EPA Tools and Resources Webinar: Urban Background Study

January 17, 2018

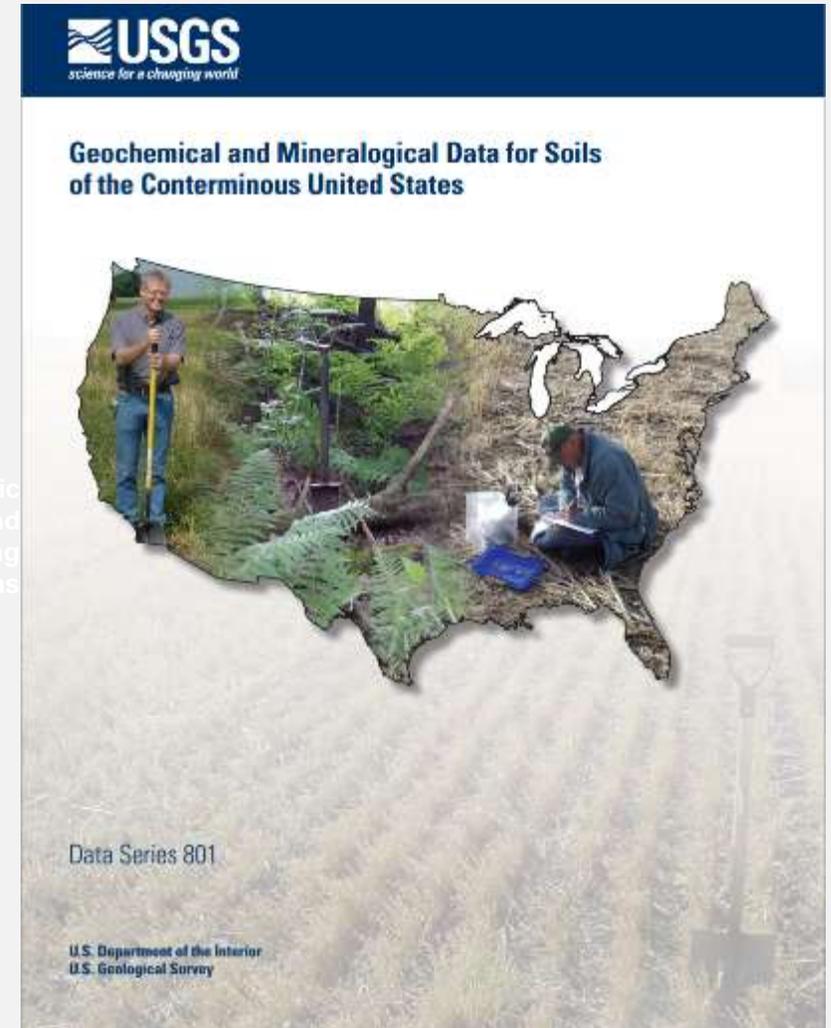*Tim Frederick, MPH and Sydney Chan, MPH*
US EPA Region 4

Anthropogenic Background (Urban Background)

- *US EPA Risk Assessment Guidance for Superfund Part A[1]* defines both natural and anthropogenic background

- There are 2 different types of background levels of chemicals:

  1. <u>Naturally occurring levels</u>, which are ambient concentrations of chemicals present in the environment that have not been influenced by humans

  2. <u>Anthropogenic levels</u>, which are concentrations of chemicals that are present in the environment due to human-made, non-site sources (e.g., industry, automobiles)

[1]US EPA Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A). December 1989. EPA/540/1-89/002
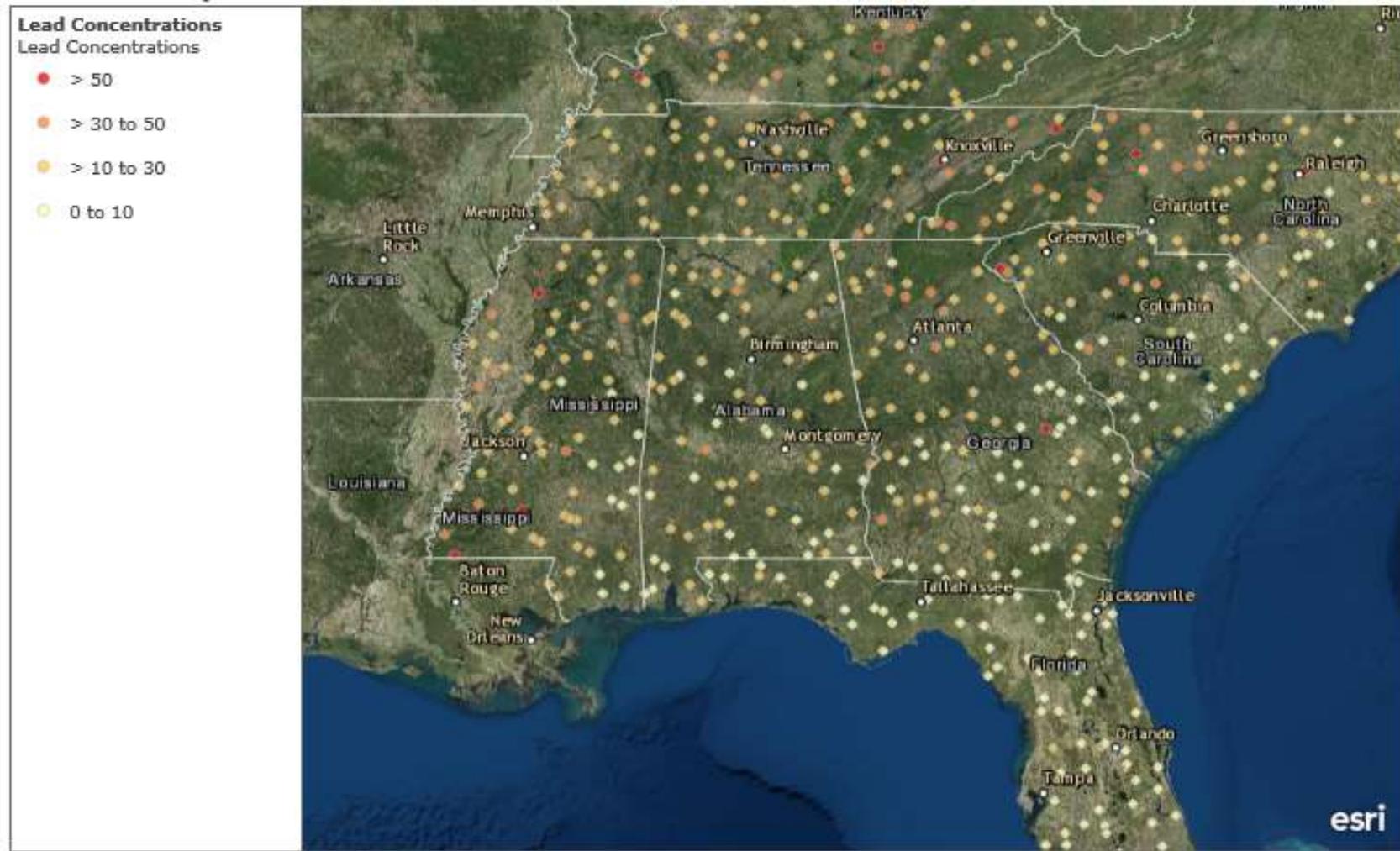
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Urban Background Problem

