# Environmental Impacts on Public Health in North Carolina

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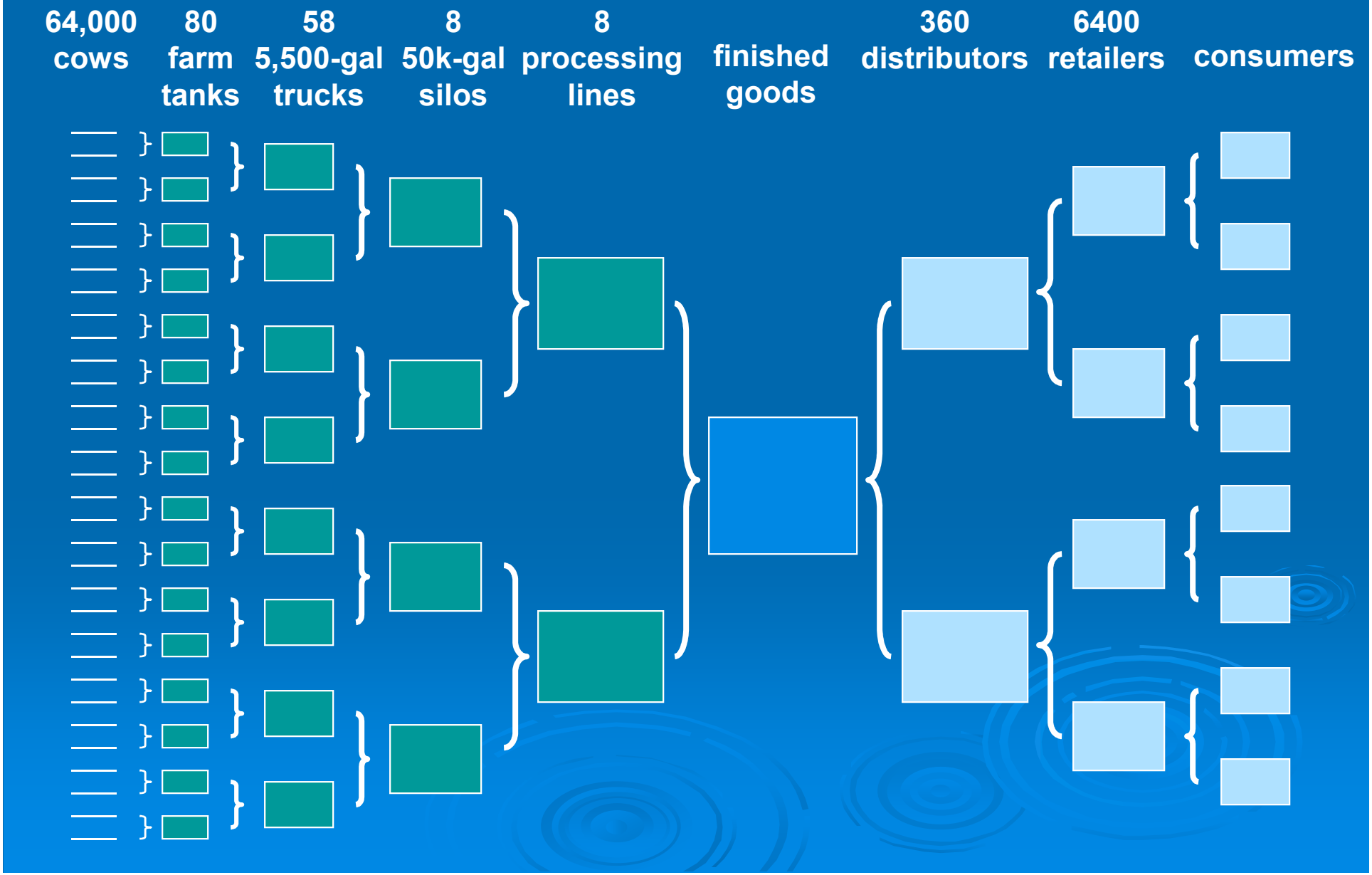
State Health Director

# Air, Water, Food
# Do We Know Public Health Impacts?

- Indoor and Outdoor Air
- Drinking Water
  - Surface, ground, public, private
- Food
  - Bacteria and chemical contamination
  - Amplification from industrialization

# The Milk Supply Chain



# Knowledge Gaps

- Dose-Response
  - Is the “solution to pollution dilution”?
- Toxicological and Epidemiological models
  - Acute effects, cumulative effects
- Environmental harm
  - Precautionary principal for human health

# NC Examples

- Heavy Metals
  - Mercury in fish
  - Lead in environment
  - Arsenic in well water
- Air pollutants
  - Second-hand tobacco smoke, particulate matter, ozone, radon


