Soil Dust ExPbosure

Bunker Hill Superfund Site

Kellogg, Idaho

Soil → Dust
→ Floors & Stuff →
Hands → Mouth
→Blood

State the Problem ?

- Lead has no apparent threshold
- Lead is ubiquitous in urban areas
- Lead dust occurs inside and outside
- What are the decisions?
- What are our geographic and temporal boundaries?

State the Problem ?

- People don't eat soil
- People eat dust
- Related, but not the same
- Dust is difficult to sample & control
- Dust moves; people move
- Dust reflects sources (in & out), climate, and behavior
- It's challenging to work in other people's homes
- We have limited money & authority

Resevoir

A place where something is **stored**

- Reservoirs are distant & indirect sources of exposure
- Soil is a reservoir for lead from gas, paint, and other sources
- Soil generates dust
- **Dust**: fine dry powdery particles (as of earth); a fine powder that often builds up on surfaces; a fine powder made from a particular substance or from something that has disintegrated
- Dust blows around and sticks to things that get eaten, licked, or mouthed

Link Environmental Data to Risk

Measures are confusing

• Concentration	mass/mass	IEUBK & dose estimates
• Loading	mass/area	epi-studies; HUD
• Dose	mass of Pb/(body mass*day)	
• Blood	mass of lead per volume blood (µg/dL)	

Mass of Soil in Dust (MSD)

- MSD is used by IEUBK to estimate the mass of soil in house dust
- Default value is 70%
- MSD is poorly defined and highly uncertain
- Soil sampling is not standardized; dust sampling is worse
- Indoor lead sources can be mischaracterized as outdoor sources

Mass of Soil in Dust (MSD)

- Soil generates dust at varying scales of time and distance
- Dust potential varies with climate and surface conditions
  - Vegetation, temperature, moisture, and wind
- Indoor dust reflects:
  - exterior environment
  - interior structure
  - resident behavior