- A major challenge for investigators at urban sites is whether contamination is site-related or is part of anthropogenic background

- Robust data on urban background concentrations on a large scale are lacking

- US Geological Survey (USGS) published a national background study that specifically ***excluded*** urban areas
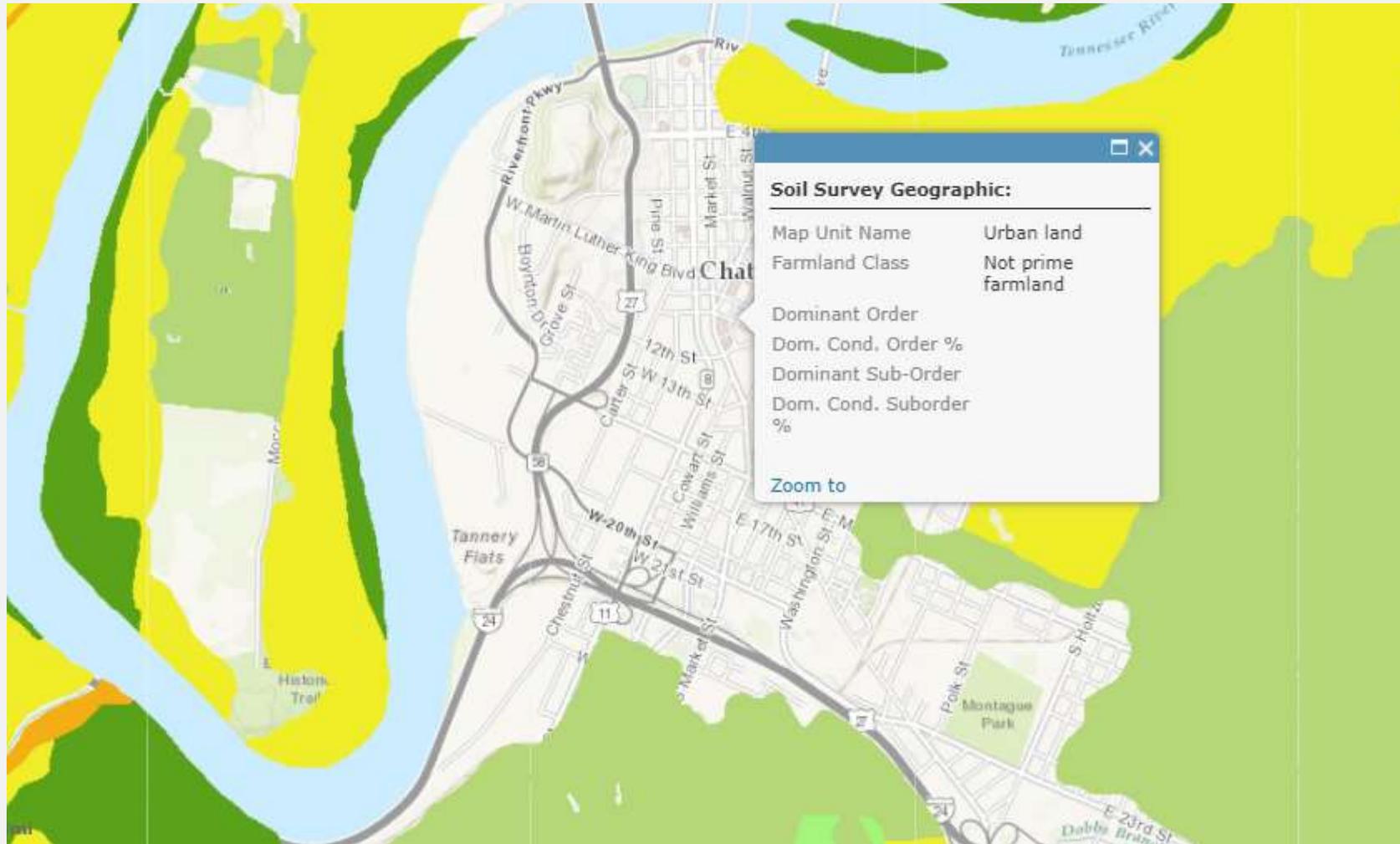

USGS
science for a changing world

Geochemical and Mineralogical Data for Soils of the Conterminous United States

Data Series 801

U.S. Department of the Interior
U.S. Geological Survey

Filling a Critical Data Gap

USGS Findings for Lead in US EPA Region 4 (Southeastern US) (n=608)

USGS data represent wide scale (national), whereas finer scale urban data are needed

USGS Data Series 801: https://pubs.usgs.gov/ds/801/

Urban Soil is Different

USDA Online Soil Survey Maps: https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

Region 4/ORD Urban Background Project

- Idea originated with Commonwealth of Kentucky

- Funding from US EPA's Office of Research and Development (ORD) Regional Applied Research Effort (RARE) grant

- Support from three US EPA ORD offices and Region 4 laboratory
  - ORD's National Exposure Research Laboratory (Las Vegas, NV)
  - ORD's National Risk Management Research Laboratory, Land Remediation and Pollution Control Division (Cincinnati, OH)
  - ORD's Office of Science Policy (Washington, DC)
  - Region 4's Science and Ecosystem Support Division (Athens, GA)

- Planning by all Region 4 states

Project Goals

1. Develop a robust, finer scale, regional dataset representative of anthropogenic "urban background" concentrations that can be added to in the future

2. Develop a data collection and analysis process that can be consistently applied in Region 4 states, and in other interested EPA regions to use in determining urban background concentrations

Overview of Plan

- Form a state and EPA workgroup

- Develop replicable sampling strategy

- Sample as many cities as funding allows

- Analyze samples for polycyclic aromatic hydrocarbons (PAHs) and metals*

- Data to be provided in accessible database

- Yield products that can be used elsewhere

*PAHs (EPA 8270D) and Metals (EPA 6010)

