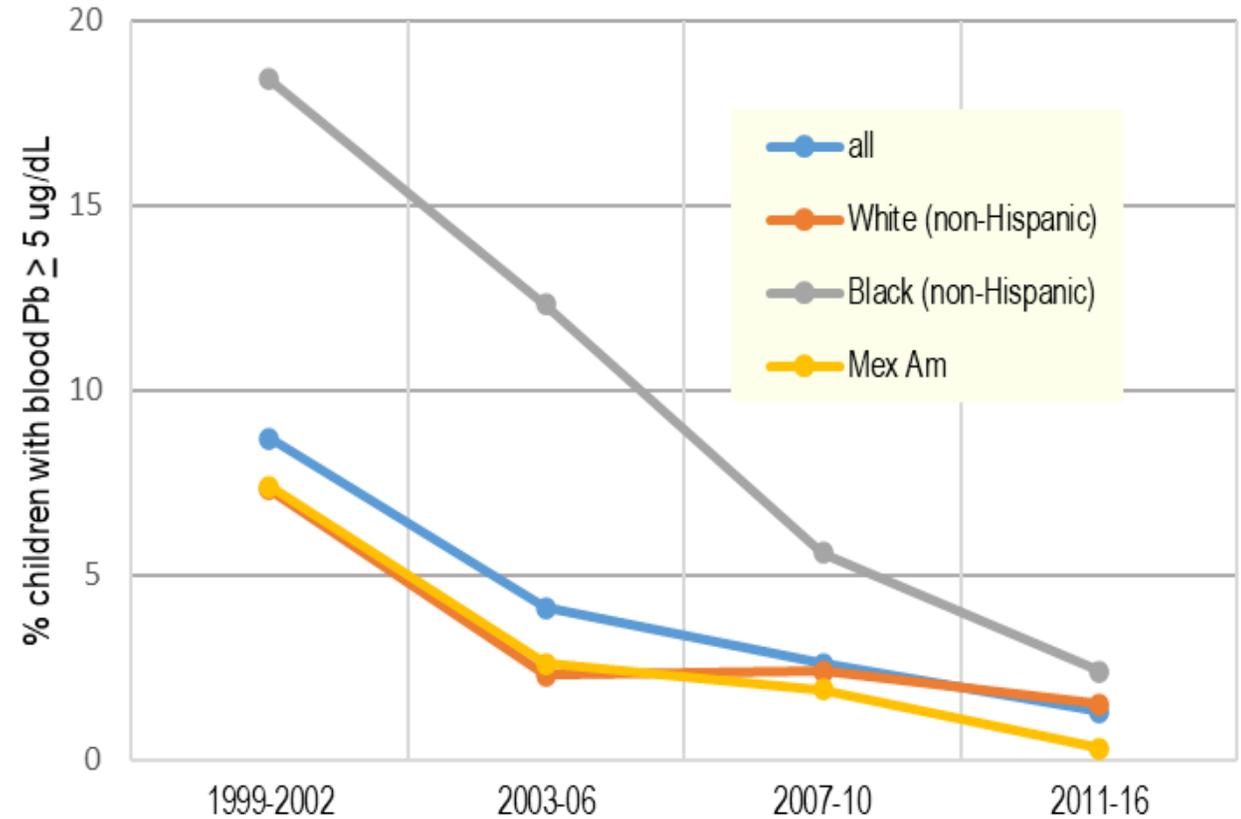
- This presentation is in non-final DRAFT form and is intended for EPA use at the LEPAC meeting only. EPA intends to use the draft preliminary results herein solely for use during limited, collaborative discussions.
- The draft maps and analyses within this presentation are part of a submitted EHP journal manuscript that is currently under review and could be modified at a later date. This presentation has not yet been peer reviewed outside of EPA.
- The views expressed in this presentation are those of the authors and do not necessarily reflect the views or policies of the U.S. EPA.
- Michigan Department of Health and Human Services (MDHHS) has provided blood lead data used in this presentation, pursuant to a Data Use Agreement. MDHHS has had an opportunity to review the use of Michigan's data as it was presented in the draft manuscript on which this presentation is based, but MDHHS has not reviewed or endorsed the methodology or results summarized in this presentation.



# Great Progress but Exposures Remain

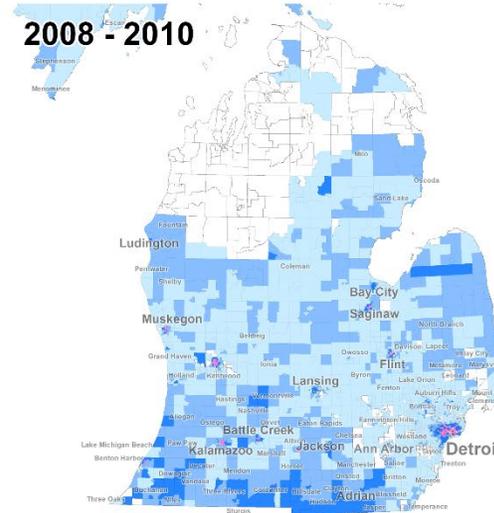
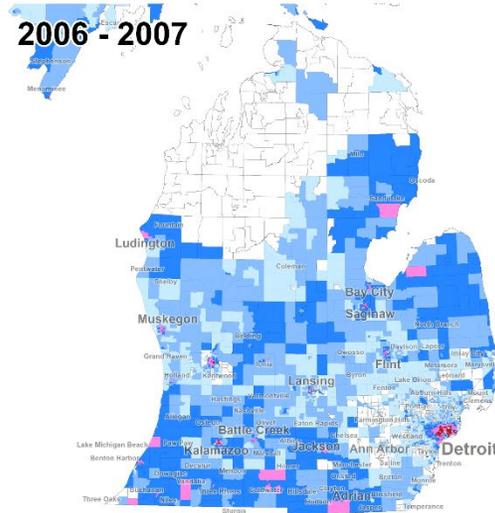
- Despite significant decreases in lead exposures nationally over the past several decades there are communities and families across the U.S. that are still exposed to elevated levels of lead.
- The burden of exposures disproportionately impacts African Americans and communities with lower socioeconomic status.
- The identity of these sources within each community are not always known, and there may be more than one media affected.
- The cost of removing all potential sources would be large.

Prevalence of "Elevated" Blood Lead, Children 1-5 yrs old



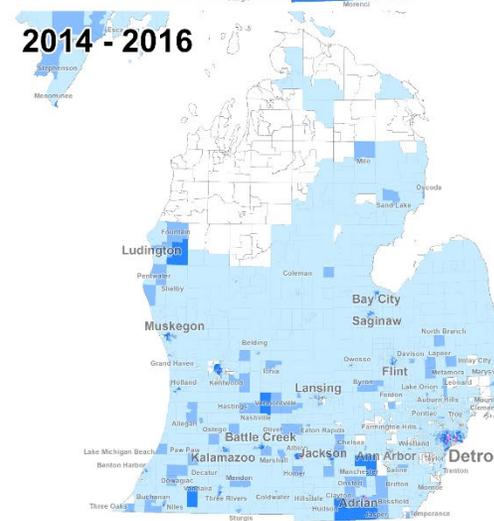
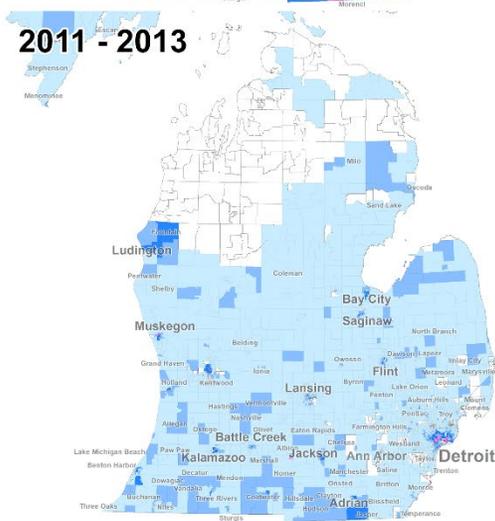


