

Lead and Arsenic in Soil and  
House Dust in Sydney:  
Physical Analysis  
and Local Knowledge

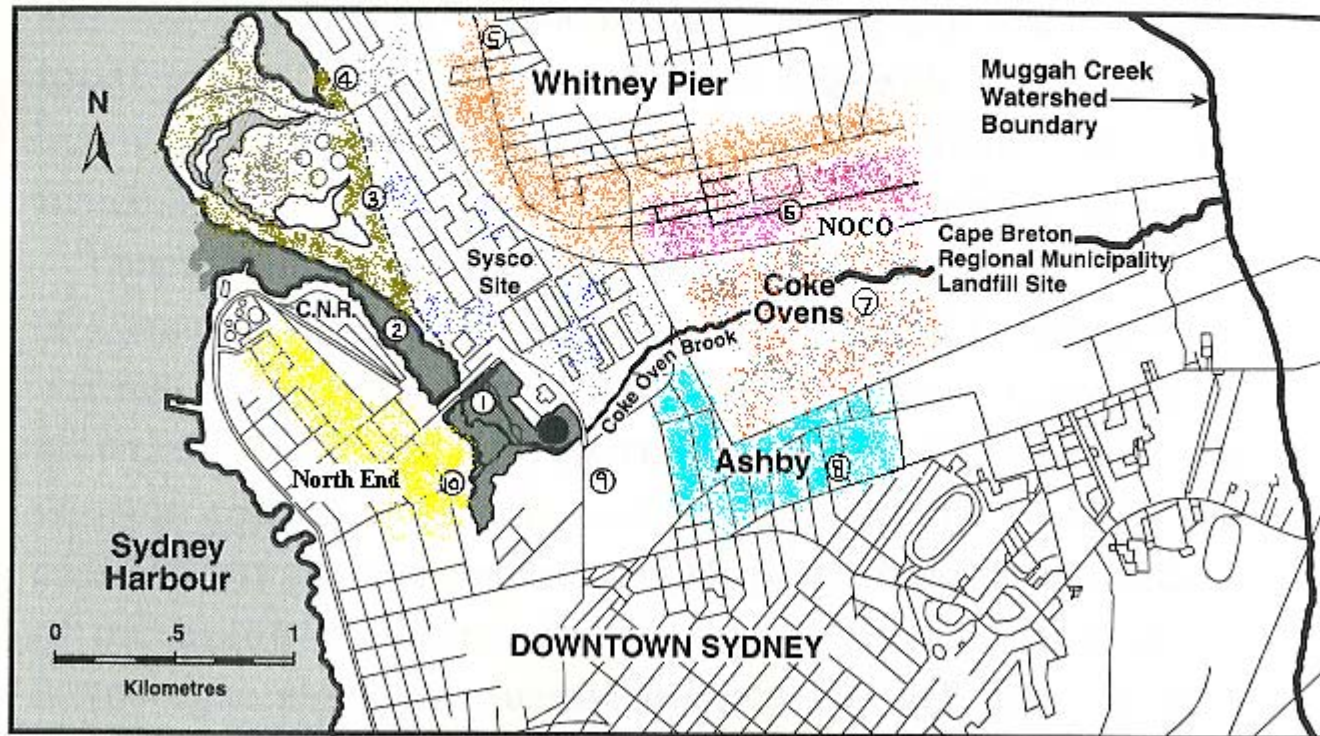
People's Health Commission

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# Overview of Presentation

- Study Area
- Study Objectives: Sampling and Local Knowledge
- Soil Results
- Dust Results
- Local Knowledge
- Why evaluate the dust?
- Health Risks
- Preventive Measures

# *The Sydney Tar Ponds and Surroundings*



# Study Objectives

1. Is Whitney Pier significantly different than control communities: Ashby and North End?
  - Soil contamination
  - house dust contamination
  - local knowledge

# Study Objectives

2. Are the contaminants entering the homes from outside in Whitney Pier, Ashby and North End?
  - Contaminants - lead and arsenic
  - local knowledge

# Soil

1. People were requested to provide us with soil data from their yards collected by the Canadian government
  - Whitney Pier (NOCO), Ashby and North End
2. Collected soil samples in Whitney Pier outside NOCO, Ashby and North End

# House Dust

1. Collected house dust in 15 homes in each community: Whitney Pier, Ashby and North End
2. Collected house dust off the doorway and off the kitchen floor

# Local Knowledge

Survey of household occupants in each community

ex.