Food Contamination
Fresh water fish
Mercury
Bantry Lake
Fish Consumption Advisory

# Adverse Health Effects of Organic Mercury Ingestion

- Cardiovascular
  (abnormal heart rhythm, myocarditis, cardiac arrest)
- GI
  (diarrhea, abdominal pain, vomiting, irritation/blisters in upper GI tract)
- Hematological
  (decreased hemoglobin, erythrocytes, hematocrit)
- Musculoskeletal
  (muscle twitching, skeletal muscle degeneration, leg and arm cramping, muscle wasting

# Adverse Health Effects of Organic Mercury Ingestion

- Dermal

  (rashes/allergic response, skin lesions as pruritus on the soils, palms, genitalia, exfoliative dermatitis of the hands & feet)
- Immunological effects seen in animals
- Death, at estimated 10-60 mg/kg

  (due to nervous system effects - non-inflammatory CNS disease, pneumonia, non-ischemic heart disease as secondary causes of death)

# NC Fish Advisory
# Action Levels for Mercury

| Average Methyl Mercury Level | Women (15-44 yrs), pregnant or nursing women, children <15 yrs | All others |
|---|---|---|
| < 0.4 mg/kg | 2 meals per week | 4 meals per week |
| 0.4 to 1.0 mg/kg | Do not eat | 1 meal per week |
| > 1.0 to 3.0 mg/kg | Do not eat | 1 meal per month |
| > 3.0 mg/kg | Do not eat | Do not eat |

mg/kg = milligrams per kilogram (or “parts per million”, ppm)
yrs = years
meal = 6 oz. of uncooked fish

# Mercury in Fish Advisories in NC

- Statewide
  - Women (15-44 yr), pregnant or nursing women, children <15 yr –
    - Do not eat fish high in mercury
    - Eat up to 2 meals per week of fish low in mercury
  - All other individuals –
    - Eat no more than 1 meal/week fish high in mercury
    - Eat up to 4 meals/week fish low in mercury

# Site-Specific Mercury Advisories in NC

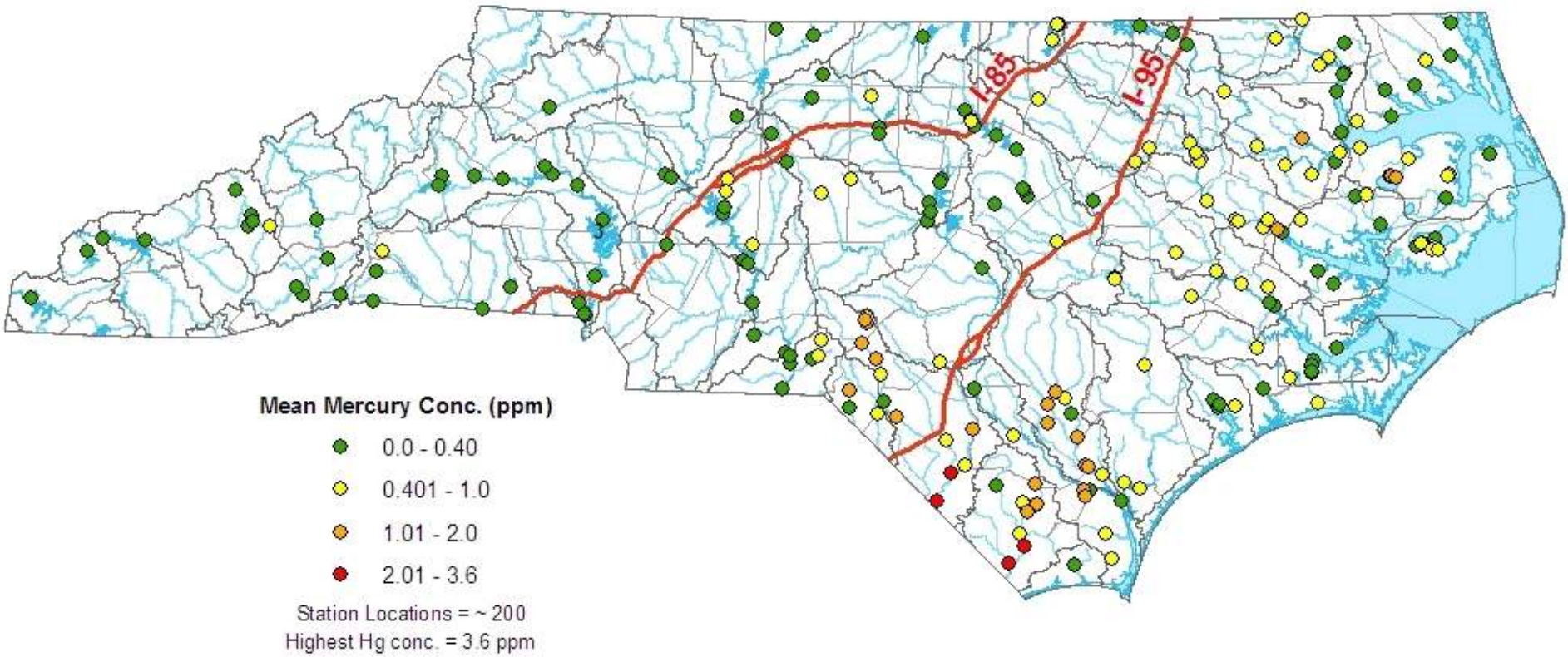
- Lake Gaston in Warren, Halifax & Northampton Counties
  - Women (15-44 yr), pregnant or nursing women, children <15 yr –
    - Do not eat walleye or largemouth bass
  - All other individuals –
    - Eat no more than 1 or 2 meals/month of walleye or largemouth bass