# Why Mapping?

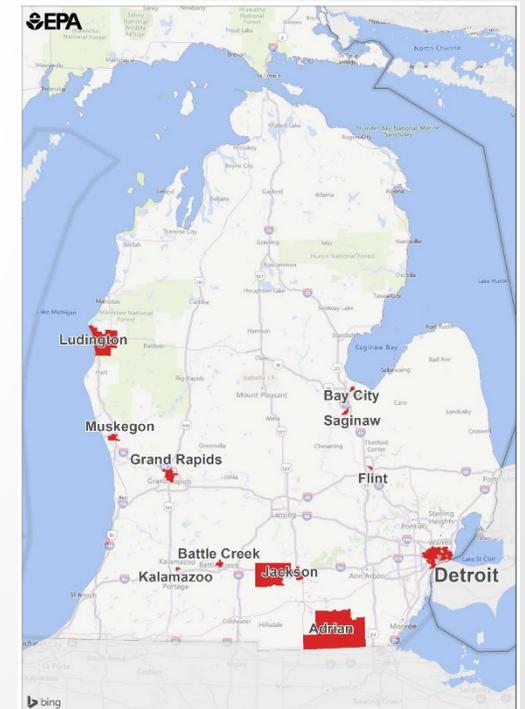


**% EBLLs (≥ 5 µg/dL)  
By Census Tract  
Children 0 to <6 yrs.**

- 0 - 5
- >5 - 10
- >10 - 20
- >20 - 40
- >40 - 70



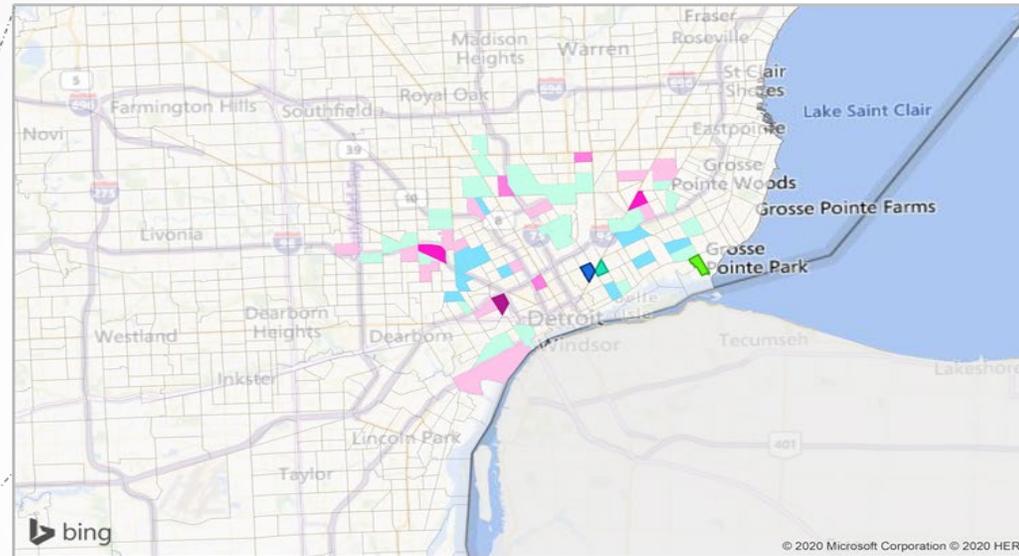
Mapping powerfully illustrates the progress made in reducing exposures and identifies locations needing further attention.





# Maps illustrate disproportionate impact

Detroit Area



### Exceedance Rate of EBLL Category - INCREASE

- 5-10 to 10-20
- 0-5 to 10-20
- 10-20 to 20-40
- 5-10 to 20-40

### Exceedance Rate of EBLL Category - DECREASE

- 10-20 to 5-10
- 10-20 to 0-5
- 20-40 to 10-20
- 20-40 to 5-10
- 40-70 to 20-40
- 40-70 to 10-20

Xue, Zartarian et al., submitted EHP journal manuscript Under Review



# Draft EPA Lead Strategy

## **Identify the communities in the U.S. with high lead (Pb) exposures and improve their outcomes**

- **Reduce lead exposures locally with a focus on communities with environmental justice concerns**
- **Collaborate across agencies and departments to identify and address lead hotspots in the U.S.**
- **Identify the dominant local environmental drivers**
- **Focus EPA lead reduction actions on overburdened communities where lead exposures and prevalence of elevated blood lead levels are among the highest**

Public comment through March 16, 2021

<https://www.epa.gov/lead/draft-strategy-reduce-lead-exposures-and-disparities-us-communities>



# Using Mapping to Prioritize Agency Actions



## **REGULATORY**

**Remediation, enforcement,  
and other actions under TSCA,  
SDWA, CWA, CAA, CERCLA,  
RCRA including:**

**Soil sampling, lead service line  
replacements, inspections,  
remediation/certification**



## **ENVIRONMENTAL JUSTICE**

**Reducing lead exposures to  
reduce racial disparities**



## **PARTNERSHIPS**

**Federal, tribal, state, and local  
governments, public health  
agencies, and non-  
governmental organizations**

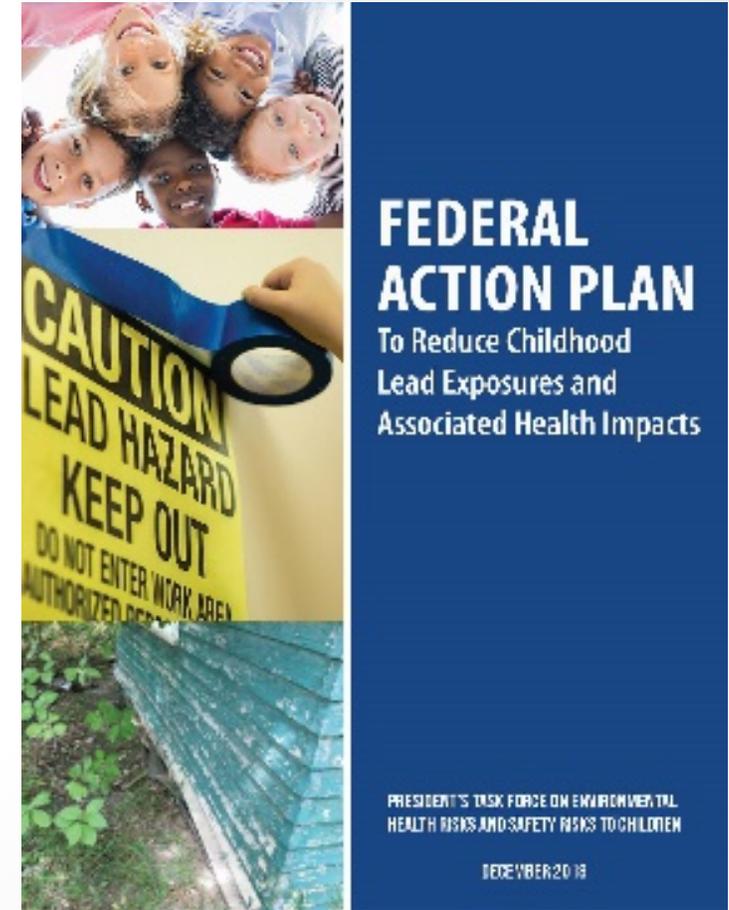


# Federal Lead Action Plan to Reduce Childhood Lead Exposure

## ➤ Five Goals

### ➤ Goal 4: Support and Conduct Critical Research to Inform Efforts to Reduce Lead Exposures and Related Health Impacts

- Prioritize, address critical research and data needs to inform lead policies & guide decisions
- Action 2. **Generate data, maps and mapping tools to identify high exposure communities or locations and disparities for prioritization efforts to reduce children's blood lead levels.**



# FEDERAL AGENCY LEAD MAPPING: DIFFERENT TOOLS & APPROACHES FOR DIFFERENT PURPOSES



It is the mission of the U.S. Department of Health & Human Services (HHS) to enhance and protect the health and well-being of all Americans.