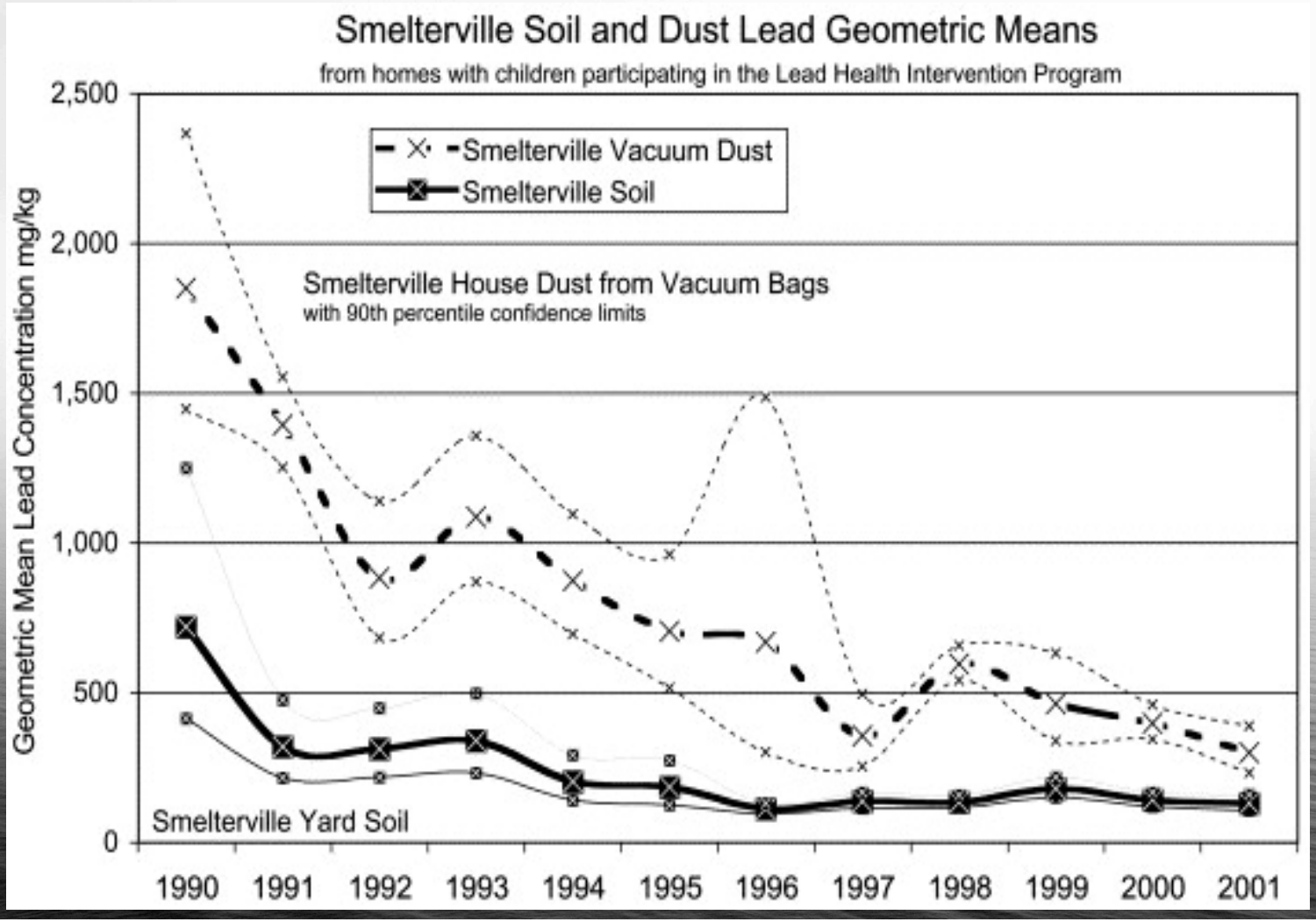
Mass of Soil in Dust

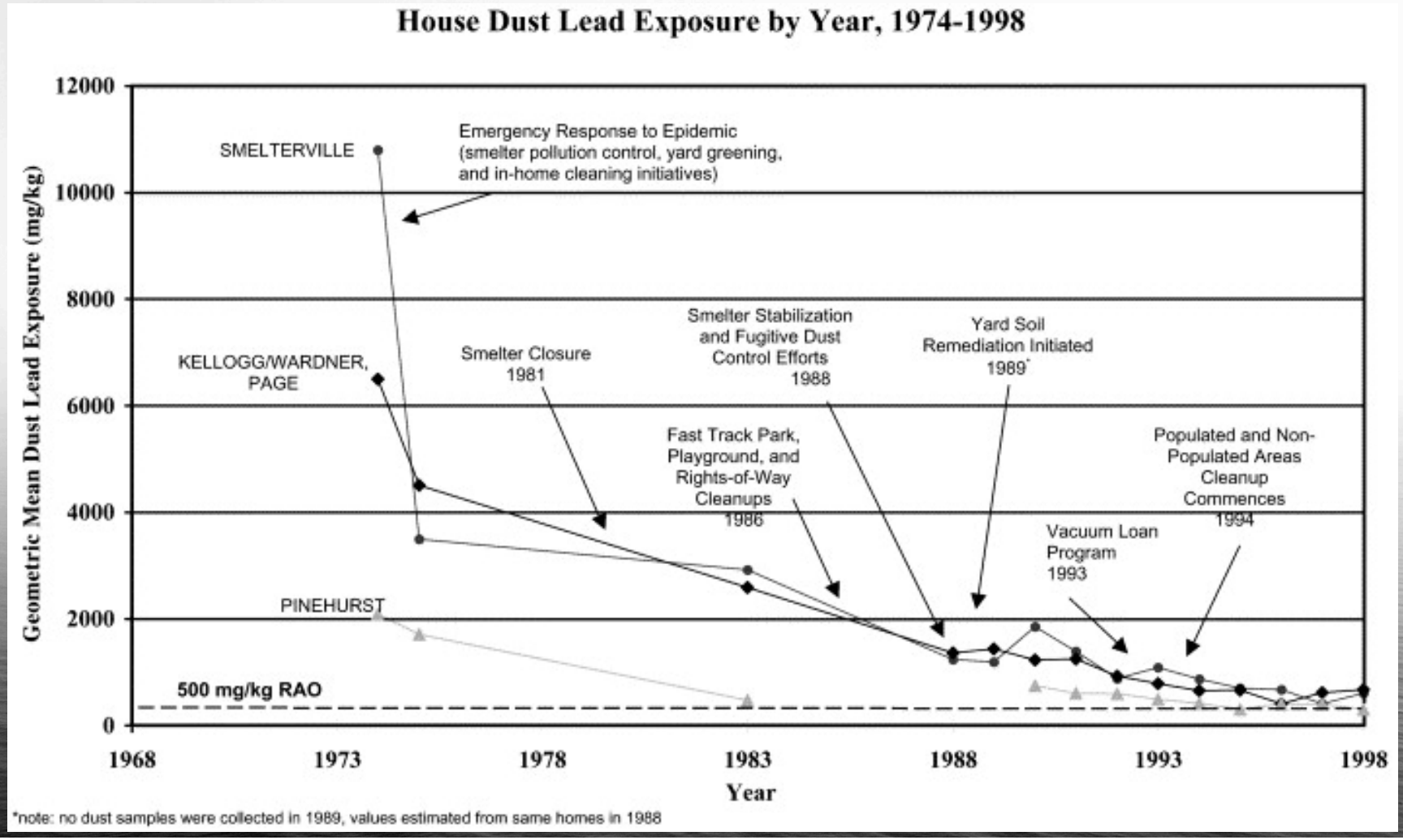
- We don't know
- We haven't given up
- Likely to vary by place and time
- ….but here's the good news:

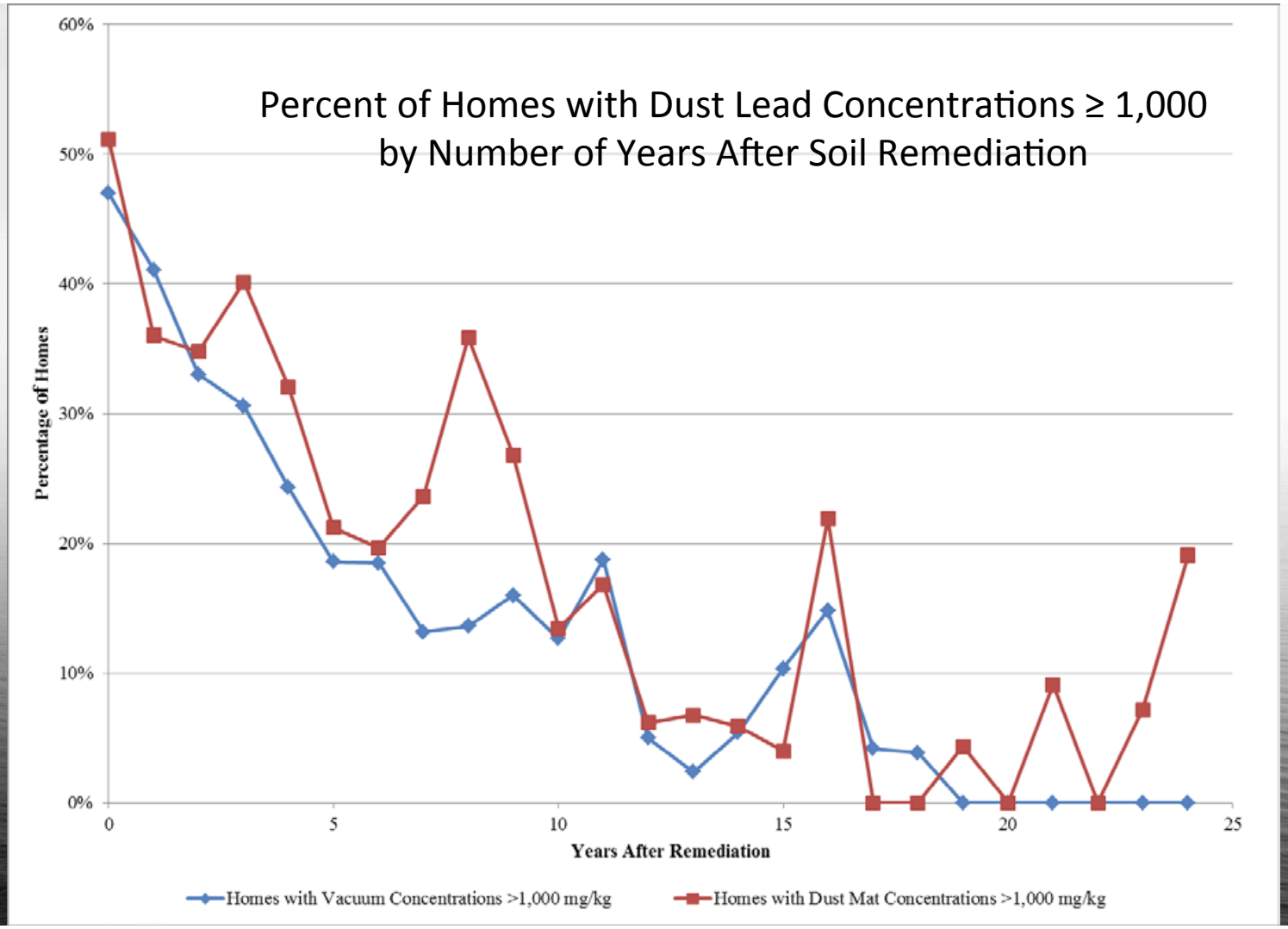
Replacing lead contaminated soil with clean soil has substantially reduced lead in house dust at Bunker Hill

