

BACKGROUND POLICY & APPROACHES FOR URBAN LEAD



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OVERVIEW

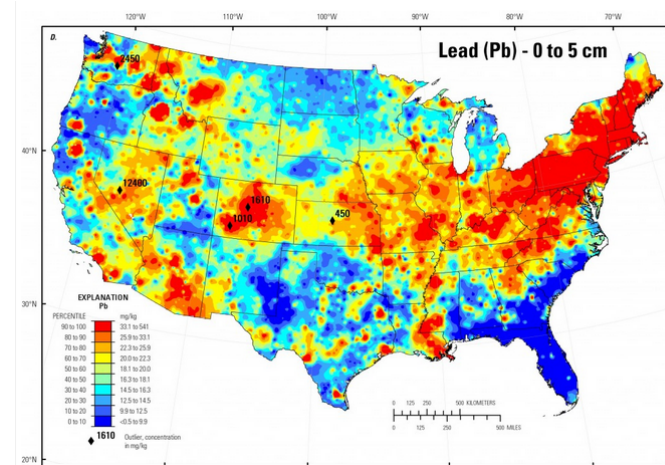
Why Background?

EPA Policy:

- What counts as background?
- How do you measure background?
- What assumptions can you make?

Methods:

- How can I identify background concentrations?
- How do I compare site and background?
- What tools are available to assist me?



http://www.usgs.gov/blogs/features/usgs_top_story/getting-the-dirt-on-soil/

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WHY BACKGROUND?

EPA Policy states that the superfund program **does not clean up below background**

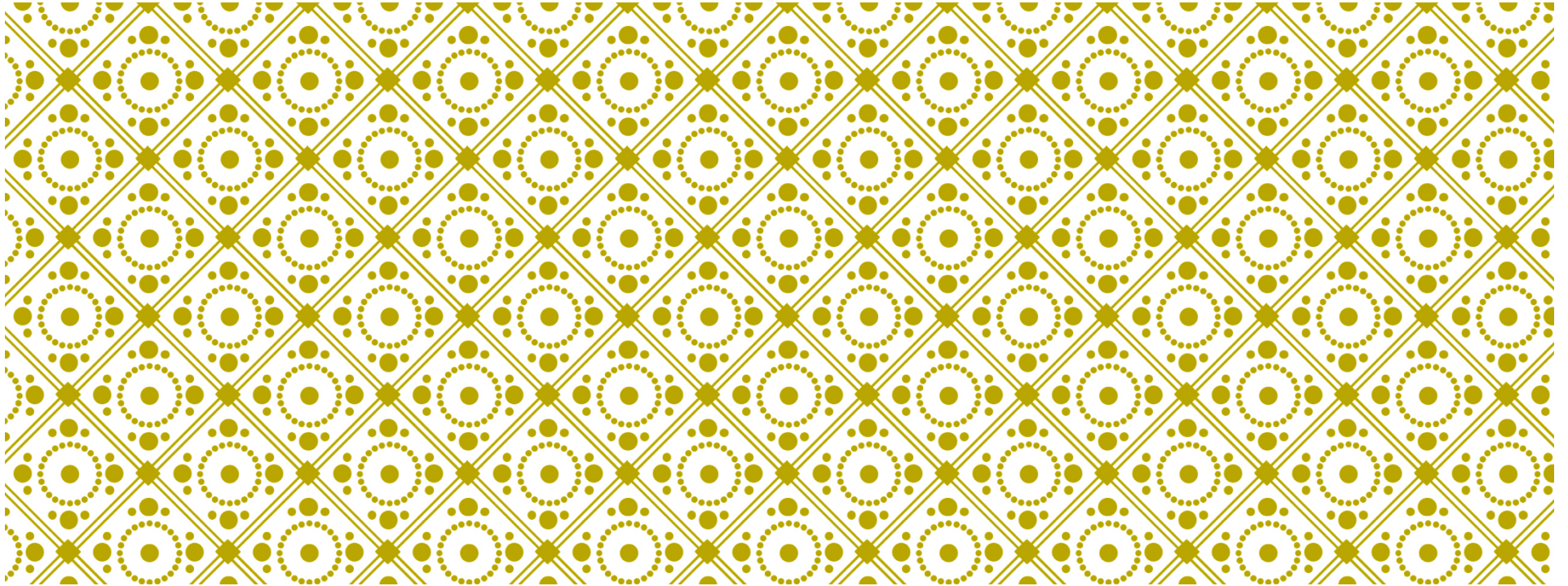
- “Contaminated Sediment Remediation Guidance for Hazardous Waste Sites,” EPA 2005
- “Role of Background in the CERCLA Cleanup Program,” EPA 2002
- “Rules of Thumb for Superfund Remedy Selection,” EPA 1996a
- “Soil Screening Guidance,” EPA 1996