*Health impacts of lead exposure.*



HUD's mission is to create strong, sustainable, inclusive communities and quality affordable homes for all.

*Lead exposure in housing.*



The mission of EPA is to protect human health and the environment.

*Lead in the environment.*



# Data Challenges and Limitations

## **SOCIODEMOGRAPHIC & HOUSING**

- Challenges with a systematic approach to selecting most relevant variables
  - e.g., schools/daycare, household status, population information
- Different choices can produce different map results
  - e.g., age of housing, income and ethnicity/race variables

## **ENVIRONMENTAL**

- Commonly considered environmental variables are contaminated media, drinking water, soil, air – but challenges obtaining, extrapolating, modeling local or site-specific data

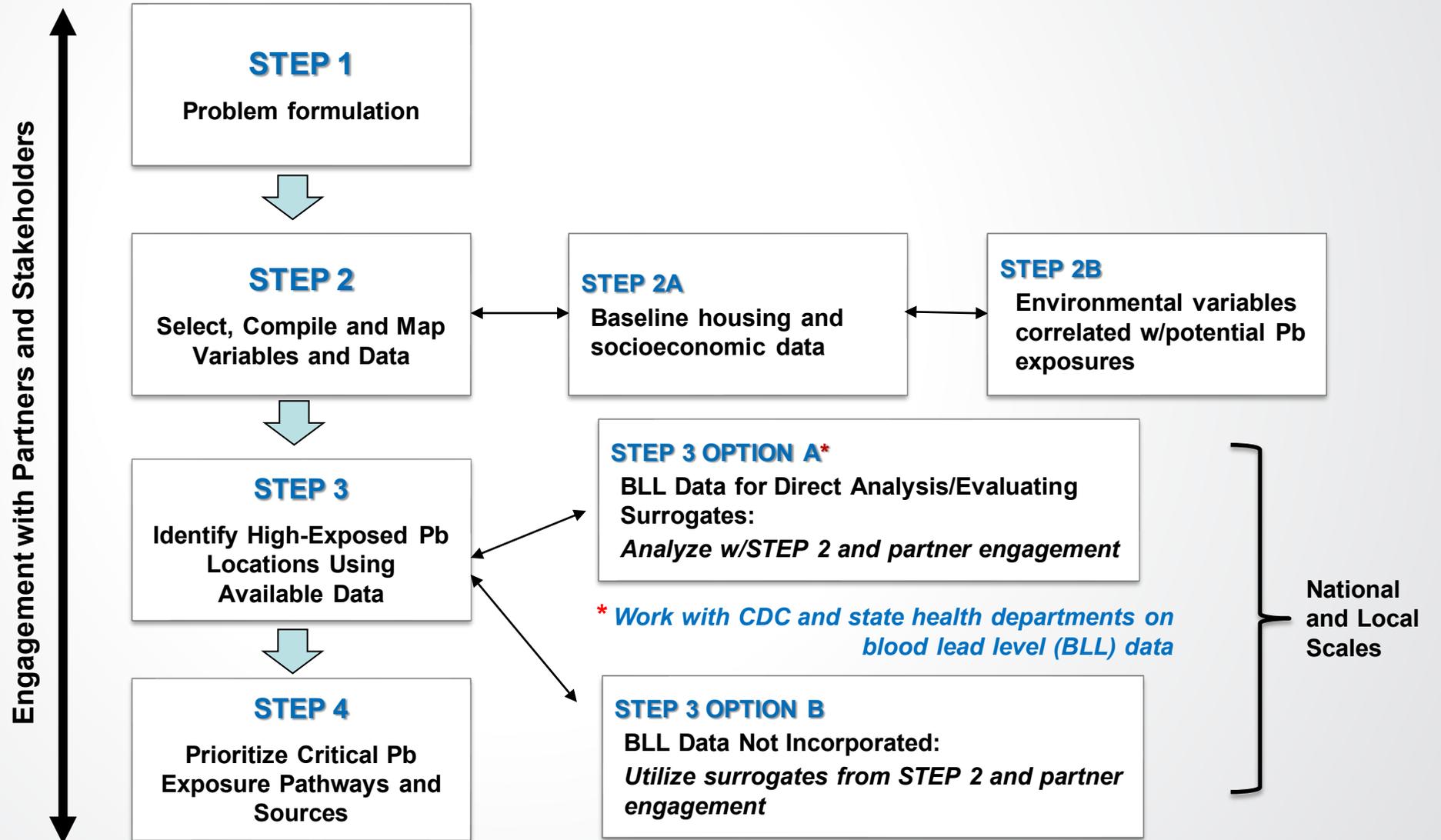
## **BLOOD LEAD LEVELS (BLLs)**

- Different availability of BLL data and geographic scales
- Variation in States' testing and methods for collecting/analyzing BLL data
- Analytical challenges for researchers using data reported as BLL > 5 or 10 ug/dL, or % exceeding the CDC reference level, rather than the actual BLL number