# Mercury in Fish Advisories in NC


- 3 Site-specific advisories (Lakes Gaston, Santeetlah, Fontana)

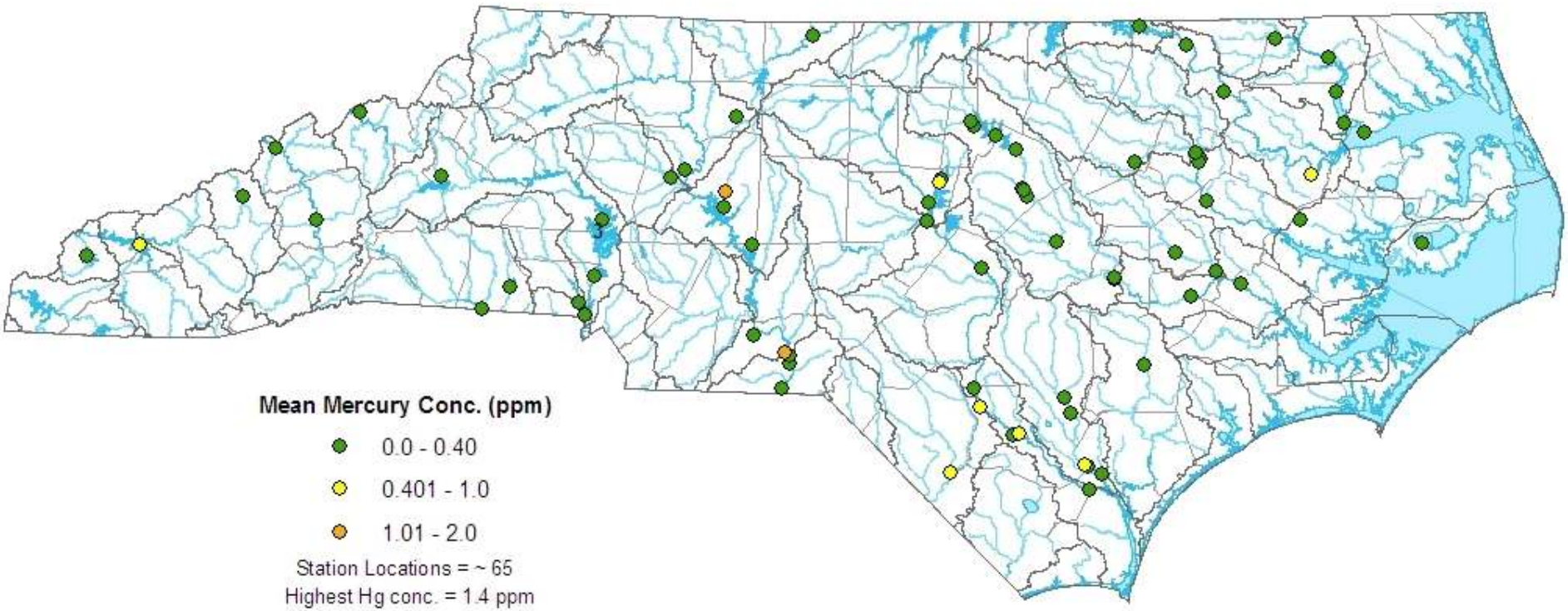
State-wide advisory (Walleye & Largemouth bass)