Why not?

- Non-site related releases are not covered by CERCLA
- Avoid creating “donut hole” where recontamination is inevitable

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COLLECTING BACKGROUND DATA

When do I need it?
How should I collect it?
Which data should I use?

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SO WHAT COUNTS AS BACKGROUND?

From Risk Assessment Guidance for Superfund, Part A:

There are two different types of background levels of chemicals:

- (1) naturally occurring levels, which are ambient concentrations of chemicals present in the environment that have not been influenced by humans (e.g., aluminum, manganese); and
- (2) anthropogenic levels, which are concentrations of chemicals that are present in the environment due to human-made, non-site sources (e.g., industry, automobiles).

Both are contributors to background lead in urban environments, but especially anthropogenic sources

- Leaded gasoline
- Historic manufacturing (including smelters)
- Waste dumps and incinerators

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DO I REALLY HAVE TO COLLECT BACKGROUND?

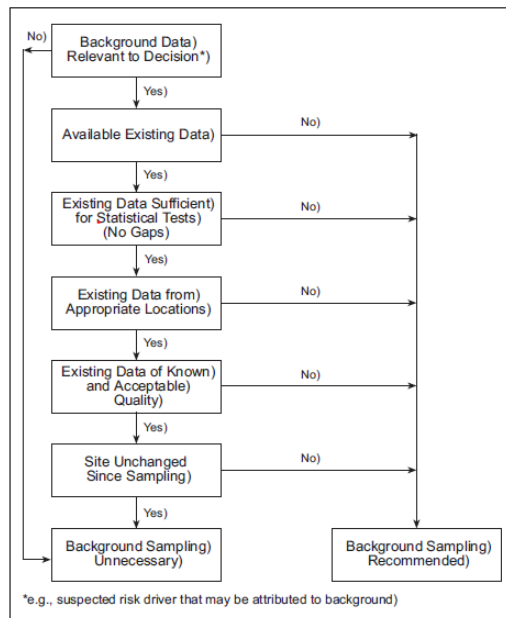


Figure 2.1 Determining the need for background sampling

From *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites*

Recommended whenever background concentrations are likely to influence decisions

If relevant, site specific data is available, guidance says sampling may not be needed:

- State and local or USGS surveys
- Data from preliminary investigations
- Published papers

Historical data can help inform decisions about background sampling

- Nearby roads and industrial sites
- Appropriateness of sampling locations
- Changes at or around site

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SAMPLING AND QUANTIFYING BACKGROUND

Where to sample?