Zartarian et al., 2019,  
NEHA Conference,  
Nashville, TN



# OVERALL APPROACH

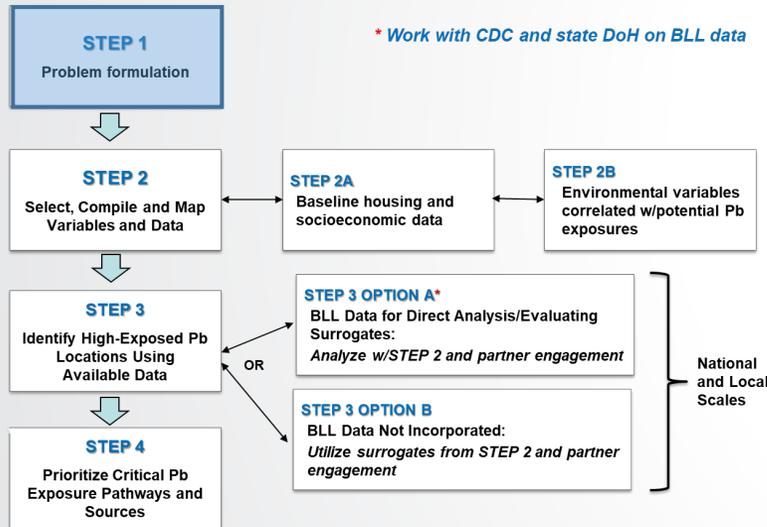




# STEP 1 – Problem Formulation

## ■ Fit-for-Purpose Mapping:

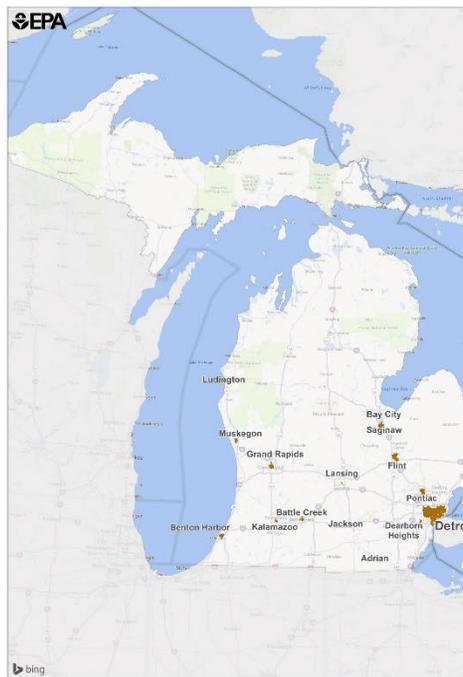
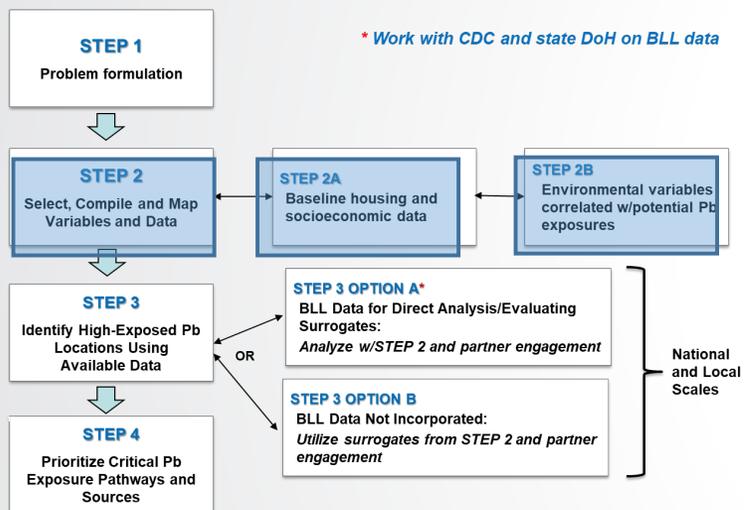
- How can we focus multi- environmental media resources in the most disproportionately impacted communities?
- Can we prioritize potential sources of lead exposure, e.g., soil, dust, drinking water, air, in different locations?
- Where might additional data be needed to identify sources of exposure?
- Where can we focus resources to reduce lead-based paint exposures?
- What places might be eligible for federal or state lead mitigation programs?



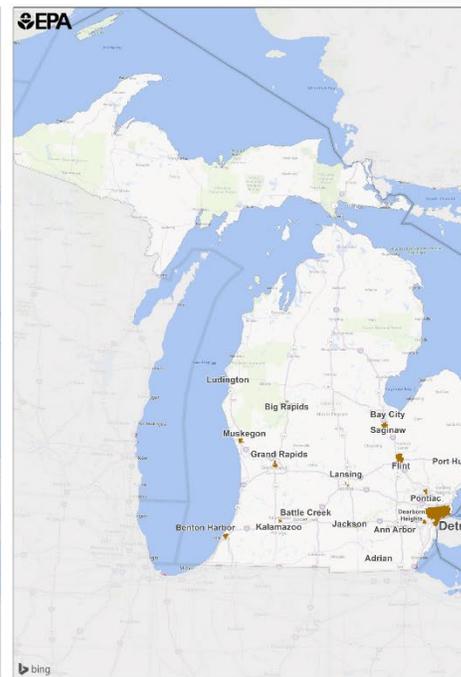
- **Identify and engage partners:** e.g., through state, tribal, and local agency joint planning workgroups



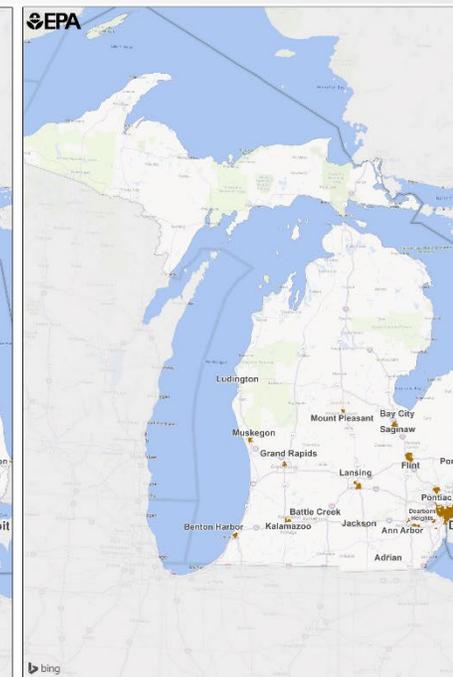
# STEP 2 – Select, Compile, Map Variables & Data (data convergence analysis)



**EPA EJSCREEN Pb  
Paint EJ Index**



**EPA Schultz et al. (2017)  
Modeled BLL Data**



**HUD Deteriorated  
Paint Index**

Xue, Zartarian et al.,  
submitted EHP journal  
manuscript Under Review

3 Available Pb Exposure Models/Indices Based on Old Housing and  
Sociodemographics (2 from EPA, 1 from HUD) are Statistically  
Consistent (e.g. Kappa Score >0.8)



## Data Sources: Lead Indices

- **EPA EJSCREEN 2017 Pb Paint EJ Index** ([www.epa.gov/ejscreen](http://www.epa.gov/ejscreen))
  - EPA Office of Environmental Justice developed at Census Block Group level
  - Uses American Community Survey 2011-2015 5-year summary file
    - Based on pre-1960 homes, % low income, % minority, population
  - Aggregated per Census Tract
  
- **EPA multiple regression model** ([Schultz et al., 2017, Env. Justice](#))
  - Predict children's blood lead levels (BLLs) at Census Tract level
  - Uses American Community Survey 2012-2016 5-year summary file
    - Significant variables: % pre-1960 homes, % below poverty line, % non-Hispanic African Americans
  - EPA ORD Modeled BLL values are for the year 2015 and children aged 1-2 years
  - Evaluated against 3 States' measured BLL data
  
- **HUD Deteriorated Paint Index** ([Garrison & Ashley, 2020](#))
  - Provided by the US Department of Housing and Urban Development (<https://hudgis-hud.opendata.arcgis.com/datasets/deteriorated-paint-index-by-tract>)
  - Uses 2011 American Housing Survey and 2009-2013 American Community Survey Data