# Largemouth Bass Hg - 1990 to 2008



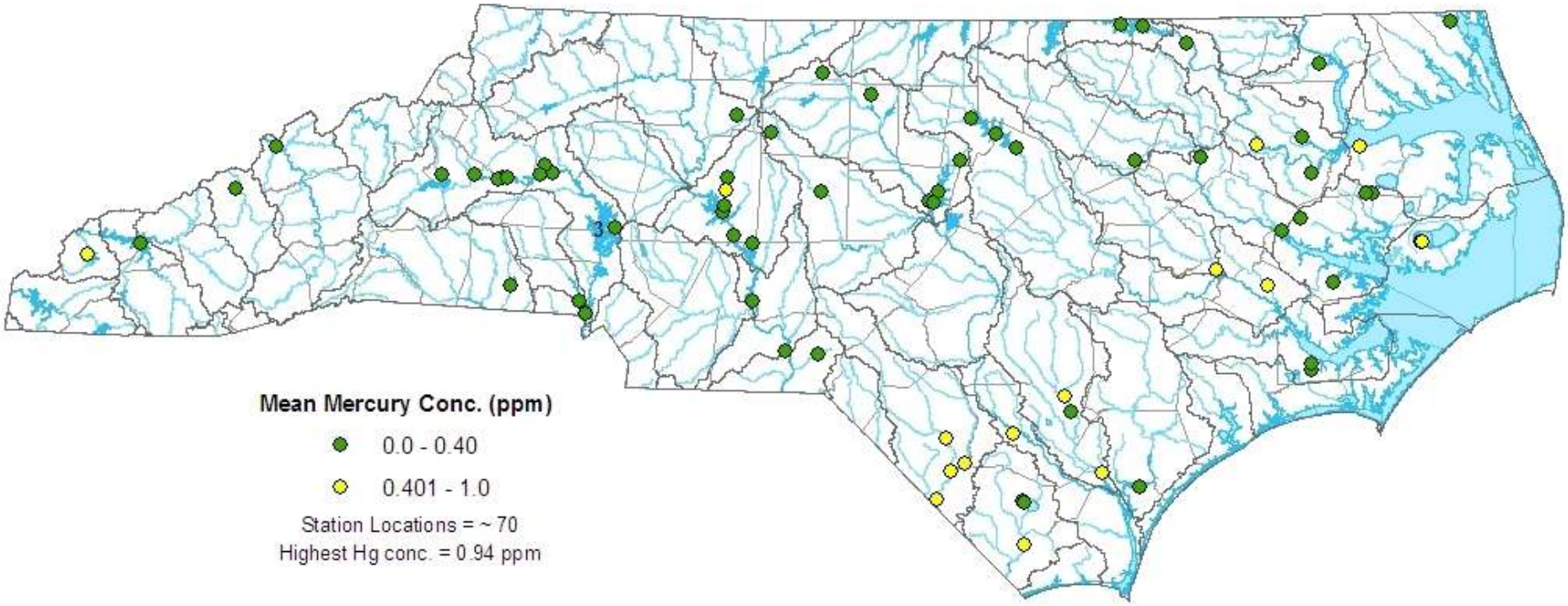

Map provided by N.C. DENR Div. of Water Quality, Sept. 14, 2010

# Channel Catfish Hg - 1990 to 2008



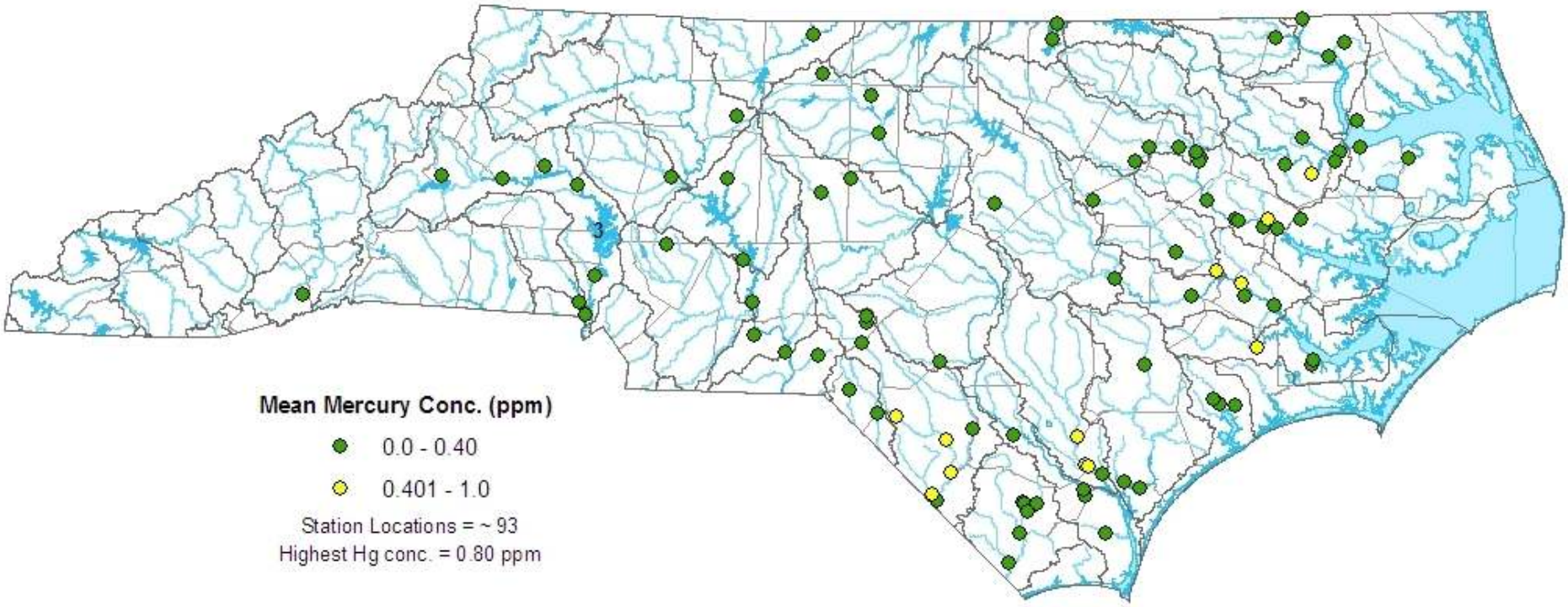

Map provided by N.C. DENR Div. of Water Quality, Sept. 14, 2010

# Black Crappie Hg - 1990 to 2008



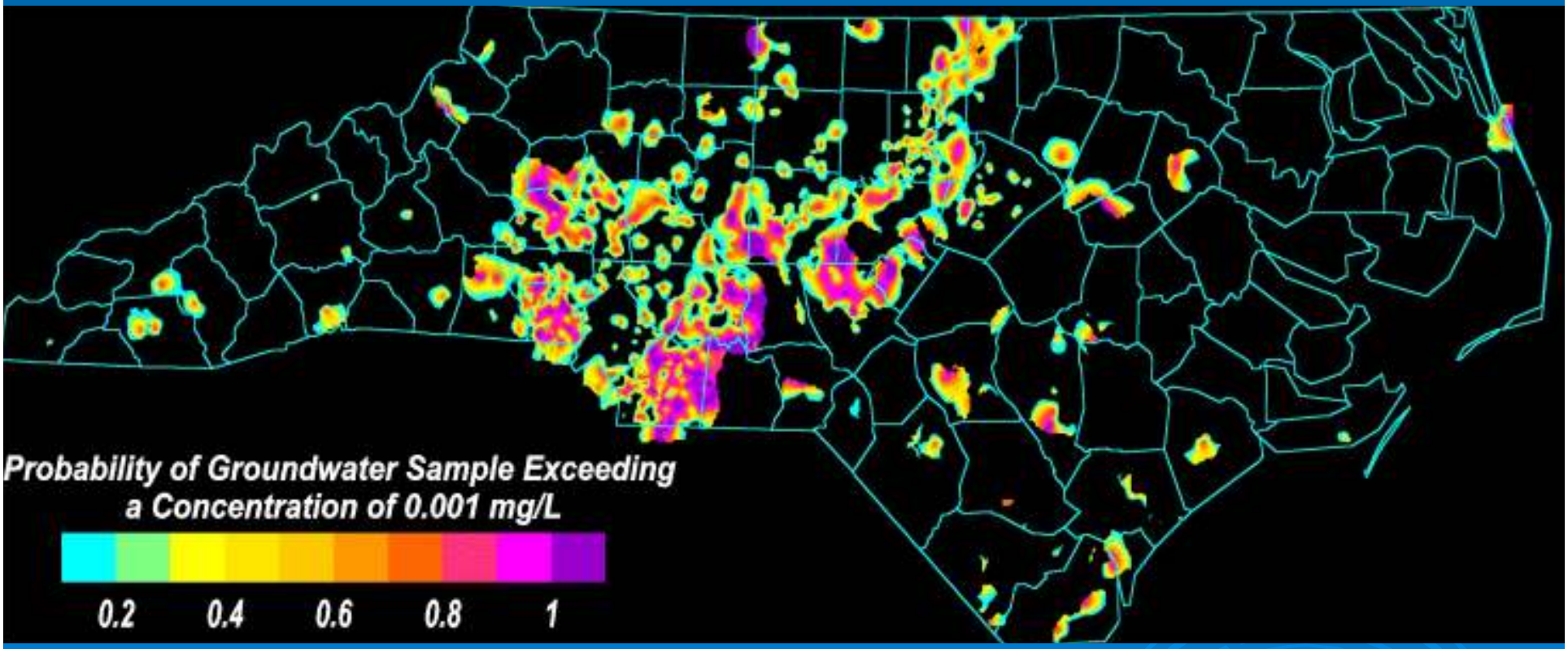

Map provided by N.C. DENR Div. of Water Quality, Sept. 14, 2010