Soil in Dust

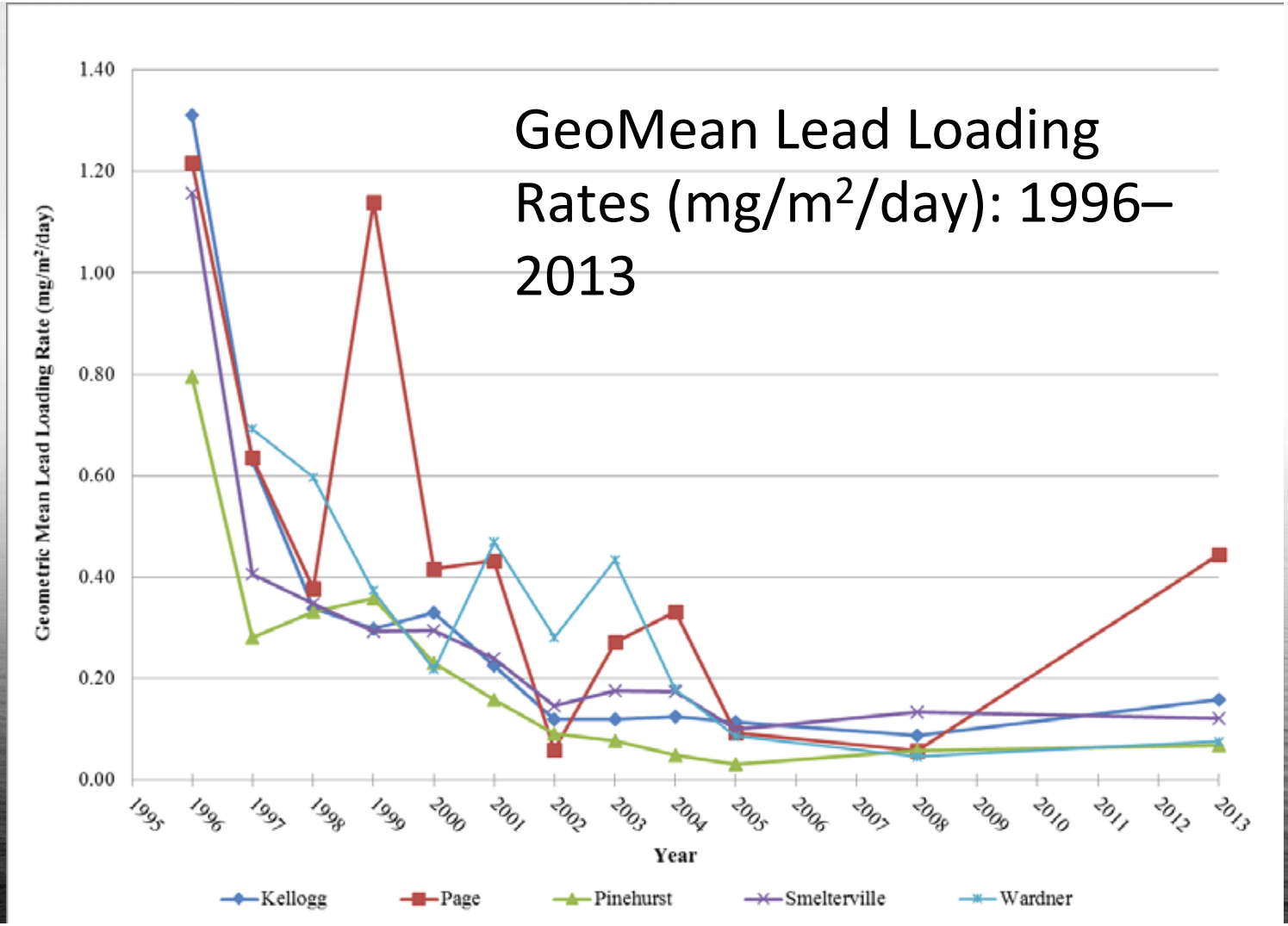
- Soil removal must be widespread influence indoor dust
- City & neighborhood scale
- Single property likely insufficient
- Lag time (years) for effect