**Note: Other peer-reviewed indices could be incorporated into EPA data convergence analyses.**



## Data Sources: Blood Lead Levels (BLLs)

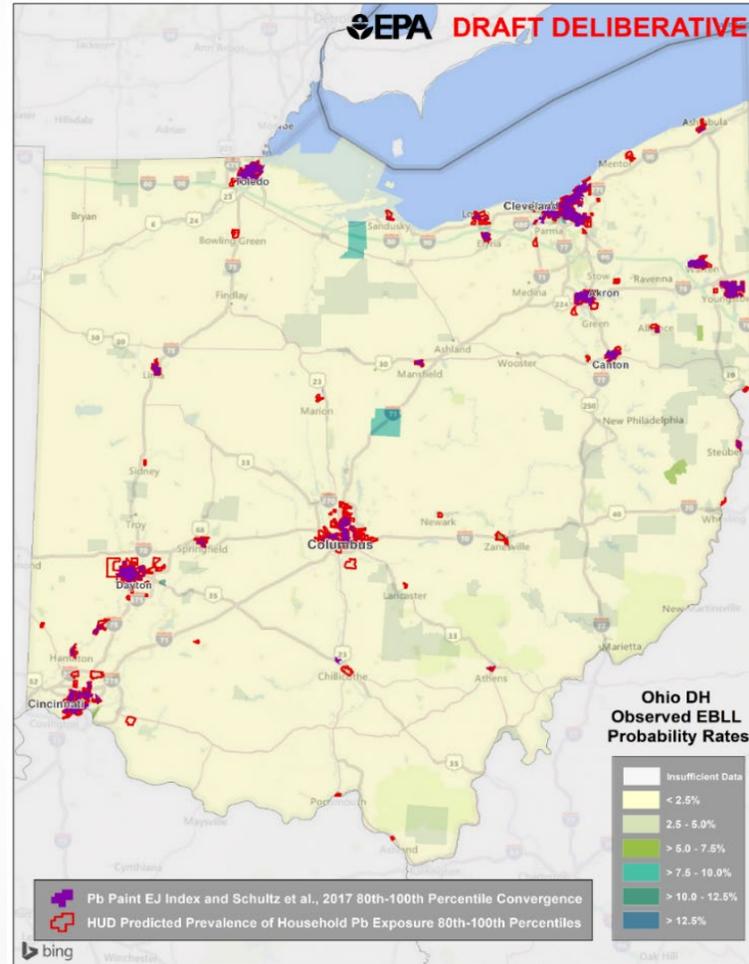
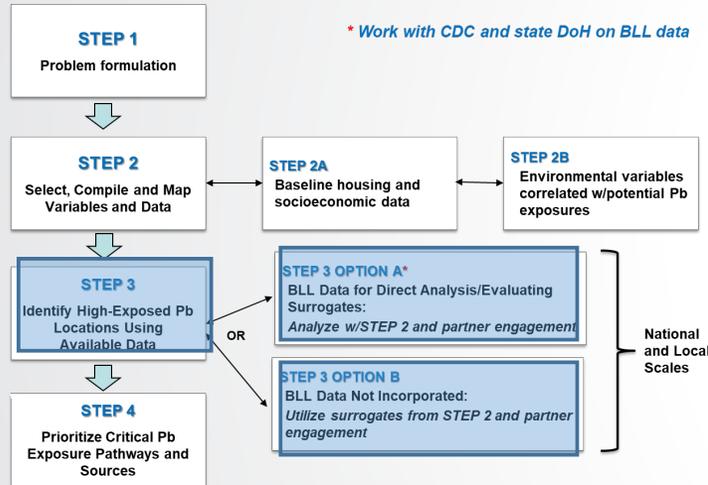
- **Publicly available blood lead level (BLL) data and maps**
  - [Reuters 2016 Analysis: Nationwide Analysis Map for Prevalence of Childhood Elevated BLL by Census Tract or Zip Code](#)
    - Underlying data not publicly accessible. Maps used for visual comparison purposes. Data resolution and years can vary greatly from state to state.
  - [CDC National Environmental Public Health Tracking Network](#)
    - County data exists for states participating in the CDC's Childhood Lead Poisoning Prevention Program
  
- **For Michigan and Ohio case studies: BLL data acquired through states-ORD data use agreements (with IRB approvals)**

**MI:** BLL data provided by the Michigan Department of Health and Human Services Childhood Lead Poisoning Prevention Program in 2017; EPA Office of Research and Development (ORD) geocoded ~1.9 million MI BLL data points from 2006-2016

**OH:** ORD obtained and geocoded children's BLL data (ages 0-7 yrs.) from Ohio Department of Health for the years 2005-2019; ~2.35 million BLL data points



# Step 3 Methodology to Identify High-Exposed Pb Locations Using Available Data



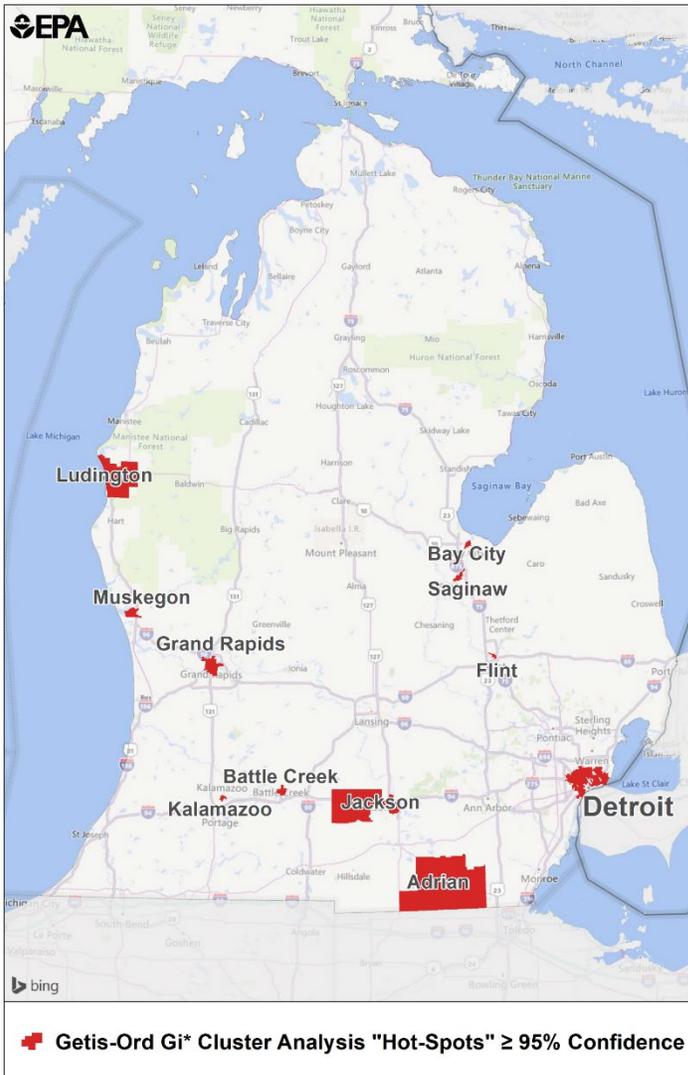
- Iterative approach with partners
- Data convergences of public indices (housing age, sociodemographics) with available blood lead level (BLL) data
- Method evaluation: case studies
- Use of existing surrogates in absence of BLLs: 2 methods
- Other environmental drivers and enhanced surrogates: *in progress*



# STEP 3 – Using Blood Lead Level (BLL) Data

## *Geospatial Statistical Analysis of Michigan BLL Data*

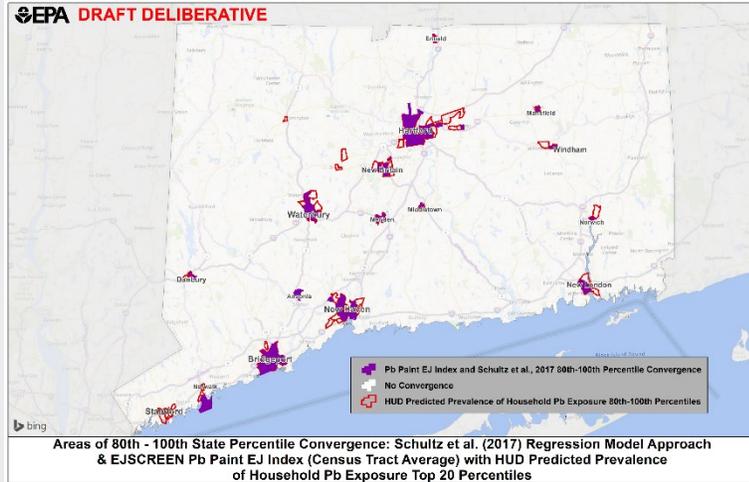
- Geocoded ~1.9 million blood lead level (BLL) data points from 2006-2016, from Michigan Department of Health and Human Services (MDHHS) Childhood Lead Poisoning Prevention Program (CLPPP)
- Analyzed BLL data for robustness to identify statistical hotspots
- [Getis-Ord Gi](#) cluster analysis & top 20 percentile methods using exceedance rate  $>5 \mu\text{g/dL}$  (2014-16;  $<6$  year-olds)
- Next: use available data and local knowledge to determine environmental drivers