Actions: Sampling Plan

- Grid of 7 x 7 miles applied over approximate center of each city

- Each cell of the grid is 0.5-mile x 0.5-mile = total of 196 cells

- Samples for laboratory analyses collected randomly from 50 of the cells within the grid
  - Random # Generator

- Final determination of target sample locations will be made in the field

LOUISVILLE, KENTUCKY
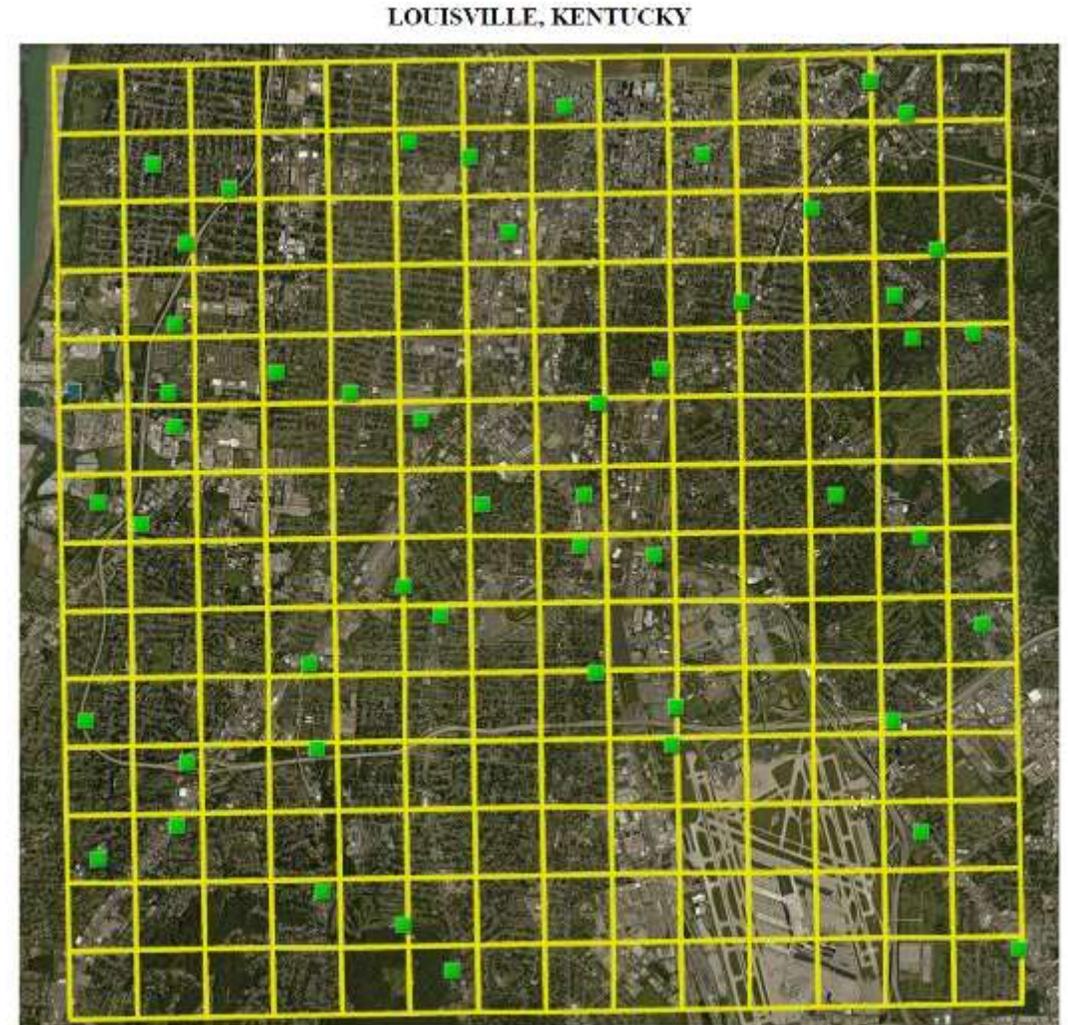
Criteria for Selected Sample Locations

Qualify:

- Areas that appear to be representative of the larger urban setting
- Locations that appear to be undisturbed by recent activity
- Public areas, such as along right-of-ways and within government-owned property

Disqualify:

- Private/residential yards
- Industrial properties or in obvious significant pollutant outfall area for nearby industry
- Areas of relatively recent development/redevelopment
- Low-lying areas that may be routinely subjected to flooding or inundation, such as wetlands and/or where surface runoff could accumulate

Teamwork

- States reviewed sampling grid for selected cities

- Most states supported sampling by providing field staff

- Some states conducted reconnaissance prior to sampling

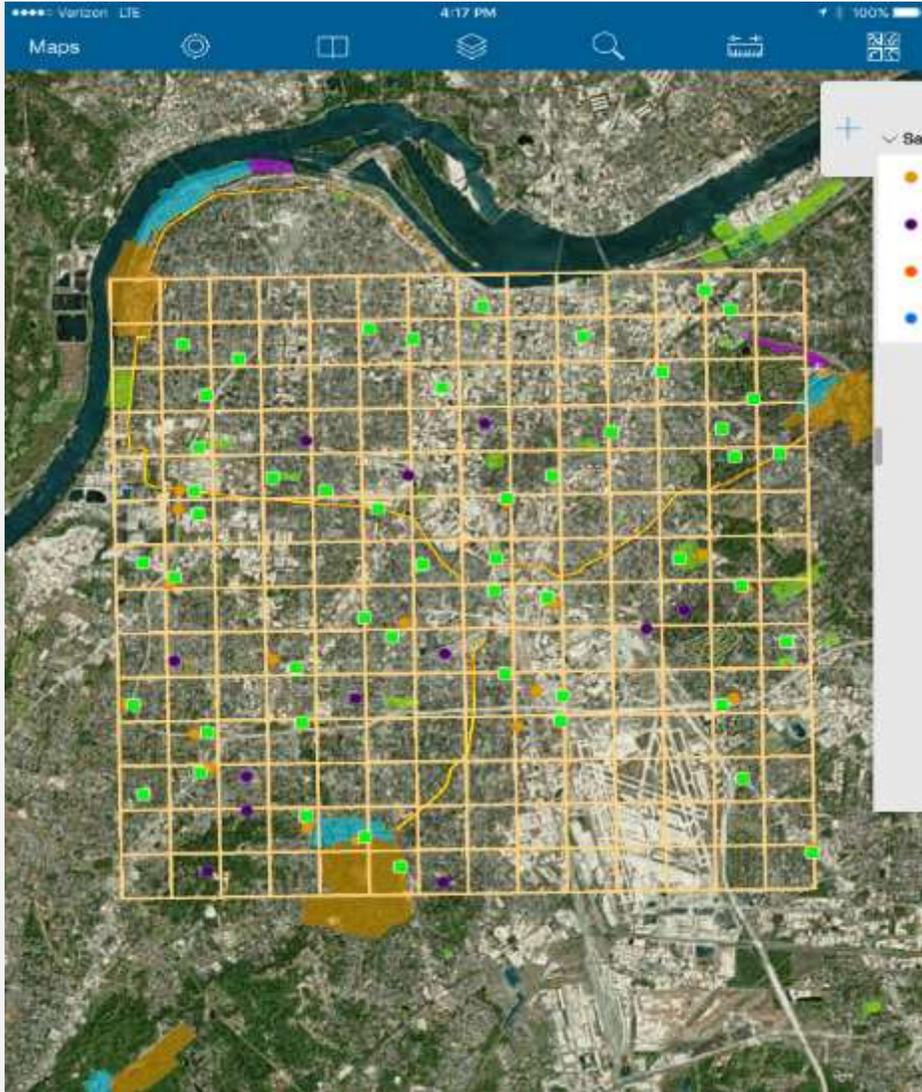- States' support was critical to obtaining access agreements