# Redear Sunfish Hg - 1990 to 2008




Map provided by N.C. DENR Div. of Water Quality, Sept. 14, 2010

# *DISTRIBUTION OF TOTAL ARSENIC IN THE GROUNDWATER RESOURCE OF THE PIEDMONT PROVINCE OF NORTH CAROLINA*




NC Department of Environment And Natural Resources, 2004

# ARSENIC IN PRIVATE DRINKING WATER WELLS IN NORTH CAROLINA

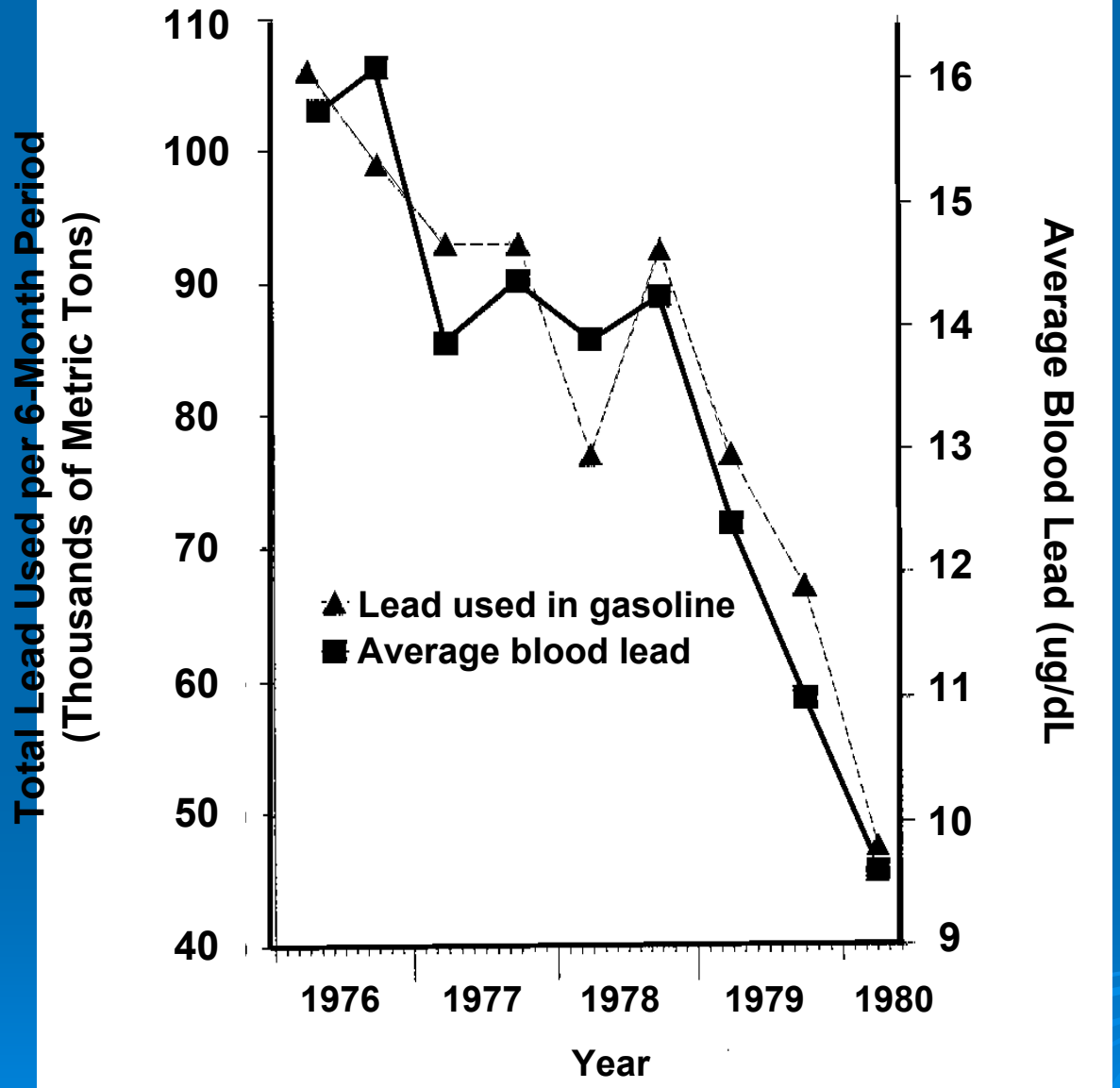
- Arsenic is the 20th most abundant element in the earth's crust
- Arsenic is found as a byproduct of the smelting process for copper, lead and gold
- Major past uses were as agricultural pesticides in the form of organic and inorganic arsenic
- The sources of arsenic are anthropogenic and natural
- Inorganic forms of arsenic consisting of As(III) – arsenite and As(V) – arsenate are found in groundwater systems in North Carolina