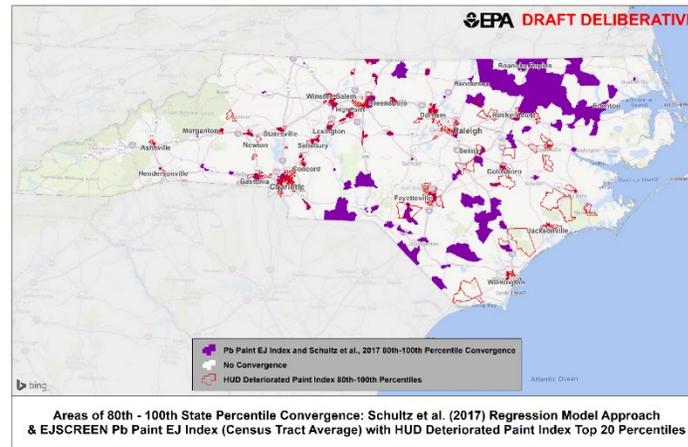


# STEP 3: USING SURROGATES (public indices based on housing age & sociodemographics): WITHOUT BLL DATA

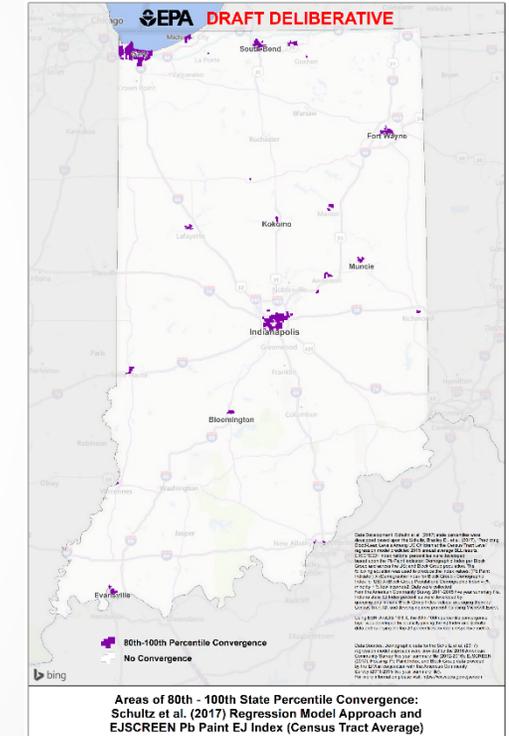
## EPA Office of Research and Development (ORD) with REGION 1



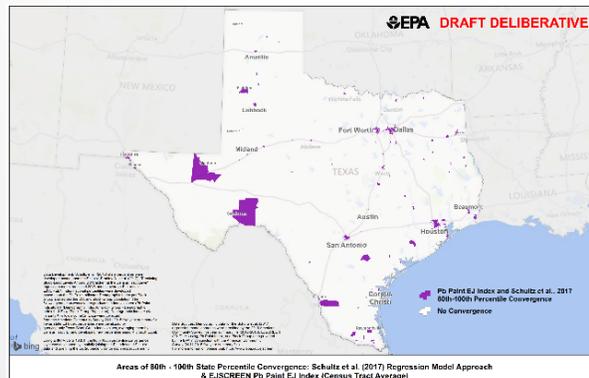
## ORD with REGION 4



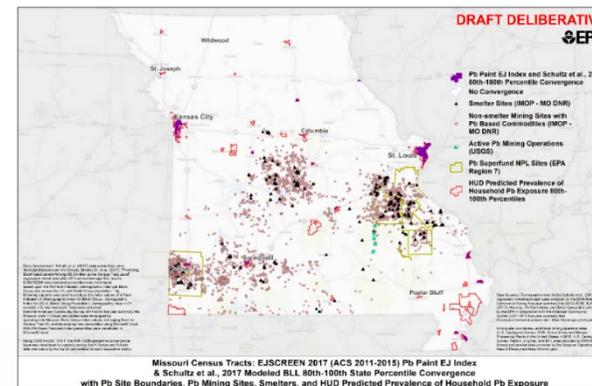
## ORD with REGION 5



## ORD with REGION 6

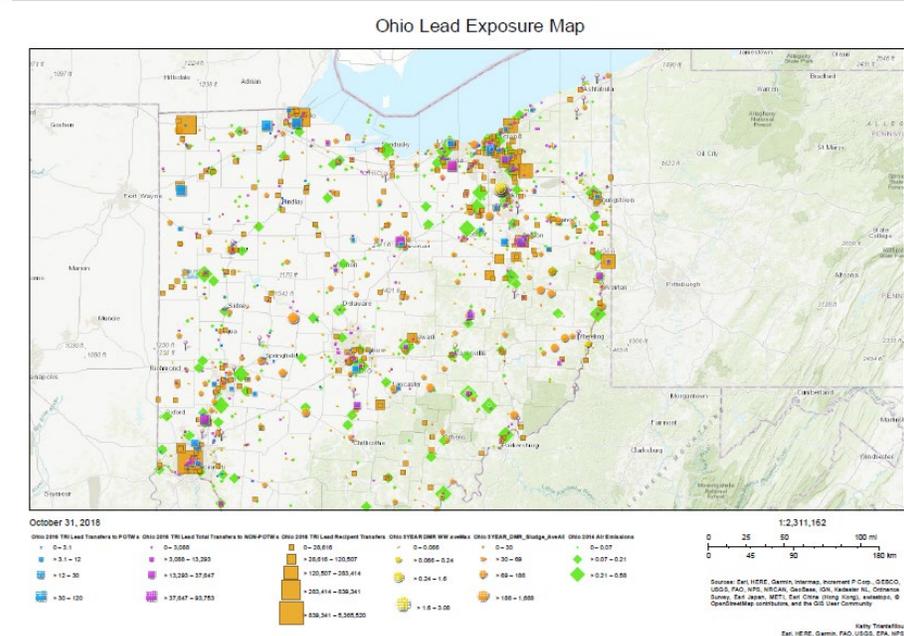
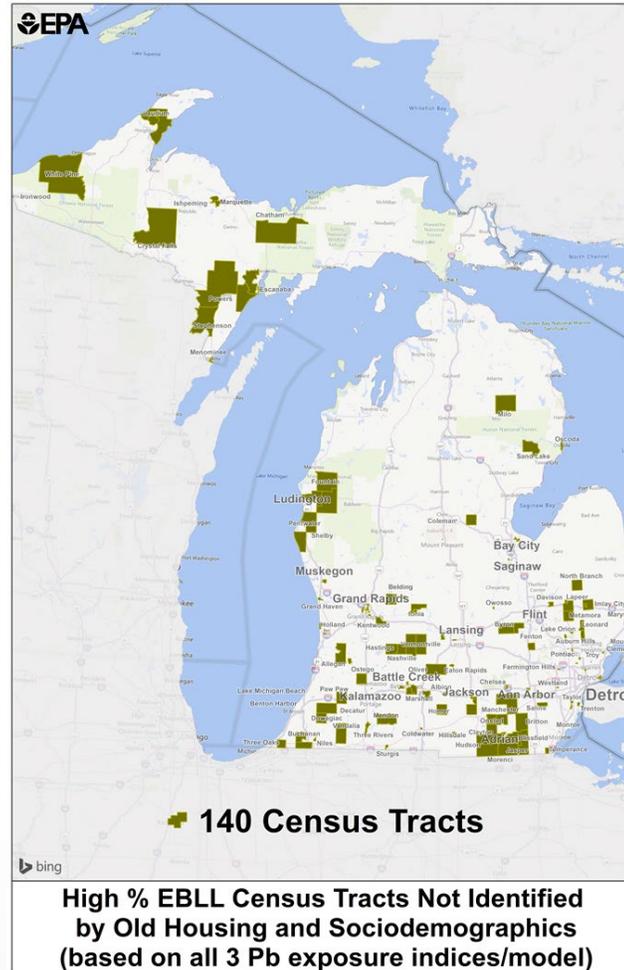
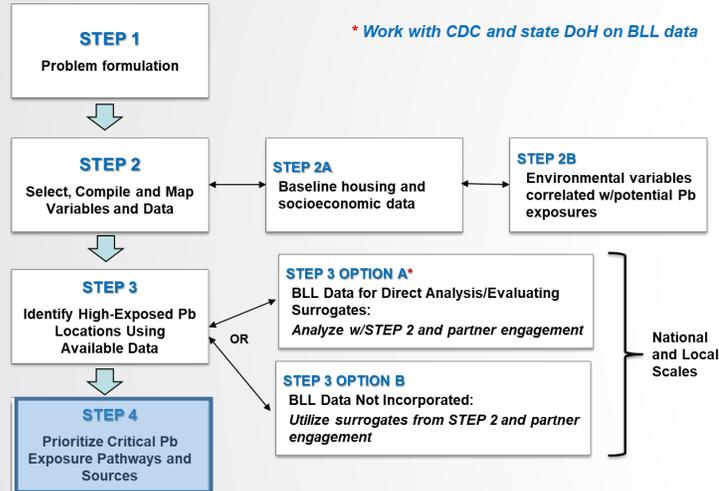