In the Field: Sample Collection

- 3.5" wide, 1" thick, 7" deep core
- 4" depth modification
- Soil compression
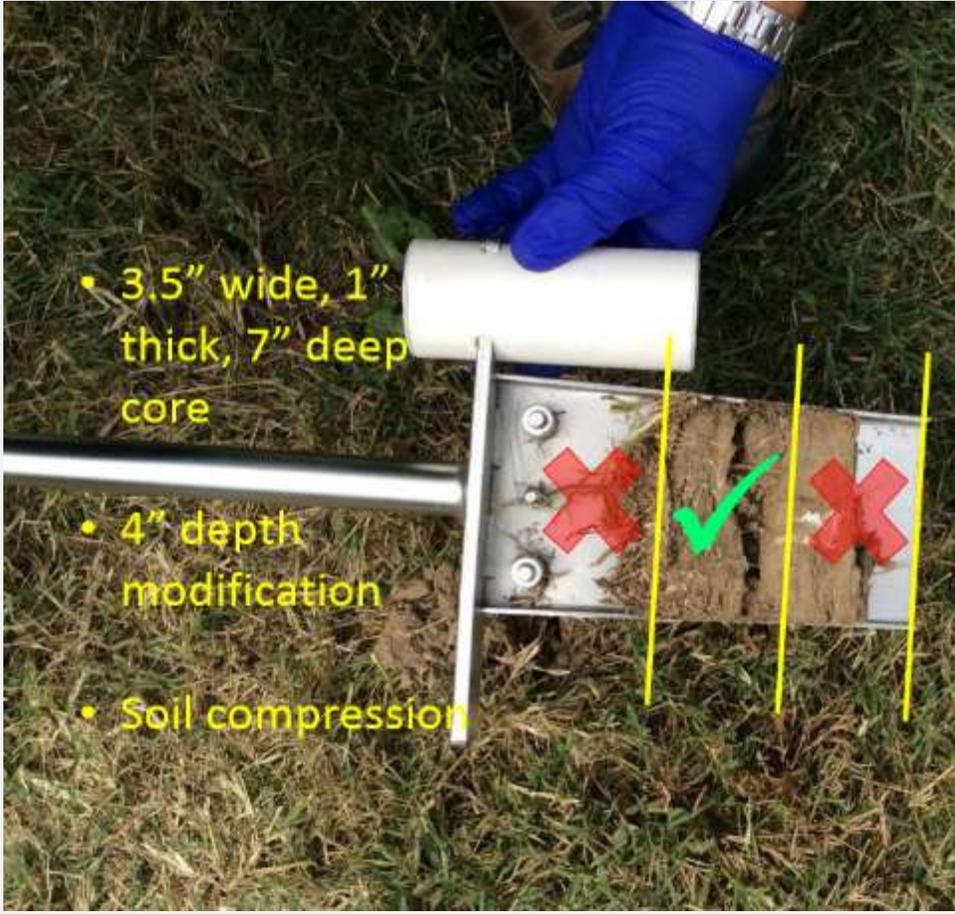
In the Field: Subsampling

Collecting Metadata

In the field, tablets were used to collect photographs and other metadata using ESRI Collector and iForms software tools. Metadata were geolocated at each sample location.
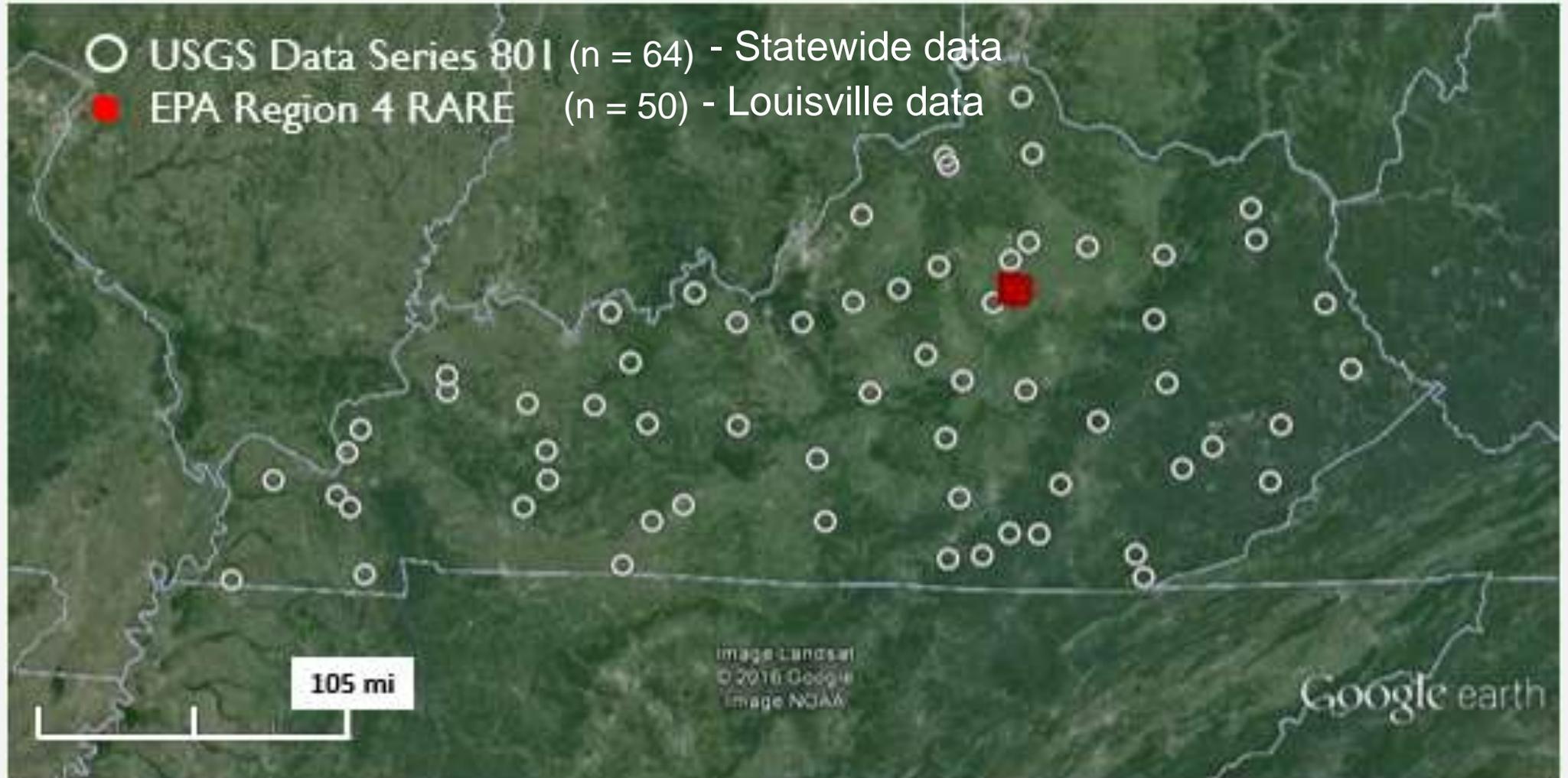
Standard metadata collected at all sample locations