- Nearby, **off site** location that matches the characteristics of the release samples on site
- For soils: particle size distribution, organic matter content, hydrologic regime, and soil chemistry
- Avoid areas with fill soils or obviously disturbed soils
- Experience and expert judgment are critical!

| | | |
|------------|---------------------------|---|
| Physical | Water | Temperature, chemistry, depth, flow |
| | Sediment | Total organic carbon; total acid-volatile sulfides; percent sand, silt, clay, water |
| | Soil | Particle size distribution, organic matter content, hydrologic regime, chemistry |
| | Habitat Structure | Stream/lake bottom structure, stream-/lake-side cover, vertical stratification, horizontal variation, percent cover |
| Climatic | Regional | Latitude, proximity to mountains and large water bodies |
| | Local | Topography (valleys, hilltops), altitude, aspect (north- or south-facing slopes), solar radiation |
| Biological | Community Characteristics | Species abundance, species richness, diversity, trophic structure, history of species introductions |

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SAMPLING AND QUANTIFYING BACKGROUND

How to sample?

- Methods should be the same as used for on site sampling
- Aim to collect samples for comparison within a similar time frame
- Incremental sampling?

How many samples?

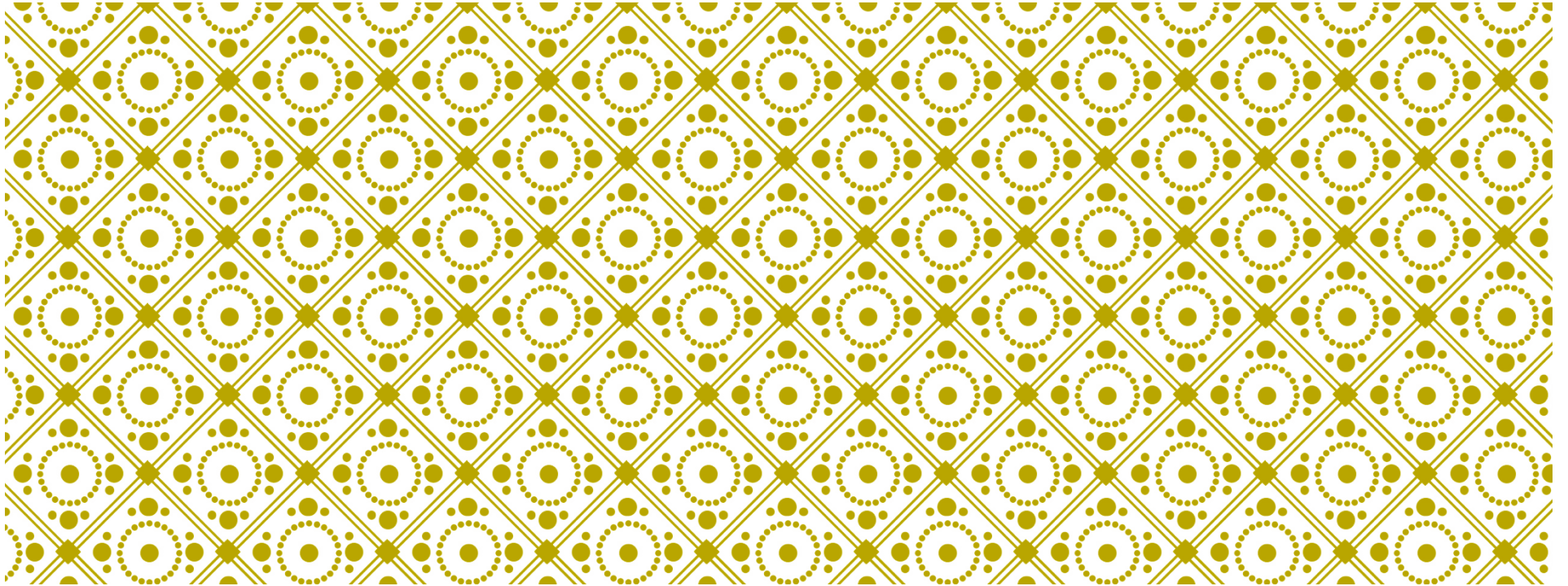
- Per EPA DQOs, conduct a power analysis to identify how many samples you need to take to have confidence in your results
- EPA guidance provides reference tables, or sample size can be calculated in a variety of open source or commercial software tools

| σ (mg/kg) | MDD/ σ | n | N |
|---------------------|---------------|--------|-----|
| 25 | 2 | 3.70 | 5 |
| 50 | 1 | 13.55 | 16 |
| 75 | 0.67 | 29.97 | 35 |
| 100 | 0.50 | 52.97 | 62 |
| 125 | 0.40 | 82.53 | 96 |
| 150 | 0.33 | 118.66 | 138 |
| 175 | 0.29 | 161.36 | 188 |
| 200 | 0.25 | 210.63 | 245 |