## ORD with REGION 7





# Step 4 - Prioritize Critical Lead (Pb) Exposure Pathways and Sources (Underway)



Working with EPA Office of Enforcement and Compliance Assurance (OECA) & EPA Region 5

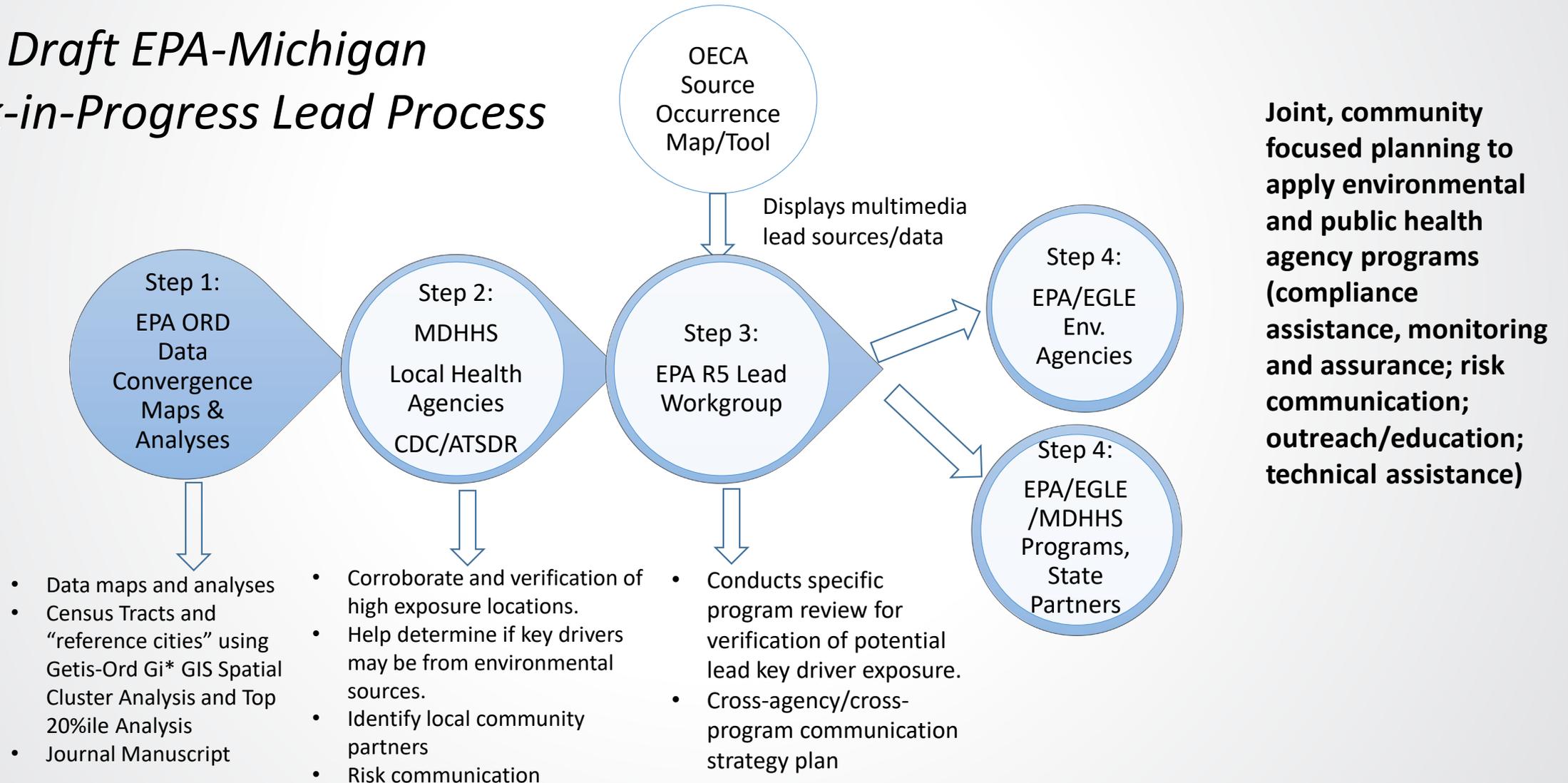
Environmental variables correlated with potential lead exposures based on literature, program/regional office expertise, and data