Did you observe smoke in your home?

Did you observe odours in your home?



# Statistics: Are the communities different?

## Kruskal-Wallis test

- evaluate if the data as whole should be considered from the same population

## Mann-Whitney test

- compare two groups to determine if they are different
- ex. Whitney Pier vs Ashby

# Soil Data

## Lead

**Guideline 140 ppm**

Whitney Pier NOCO

298 ppm

Whitney Pier non NOCO

341 ppm

Ashby

317 ppm

North End

276 ppm

## Arsenic

**guideline 12 ppm**

Whitney Pier NOCO

44 ppm

Whitney Pier nonNOCO

73 ppm

Ashby

53 ppm

North End

33 ppm

# Background Soil

20 km south of town

Lead 9 ppm; Arsenic 2 ppm

Ashby under a 100 year old house

Lead 37 ppm; Arsenic 9 ppm

NE under a house beside the tar ponds

Lead 297 ppm; Arsenic 37 ppm

# Statistical Analysis of Soil

	KW All	MW WP	MW WP v AH	MW WP v NE
Lead	0.26	0.07	0.82	0.17
Arsenic	0.15	0.034	0.71	0.57

Is Whitney Pier significantly different than the control locations Ashby and North End for soil contamination?

There is no evidence to suggest the communities are different with respect to soil contamination.

# House Dust - Lead

Doorway (ug/cm<sup>2</sup>)

Whitney Pier

average: 0.16

Ashby

average: 0.15

North End

average: 0.32

Kitchen ug/cm<sup>2</sup>

Whitney Pier

average: 0.0036

Ashby

average: 0.013

North End

average: 0.014

# House Dust - Arsenic

Doorway (ug/cm<sup>2</sup>)

Whitney Pier

average: 0.019

Ashby

average: 0.0062

North End

average: 0.008

Kitchen (ug/cm<sup>2</sup>)

Whitney Pier

average: 0.0009

Ashby

average: 0.0009

North End

average: 0.0012

# Statistical Analysis of Dust

	KW	MW	MW	MW
	All	WP vs Ah	WP vs NE	Ah vs NE
Door Pb	0.14	0.33	0.08	0.17
Door As	0.78	0.72	0.80	0.46
In Pb	0.015	0.13	0.004	0.16
In As	0.41	0.63	0.11	0.73



Is Whitney Pier significantly different than the control locations Ashby and North End for house dust contamination?

There is no evidence to suggest the communities are different with respect to house dust contamination.

# Local Knowledge

Were the observations of the people in Whitney Pier, Ashby and North End significantly different?

Two primary questions in the survey:

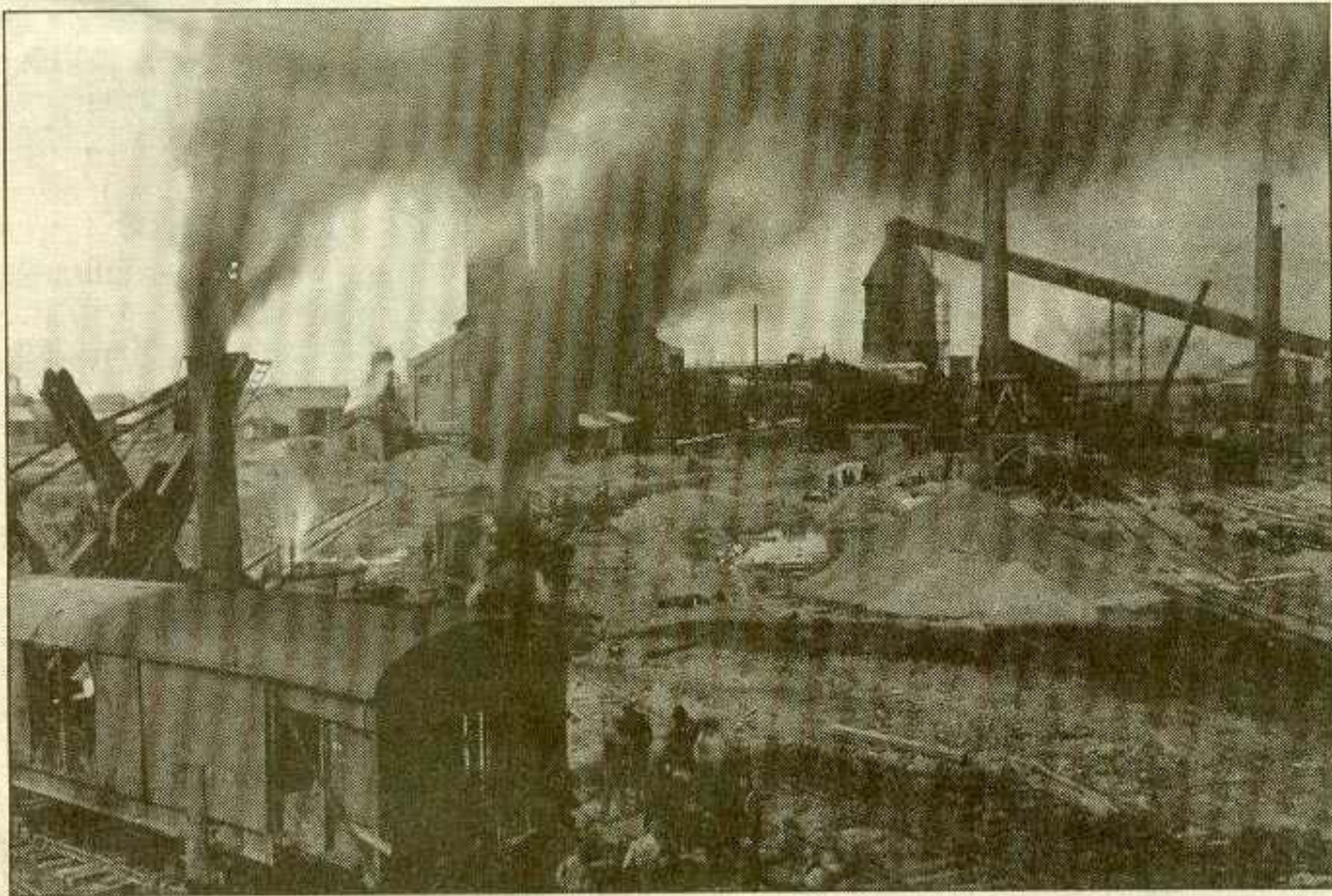
- Smoke
- odours

# Smoke

- All communities observed smoke in their neighborhoods and coming into their homes

common themes:

- daily occurrence
- orange colour
- black spots on laundry
- sheen on the windows facing the site



This picture from the archives of the Beaton Institute shows Dominion No. 6 in 1920.





# Odour

- Observed odours on a daily occurrence
- rotten egg smell
  
- Furimsky (2002) coking released significant amounts of H<sub>2</sub>S - hydrogen sulfide
- H<sub>2</sub>S smells like rotten eggs

# Statistical Analysis of Local Knowledge

	<b>KW All</b>	<b>MW WP vs Ah</b>	<b>MW WP vs NE</b>	<b>MW Ah vs NE</b>
Smoke	0.48	0.32	0.96	0.36
Odour	0.48	0.32	0.96	0.36
Rotten Eggs	0.28	0.44	0.41	0.11
Time	0.83	0.93	0.57	0.61

Is Whitney Pier significantly different than the control locations Ashby and North End with respect to local knowledge?

There is no evidence to suggest the communities are different with respect to local knowledge.



Are the contaminants entering the homes from outside in Whitney Pier, Ashby and North End?

# Three Approaches To Answer the Question

1. Is lead and arsenic loading at the doorways higher than in kitchen?
2. Is the ratio of lead to arsenic correlated at the doorway and the kitchen?
3. Is lead and arsenic loading at doorway and kitchen correlated?

# Are lead and arsenic at the doorways higher than in kitchen?

- Loading of lead and arsenic is ~10 times greater at the doorway than kitchen
- the Mann-Whitney test suggests that doorway and kitchen are significantly different ( $<0.0005$ )
- Suggests lead and arsenic are from outside

# Is the ratio of lead to arsenic correlated at the doorway and the kitchen?

- Lead and arsenic ratios are positively correlated at the doorway and kitchen for all data and for each community considered individually
- Suggests lead and arsenic are from outside