Table 3.1 Required sample size for selected values of σ ($\alpha = \beta = 0.10$ and MDD = 50 mg/kg)

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DISTINGUISHING SITE AND BACKGROUND DATA

What data are relevant?
What if my data overlap?

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WHICH DATA TO USE?

Data distributions

- Urban data often has many non-site related contributors to background
- Normal populations are unlikely

Outliers

- There is no reason to assume that background data follows a normal distribution or belongs to a single population
- Statistical tests may be used to identify outliers, **but**
- EPA guidance states that data points cannot be removed solely based on a statistical test; further review is needed to identify why a data point was elevated and if it is appropriate to remove

Note: Pro-UCL is a tool for data analysis, but the user's manual *is not EPA guidance*

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PARTITIONING SITE & BACKGROUND

Ideally, you should have samples free of site influence (and not have to use any of this!)

Analytical approaches:

- Finite mixtures models
- Regression based models
- Classification algorithms

Common sense:

- Think carefully about your assumptions
- Background concentrations may be elevated and may overlap with site contamination
- Multiple non-site releases may contribute to urban background
- Additional data may be useful

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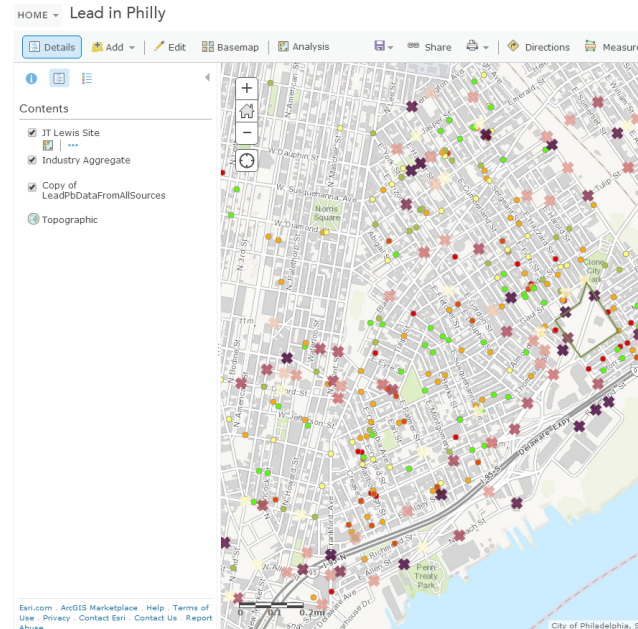
EPA GEOPLATFORM

One critical part of analyses is simple visual analysis and data integration

- Where did my data come from
- What does my distribution look like
- What's nearby