Relative Sample Density

USGS Data Series 801 (n = 64) - Statewide data
EPA Region 4 RARE (n = 50) - Louisville data

105 mi

Preliminary Results

Statistical Summary: Lead

General Statistics for Uncensored Data Sets

| Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	SEM	MAD/0.675	Skewness	CV
Lexington Lead	50	0	18	420	81.74	56.46	88.85	12.57	30.39	2.493	1.087
Louisville Lead	50	0	25	1100	156.2	99.41	192.7	27.26	76.35	3.177	1.234
Memphis Lead	50	0	13	1000	121.3	63.57	202.1	28.58	42.99	3.508	1.666
Raleigh Lead	50	0	7.2	180	33.61	22.5	37.15	5.253	13.34	2.265	1.105
Winston-Salem Lead	50	0	20	1400	215.7	128.4	247.2	34.96	120.8	2.692	1.146
Gainesville Lead	50	0	2	110	15.05	9.169	18.63	2.634	7.339	3.204	1.238
Chattanooga Lead	50	0	14	580	96.24	59.82	122.2	17.28	30.39	2.667	1.27

Percentiles for Uncensored Data Sets

Variable	NumObs	# Missing	10%ile	20%ile	25%ile(Q1)	50%ile(Q2)	75%ile(Q3)	80%ile	90%ile	95%ile	99%ile
Lexington Lead	50	0	23.9	29	32.25	46	92.5	122	174	240	415.1
Louisville Lead	50	0	30	50.4	53.25	95.5	187.5	210	323	500	899.1
Memphis Lead	50	0	19.9	29.8	35	52	96.75	108	260	434	990.2
Raleigh Lead	50	0	9.8	11.6	12	19	36	40.2	90.1	108.8	160.4
Winston-Salem Lead	50	0	26	52.6	57.75	130	292.5	344	502	652	1052
Gainesville Lead	50	0	2.65	3.98	4.45	8.1	18	23	30.2	47.1	83.54
Chattanooga Lead	50	0	24.9	26.8	34.25	45.5	99	132	214	361.5	550.6