# ARSENIC IN PRIVATE DRINKING WATER WELLS IN NORTH CAROLINA

- Arsenic is a known human carcinogen
- Arsenic exposure in drinking water may cause skin, bladder and lung cancer in humans
- Non-cancer effects from arsenic in drinking water include adverse cardiovascular, liver and GI-tract effects
- Other non-cancer effects from arsenic in drinking water consist of hyperkeratotic warts or corns on the face, neck and back. Arsenic may also cause peripheral neuropathies which may begin as numbness in the hands and feet and progress to muscle weakness

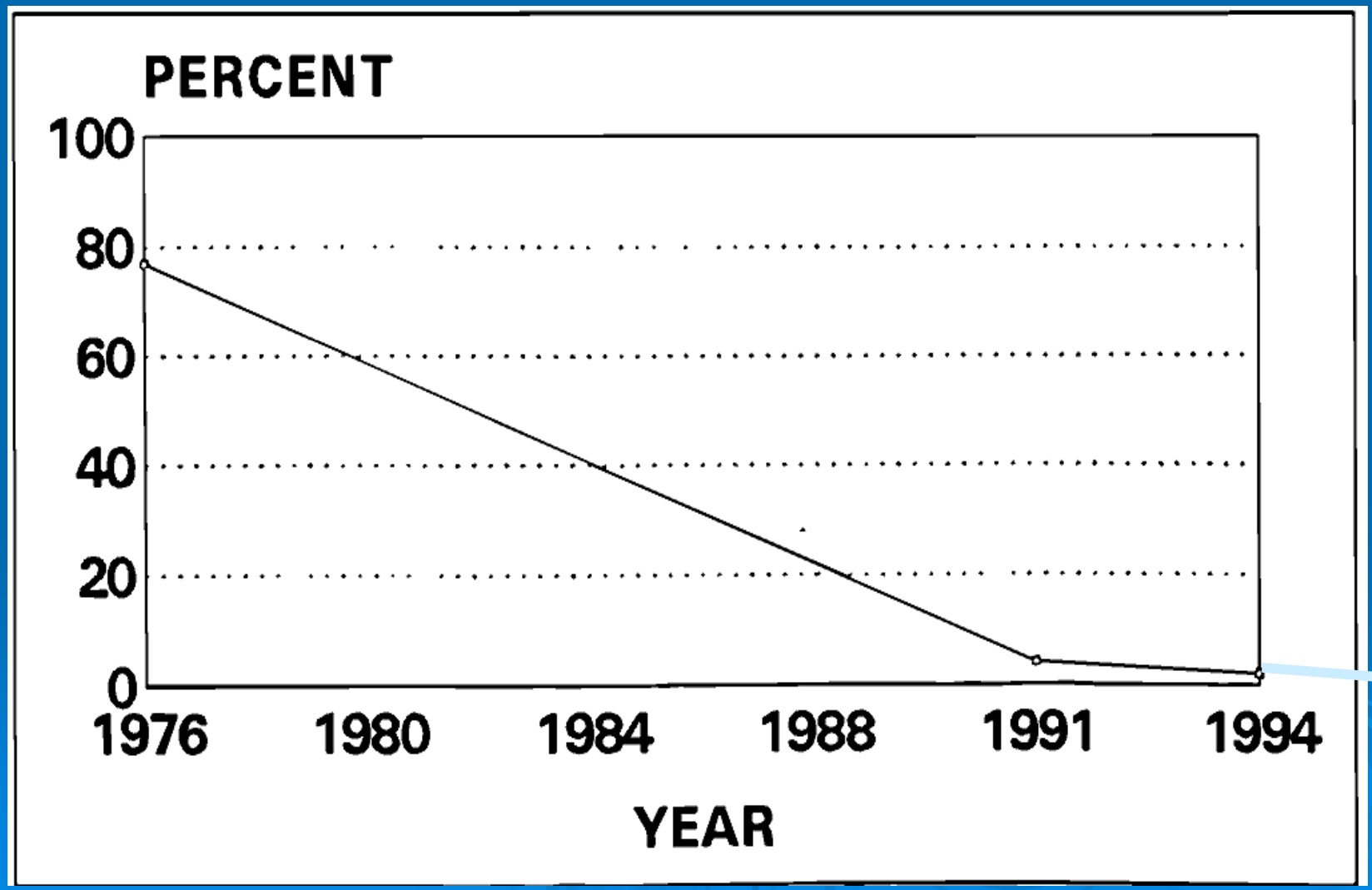
# ARSENIC IN PRIVATE DRINKING WATER WELLS IN NORTH CAROLINA

- There are over 7700 private wells in North Carolina with arsenic contamination from 1998-2010
- The top 15 counties with the highest number of arsenic contaminated private wells in North Carolina are Union, Orange, Stanly, Chatham, Randolph, Gaston, New Hanover, Alamance, Moore, Guilford, Person, Wake, Nash, Lincoln, and Dare
- Arsenic contaminated private wells have been identified in over 85 North Carolina counties
- The drinking water standard for arsenic in private wells in North Carolina is 10 parts per billion