Xue, Zartarian et al., submitted EHP journal manuscript Under Review



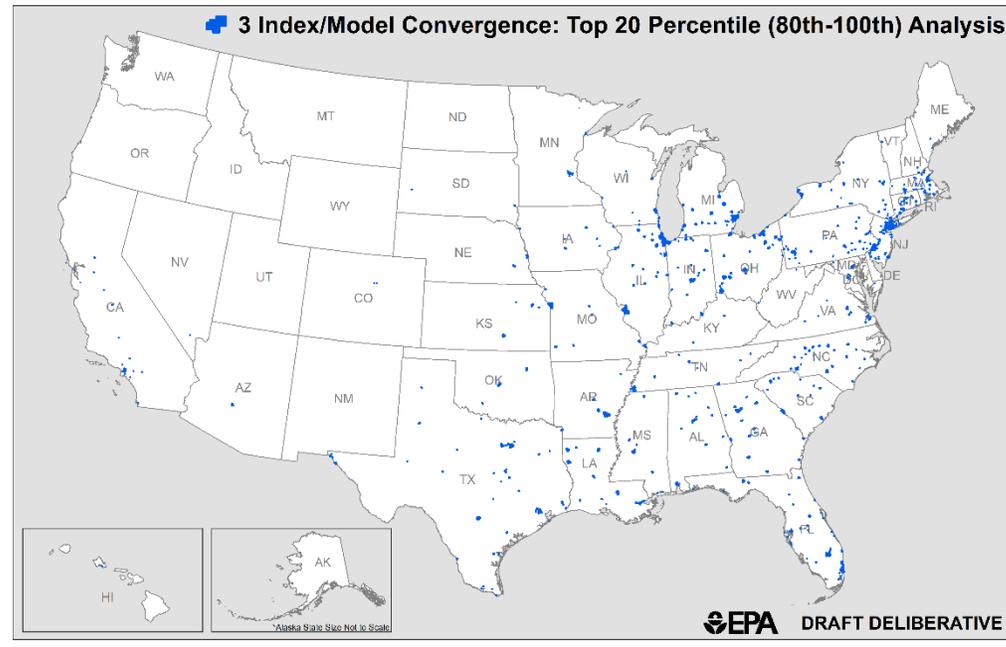
# Example Application of Lead Mapping Science

## Draft EPA-Michigan Work-in-Progress Lead Process

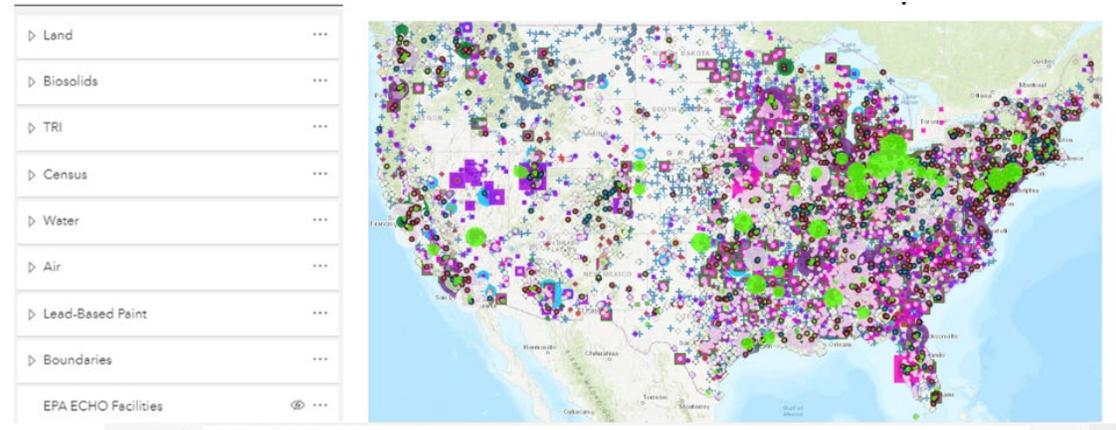




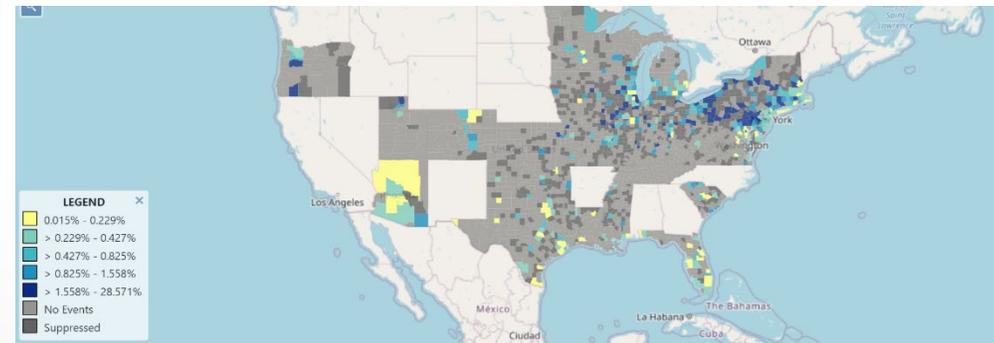
# National-scale efforts underway to target lead (Pb) exposure prevention



## EPA Office of Enforcement and Compliance Assurance (OECA) Work-in-Progress Lead Occurrence and Source Map



## CDC Environmental Public Health Tracking Network (EPHTN) County Elevated Blood Lead Level (EBLL) Map



EPA Office of Research and Development (ORD) Work-in-Progress convergence analyses of 3 public Pb indices (2 EPA, 1 HUD) based on old housing and sociodemographics

Methodology from Xue, Zartarian et al. MI case study, submitted EHP journal manuscript Under Review



## ANTICIPATED IMPACTS

- **The Agency** will be able to better address/support:
  - EPA Federal regulations and guidance for Pb; actions for environmental justice (EJ); Partnerships with states and Federal/local governments; and the Federal Lead Action Plan.
  - Lead (Pb) geographic initiatives focused on multi-media enforcement targeting, compliance assistance, and EJ efforts; and inform Federal-state joint planning collaborations for Pb reduction actions.
  
- **States, Communities** will be able to:
  - more effectively target and prioritize Pb risk reduction, prevention and mitigation efforts in the most vulnerable locations/populations.



## PLANNED NEXT STEPS

- Expand use of peer-reviewed approach to U.S. map and analysis; ground-truth through EPA Regional and state collaborations with available data and local knowledge
  - Examine environmental data in lead (Pb) hotspots
- Leverage opportunities for synergizing federal Pb mapping tools/approaches
  - Considerations for use of state BLL data
  - Data sharing agreements for environmental and BLL data
    - Collect additional data (e.g., state/federal partnerships) via data use agreements (DUAs), memoranda of understandings/agreements (MOUs/MOAs), potentially new field studies
- Conduct modeling with available data to identify key environmental exposure pathways and drivers of elevated blood lead levels (EBLLs)
- Disseminate results to inform decisions; develop coordinated risk communication



## REFERENCES

- **A Generalizable Evaluated Approach, Applying Advanced Geospatial Statistical Methods, to Identify High Lead (Pb) Exposure Locations at Census Tract Scale: Michigan Case Study.** J. Xue, V. Zartarian, R. Tornero-Velez, L. Stanek, A. Poulakos, A. Walts, K. Triantafillou, M. Suero, N. Grokhowsky. Journal manuscript submitted to *Environmental Health Perspectives*, Under Review.
- **Collaborative Evidence-Based Approach for Identifying High Lead (Pb) Exposure Locations with Draft Examples from Several States.** (2019). V. Zartarian, R. Tornero-Velez, A. Poulakos, J. Xue, L. Stanek, C. Lee, A. Walts, K. Triantafillou, M. Suero, A. Brees, G. Gunn, C. McLaughlin. National Environmental Health Association (NEHA) Conference. Nashville, TN, July 11, 2019.



## Acknowledgments

- EPA colleagues
  - Office of Research and Development (ORD) Lead mapping team: Jianping Xue, Lindsay Stanek, Rogelio Tornero-Velez; contractors Antonios Poulakos and Nicholas Grokhowsky
  - Regional Offices collaborators and science liaisons (Regions 1, 4, 5, 6, 7)
  - ORD managers and communications, including Steve Dutton, Emily Snyder, Lisa Baxter, Samantha Jones, Wayne Cascio, Tim Watkins, Maureen Gwinn, Jennifer Cashdollar, Susan Julius, Marjorie Jones, Kelly Widener
  - EPA Program Offices collaborators involved in Pb mapping efforts
- Collaborators in other agencies, including:
  - HUD
  - MDHHS
  - OH DH
  - CDC/ATSDR