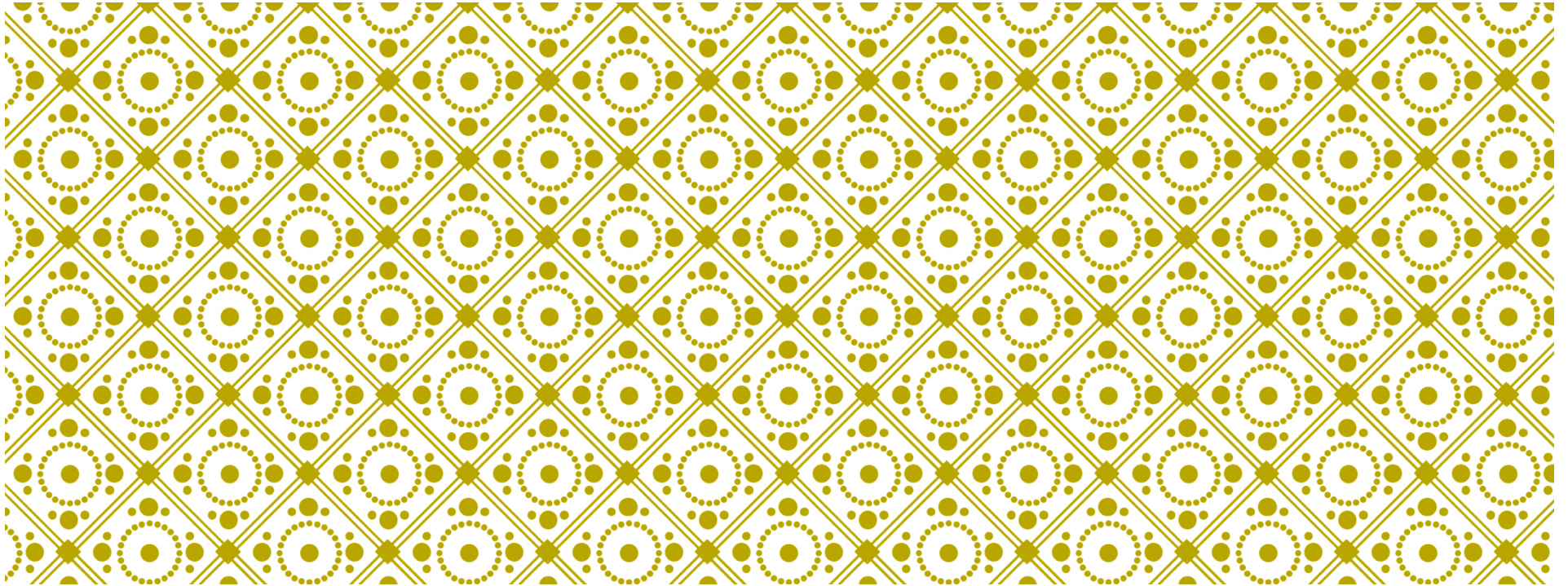
EPA Geoplatform/ArcGis

- <http://epa.maps.arcgis.com/home/>
- Free for EPA users
- Fairly intuitive,
- Easy to keep private or share,
- Ability to overlay relevant data sets
- Quick built in geospatial analyses



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WHAT DO I DO WITH BACKGROUND?

Statistical Tests
Recommendations

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WHAT DO I DO WITH BACKGROUND?

Identify whether a release falls under CERCLA authority

Develop remedial goals

Characterize risks from contaminants that may also be attributed to background sources

Communicate cumulative risks

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DESCRIPTIVE STATISTICS

When a single value is needed, descriptive statistics are often used

- Establishing PRGs
- Identifying where cleanup needs to occur

But what do I use?

- Historically, the highest value measured was used
- UCL: Upper confidence limit on the mean of a population
- UPL: Estimate of right tail of a distribution (usually 95th percentile)
- BTV: “background threshold value” – some value delineating the upper end of a background population versus site contamination
- ...usually whatever everyone agrees on