EPA ProUCL Software: https://www.epa.gov/land-research/proucl-software

Urban Lead Distributions by City
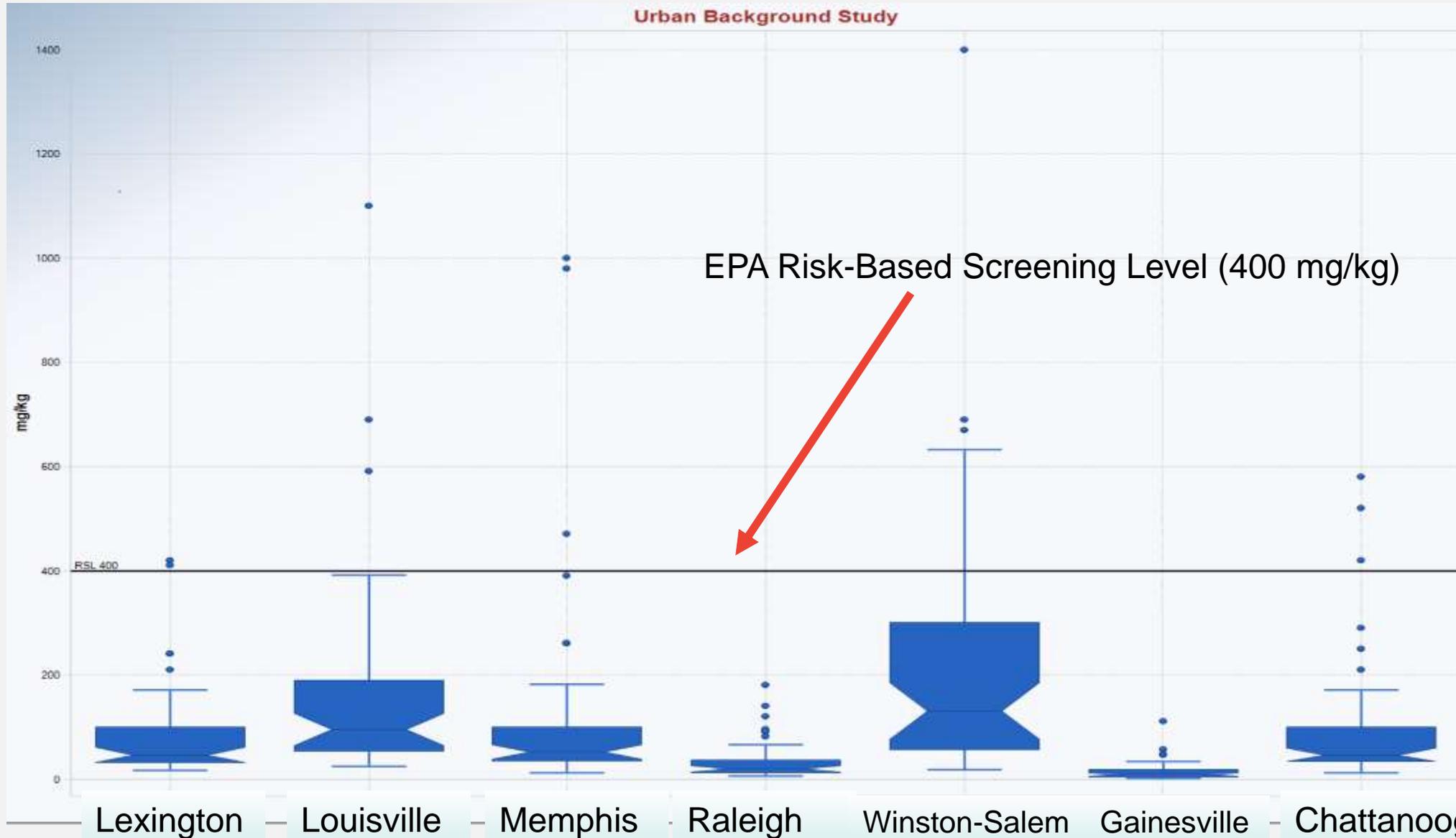
*Medians are below RSL with some potential outliers
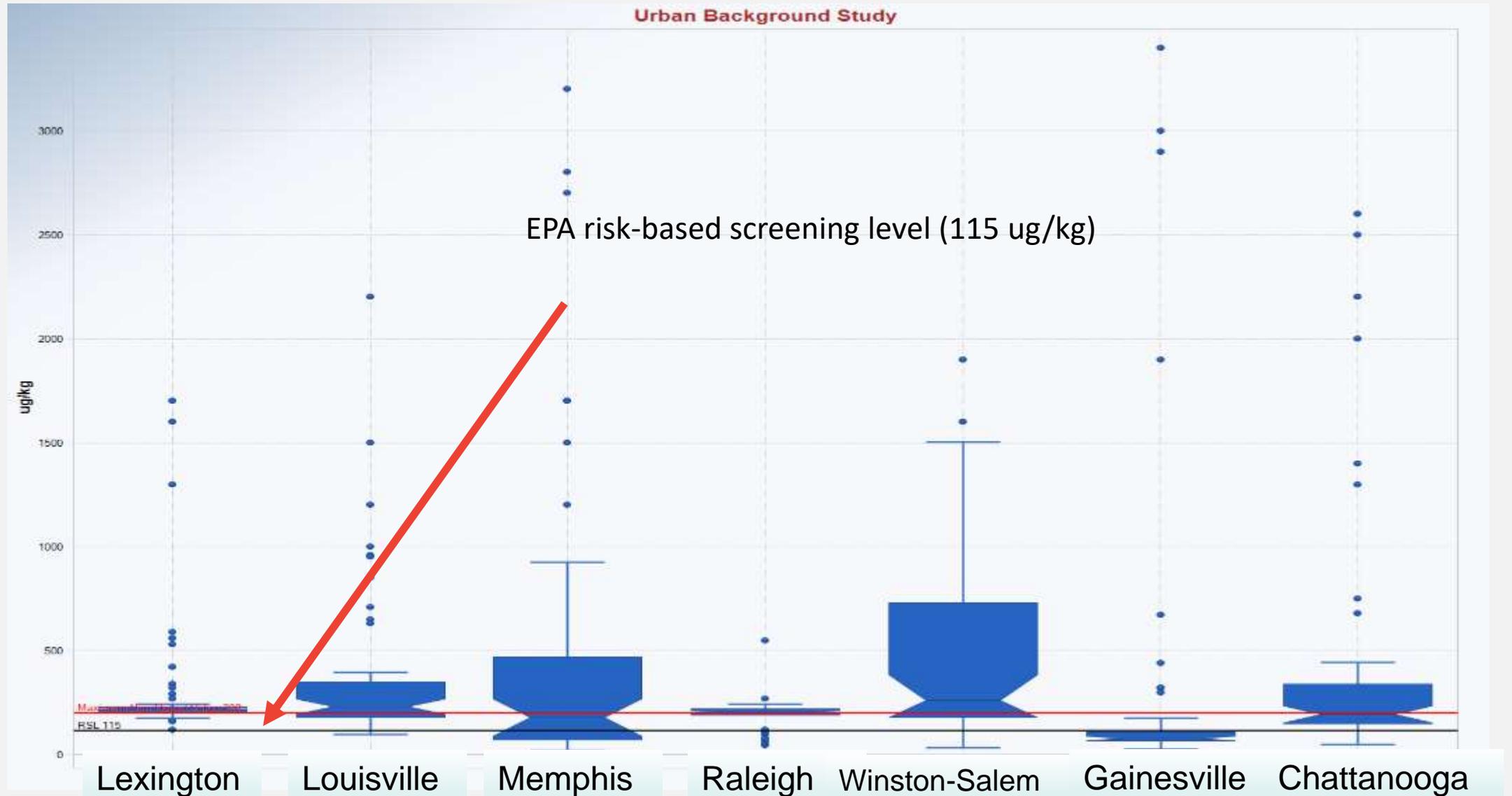
Urban Lead vs USGS: Kentucky
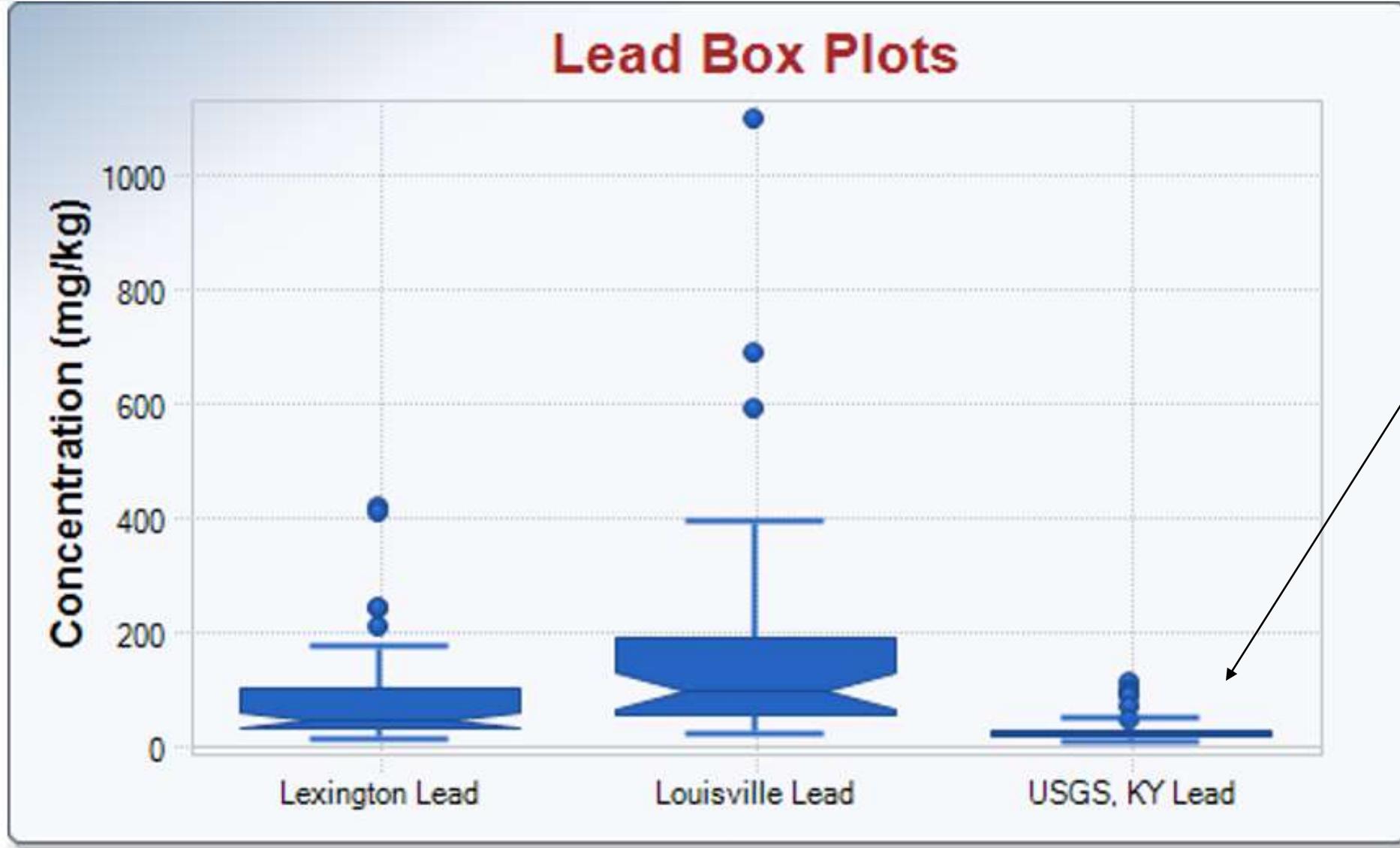
*USGS median for entire state is below medians for the cities