Smelterville Soil and Dust Lead Geometric Means
from homes with children participating in the Lead Health Intervention Program
Geometric Mean Lead Concentration mg/kg
2,500
2,000
1,500
1,000
500
0
Smelterville Vacuum Dust
Smelterville Soil
Smelterville House Dust from Vacuum Bags
with 90th percentile confidence limits
Smelterville Yard Soil
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001

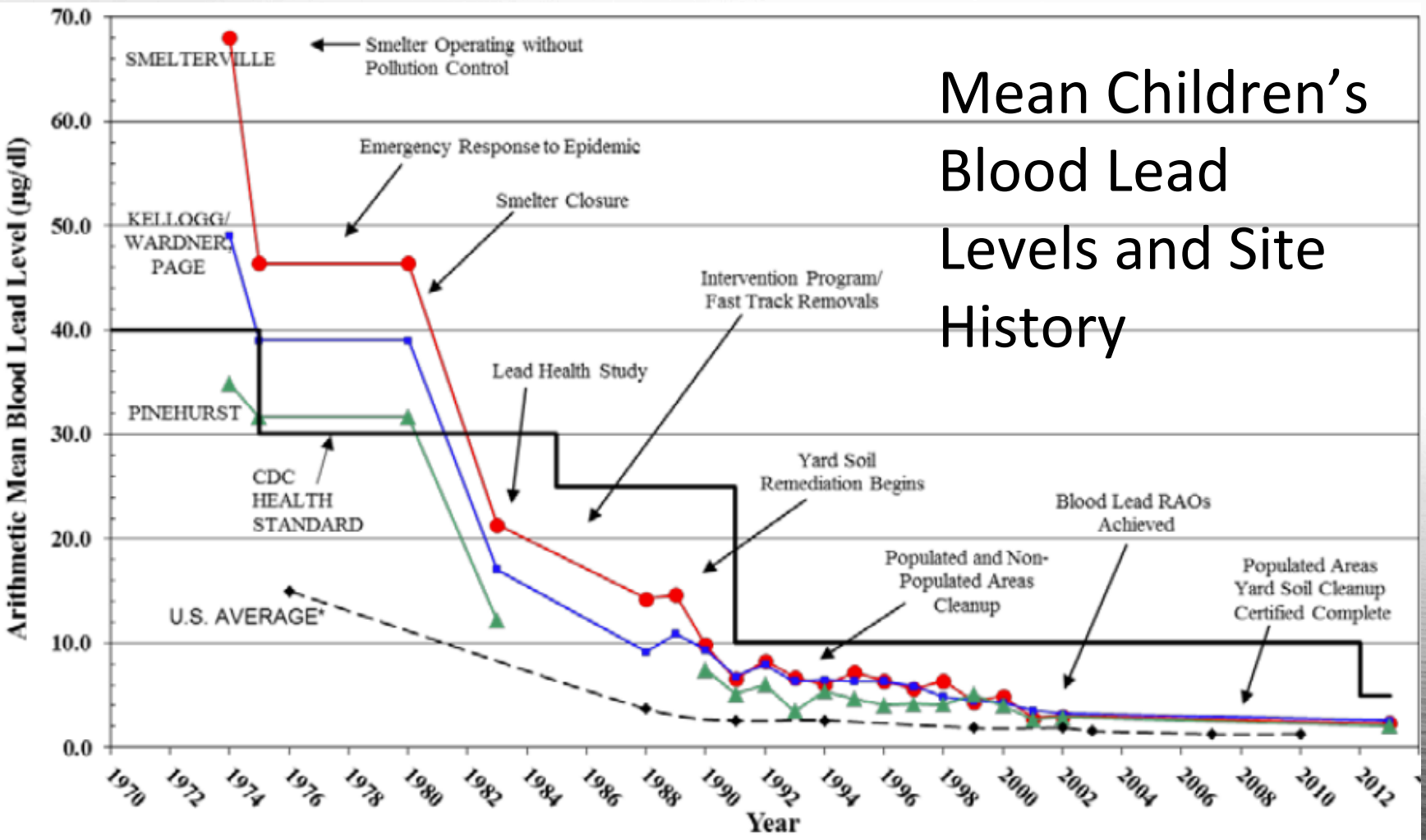

House Dust Lead Exposure by Year, 1974-1998
Geometric Mean Dust Lead Exposure (mg/kg)
12000
10000
8000
6000
4000
2000
0
1968
1973
1978
1983
1988
1993
1998
Year
SMELTERVILLE
Emergency Response to Epidemic
(smelter pollution control, yard greening,
and in-home cleaning initiatives)
KELLOGG/WARDNER,
PAGE
Smelter Closure
1981
Smelter Stabilization
and Fugitive Dust
Control Efforts
1988
Yard Soil
Remediation Initiated
1989*
Fast Track Park,
Playground, and
Rights-of-Way
Cleanups
1986
Vacuum Loan
Program
1993
Populated and Non-
Populated Areas
Cleanup
Commences
1994
PINEHURST
500 mg/kg RAO
*note: no dust samples were collected in 1989, values estimated from same homes in 1988


Percent of Homes with Dust Lead Concentrations ≥ 1,000
by Number of Years After Soil Remediation
60%
50%
40%
30%
20%
10%
0%
Percentage of Homes
0
5
10
15
20
25
Years After Remediation
Homes with Vacuum Concentrations >1,000 mg/kg
Homes with Dust Mat Concentrations >1,000 mg/kg

GeoMean Lead Loading Rates (mg/m²/day): 1996–2013



Mean Children's Blood Lead Levels and Site History



*Ref.=(Mahaffey et al. 1982; Pirkle et al. 1994; Pirkle et al. 1998; Lofgren et al. 2000; CDC 2013)

Soil → Dust
→ Floors & Stuff →
Hands → Mouth
→Blood

Replacing lead contaminated soil with clean soil has substantially reduced lead in house dust & blood