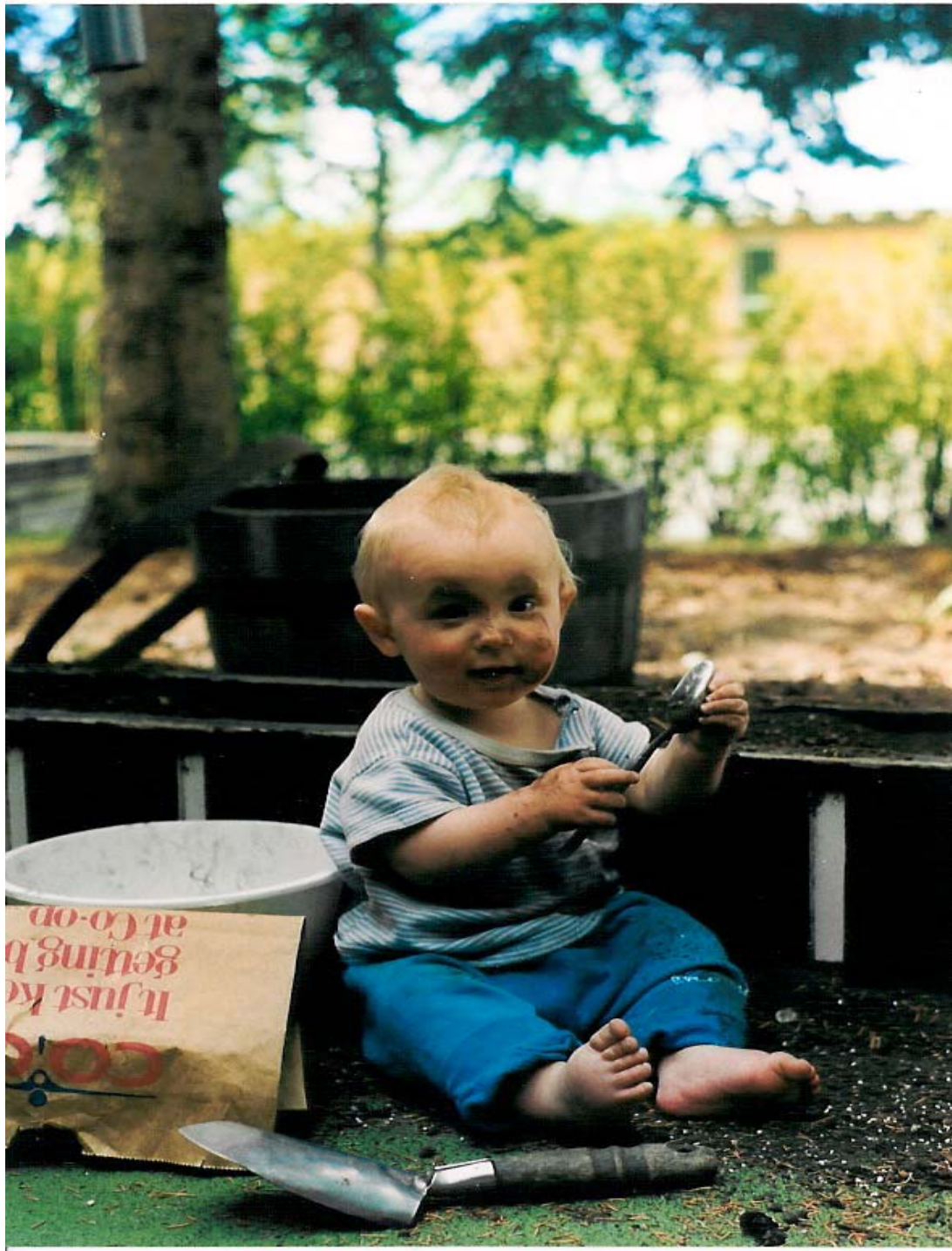
# Is lead and arsenic loading at doorway and kitchen correlated?

- Lead and arsenic loading at the doorway and kitchen are correlated
- lead loading at the doorway and kitchen are correlated
- arsenic loading at the doorway and kitchen are correlated only in Ashby
- suggests that lead and arsenic are from outside

# Why Study Dust?

Manton 2000

dust is the major and perhaps only contributor to blood lead given that dietary lead is almost negligible



# Health Risk Assessment - Lead

Can estimate the health risk from lead from previous studies of children



TABLE 5

Likelihood of a Child's Blood Lead  $\geq 10$   $\mu\text{g/dL}$  for Floor Dust Lead Loadings and Exterior Exposure Levels (ppm)<sup>a</sup>