Urban Benzo(a)pyrene Distributions by City

*Some city medians above the RSL

EPA risk-based screening level (115 ug/kg)

Project Status

- Seven cities sampled (Chattanooga, Gainesville, Lexington, Louisville, Memphis, Raleigh and Winston-Salem)

- Two more cities planned (Atlanta and Columbia)

- Data QA/QC'd, will be publicly available soon

- Sampling Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP) publicly available

- Data/analysis to be published in peer-reviewed journal

Impact: Uses of Data by US EPA and States

- Provides context of distribution of anthropogenic contaminant concentrations at urban scale
- Provides information on whether site-specific background concentrations are relatively consistent with other Region 4 cities
- Robust background datasets can be ready for Remedial Investigation/baseline risk assessment phases and Preliminary Remediation Goal development
- May be able to provide a snapshot of concentrations in time that can be used to evaluate impacts of floods, hurricanes or other disasters

"This project is especially unique because it is not EPA prescribing guidance or rules as an end result – it is a truly collaborative effort between EPA and member states to develop a replicable sampling regimen along with defensible analytical results that each state can utilize individually to make better site decisions... this study provides a significant overall benefit to the individual southeastern states, this region, and all other states, regions and cities that are faced with Urban Background issues."
– Sheri Adkins, KY Department for Environmental Protection

CASE STUDY: FORMER CHATTANOOGA FOUNDRIES

Problem

60+ foundries historically located in Chattanooga, TN.

Foundries generated spent sand and baghouse dust over many decades.

Foundry sand and baghouse dust used as fill material in residential yards.

Partners

Tennessee Department of Environment and Conservation, Tennessee Department of Health, and City of Chattanooga

Why Use Urban Background Study?

- Determine whether lead was a city-wide issue or specific to areas around the foundries

- SAP/QAPP available for adaptation

- Field teams familiar with process from sampling other cities

- Inform site assessment and future remedial investigation at this site

Foundry waste material
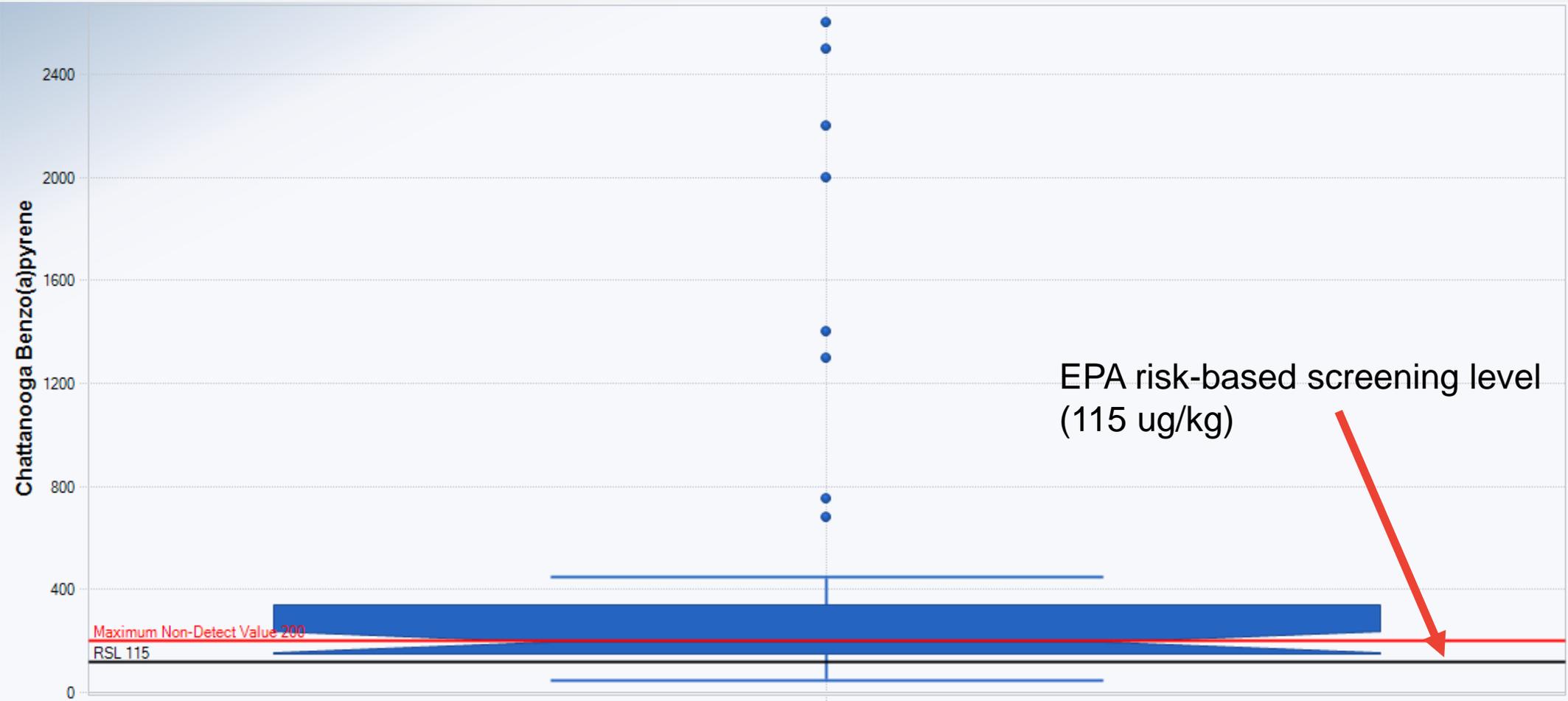
Chattanooga Urban Background Study