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HYPOTHESIS TESTING

Comparing site and background

- Null hypothesis: no difference
- Used as evidence of a release

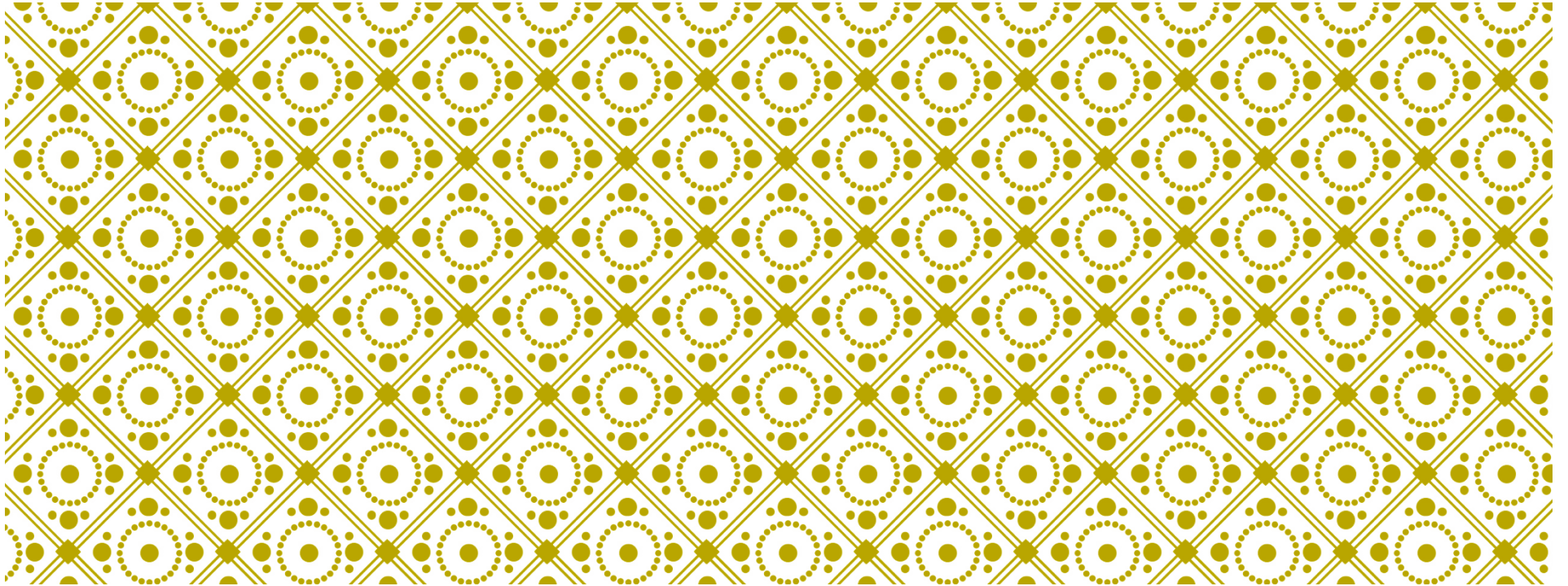
Urban data sets tend to be non-normal and drawn from multiple populations

- Non-parametric tests (Wilcoxon Rank-Sum)
- Data transformations

| Method | Application | Comments |
|--|---|---|
| Descriptive Summary <ul style="list-style-type: none"> ▪ Mean ▪ Median ▪ Standard deviation ▪ Variance ▪ Percentiles | Preliminary examination of data for comparison with site history and land use activities in the establishment of background. Use as a preliminary screening tool. | Simple and straightforward; less statistical rigor. |
| Simple Comparisons | Used with very small data sets. | Not recommended |
| Parametric Tests <ul style="list-style-type: none"> ▪ Student t-test ▪ Behrens-Fisher Student t-test | Tests require approximate normality of the estimated means. Use if a larger number of data points are available ($n > 25$). For smaller data sets, examine data for normality or lognormality in distribution. ⁴ | Statistically robust and used frequently in parametric data analysis. |
| Nonparametric Tests <ul style="list-style-type: none"> ▪ Wilcoxon Rank Sum Test (also called the "Mann-Whitney Test") ▪ Gehan Test | Use when data are not normally distributed, as rank-ordered tests make no assumption on distribution. | Statistically robust and used frequently in background estimation. |

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CONCLUSIONS

Urban background is complicated.

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CONCLUSIONS

Urban background is complicated

EPA guidance is fairly open ended

- How to measure background
- What statistics are appropriate
- But... you do usually need to at least consider background

Expert judgment is critical!

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