Dust lead loading ( $\mu\text{g}/\text{ft}^2$ )	Probability of blood lead greater than 10 $\mu\text{g}/\text{dL}$							
	Exterior lead exposure (ppm)							
	10	72 <sup>b</sup>	100	500	1000	1500	2000	4000
1	0.33% (0.05, 2.24)	1.0% (0.3, 3.8)	1.2% (0.3, 4.2)	2.7% (0.9, 7.4)	3.7% (1.3, 9.7)	4.4% (1.6, 11.5)	4.9% (1.8, 12.8)	6.5% <sup>c</sup> (2.3, 16.9)
5	1.8% (0.4, 7.9)	4.4% (1.7, 11.0)	5.0% (2.0, 11.8)	9.3% (4.7, 17.6)	12% (6, 21)	14% (7, 24)	15% (8, 26)	18% (9, 32)
10	3.3% (0.8, 12.6)	7.4% (3.1, 16.5)	8.3% (3.8, 17.5)	14% (8, 24)	18% (10, 29)	20% (12, 32)	22% (13, 35)	26% (15, 41)
15	4.5% (1.2, 16.2)	9.8% (4.3, 20.7)	11% (5, 22)	18% (11, 29)	22% (14, 34)	25% (15, 37)	27% (16, 40)	31% (19, 47)
20	5.7% (1.5, 19.2)	12% (5, 24)	13% (6, 25)	21% (13, 33)	26% (16, 38)	28% (18, 41)	30% (19, 44)	35% (22, 51)
25	6.7% (1.8, 21.8)	14% (6, 27)	15% (7, 28)	24% (15, 36)	28% (18, 41)	31% (20, 45)	33% (22, 47)	38% (25, 54)
40	9.4% (2.7, 27.8)	18% (9, 33)	20% (10, 35)	30% (19, 43)	35% (23, 48)	38% (25, 52)	40% (27, 54)	45% (31, 61)
55	12% (3, 32)	21% (10, 38)	23% (12, 40)	34% (22, 48)	39% (27, 53)	42% (29, 57)	45% (31, 59)	50% (35, 65)
70	13% (4, 36)	24% (12, 42)	26% (14, 44)	37% (24, 52)	43% (29, 57)	46% (32, 60)	48% (34, 63)	54% (38, 69)
100	17% (5, 41)	28% (14, 48)	31% (16, 49)	43% (28, 58)	48% (34, 63)	51% (37, 66)	54% (39, 68)	59% (43, 73)

<sup>a</sup>All other variables held at their national median.<sup>b</sup>Estimated median levels based on U.S. Housing and Urban Development national survey, 1989-1990.

# Health Risk - Lead

Considering the doorway lead and soil concentrations

- likelihood that a child may have a blood lead  $>10$  ug/dL is 30-40%

Considering the kitchen lead and soil concentrations

- likelihood that a child may have a blood lead  $>10$  ug/dL is 1-15%

# New Information on Lead

Lanphear 2000

- reading and math deficits associated with blood lead concentrations  $<10$  ug/dL in US children and adolescents
- suggests the new guideline should be 5 ug/dL
- blood lead levels much higher than pre-industrial times

# November 2001 Blood Lead and Arsenic

- Concluded there was no difference between Whitney Pier, Ashby and North End
- Our study suggests there should not be a difference
- ~ 7 children over 5 ug/dL

# Arsenic

- 15 individuals with arsenic over 20ug/L
- Highest arsenic levels in Ashby and North End
- there is a need to take preventive measures to protect against health risks in all three communities

# Lead

- No children over 10 ug/dL
- No difference between the three communities
- our results suggest levels should be similar
- boys had higher lead levels than girls

# Dodds and Seviour 2001

- Between 1988 and 1998 - after the plants were closed down
- small but statistically significant increase in birth defects - 25% higher than rest of NS
- suggest contaminants in the environment
- our study provides evidence that contaminants are in the home and could play a role

# What about other contaminants?

- In this study we predicted the PAHs inside the home based on correlations with lead in the soil
- predicted 18 PAHs at the doorway:  
ex. BaP - 280 pg/cm<sup>2</sup>



# Cape Breton Post - April 5, 2003

- Paul Moore - April 2001 confirmed neighboring streets contaminated with arsenic, lead, toluene, PAHs, benzene, thallium, and chromium
- Perhaps these will be in the dust as well

# Preventative Measures

- Prudent to clean your floors on a daily basis in particular if you have young children
- Monitor your children when they are playing in the yard so that they do not eat soil