- Adapt SAP/QAPP to site needs
  - Rotated grid to fit topographical boundaries
  - Shrunk grid to fit within boundaries
- 50 randomly selected locations
- Excluded flood plain areas, suspected contaminated areas, known industry/foundries
- Total sample time: 2 days in September 2016. Project completed 2017.

EPA risk-based screening level (400 mg/kg)
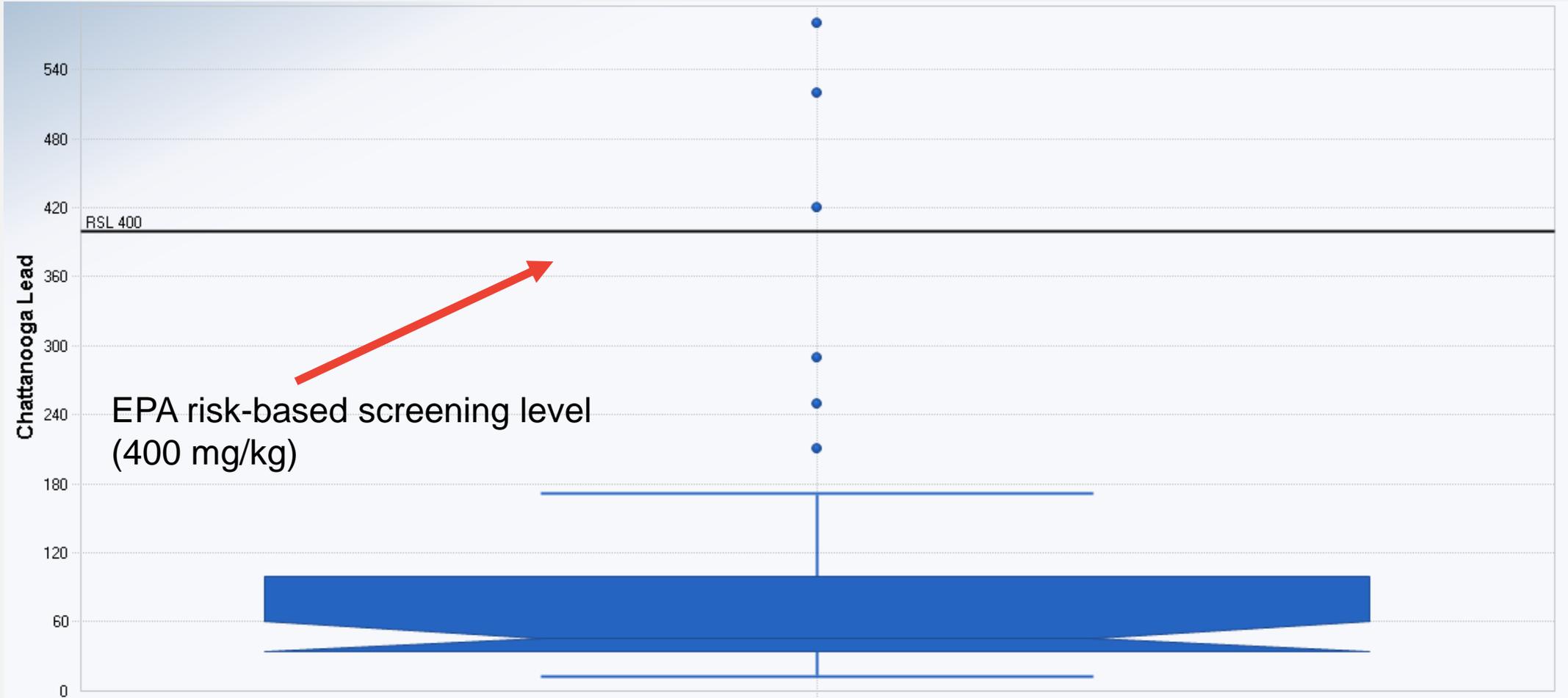
Benzo(a)pyrene Background Findings

EPA risk-based screening level (115 ug/kg)

Impact: Chattanooga Urban Background Informs the Site Assessment

- Elevated lead is not "everywhere"
  - Most background samples below lead Regional Screening Level
  - Background lead relatively consistent with other Region 4 cities
- Benzo(a)pyrene (BaP) background is typically above **new** Regional Screening Level, but within risk range
  - Background BaP relatively consistent with other Region 4 cities
- Robust background dataset ready for remedial investigation

Take Home Points

- Urban Background study begins to fill an important data gap for urban site investigations

- Anthropogenic background differs from natural background

- Adaptable to different cities, SAP/QAPP publicly available

- Data can be used for a variety of purposes

- Teamwork is critical to success

Acknowledgments

- Region 4 States: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee
- US EPA
    - ORD's National Exposure Research Laboratory (Las Vegas, NV)
    - ORD's National Risk Management Research Laboratory, Land Remediation and Pollution Control Division (Cincinnati, OH)
    - ORD's Office of Science Policy (Washington, DC)
    - Region 4's Superfund and Brownfields Divisions (Atlanta, GA)
    - Region 4's Science and Ecosystem Support Division (Athens, GA)
- Tetra Tech, Inc.

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