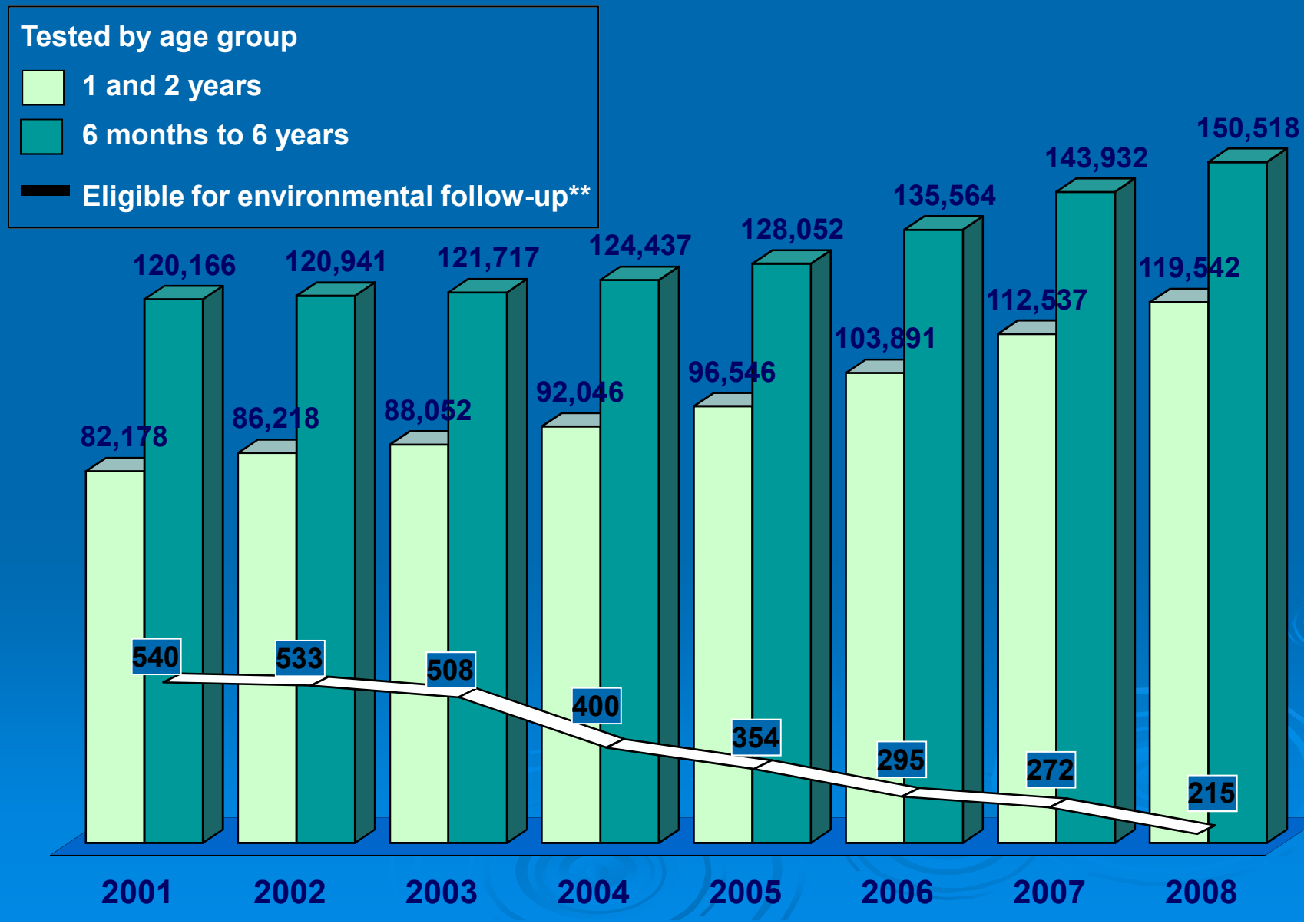

**Lead used in gasoline production and average NHANES II blood lead (Feb. 1976-Feb. 1980)**

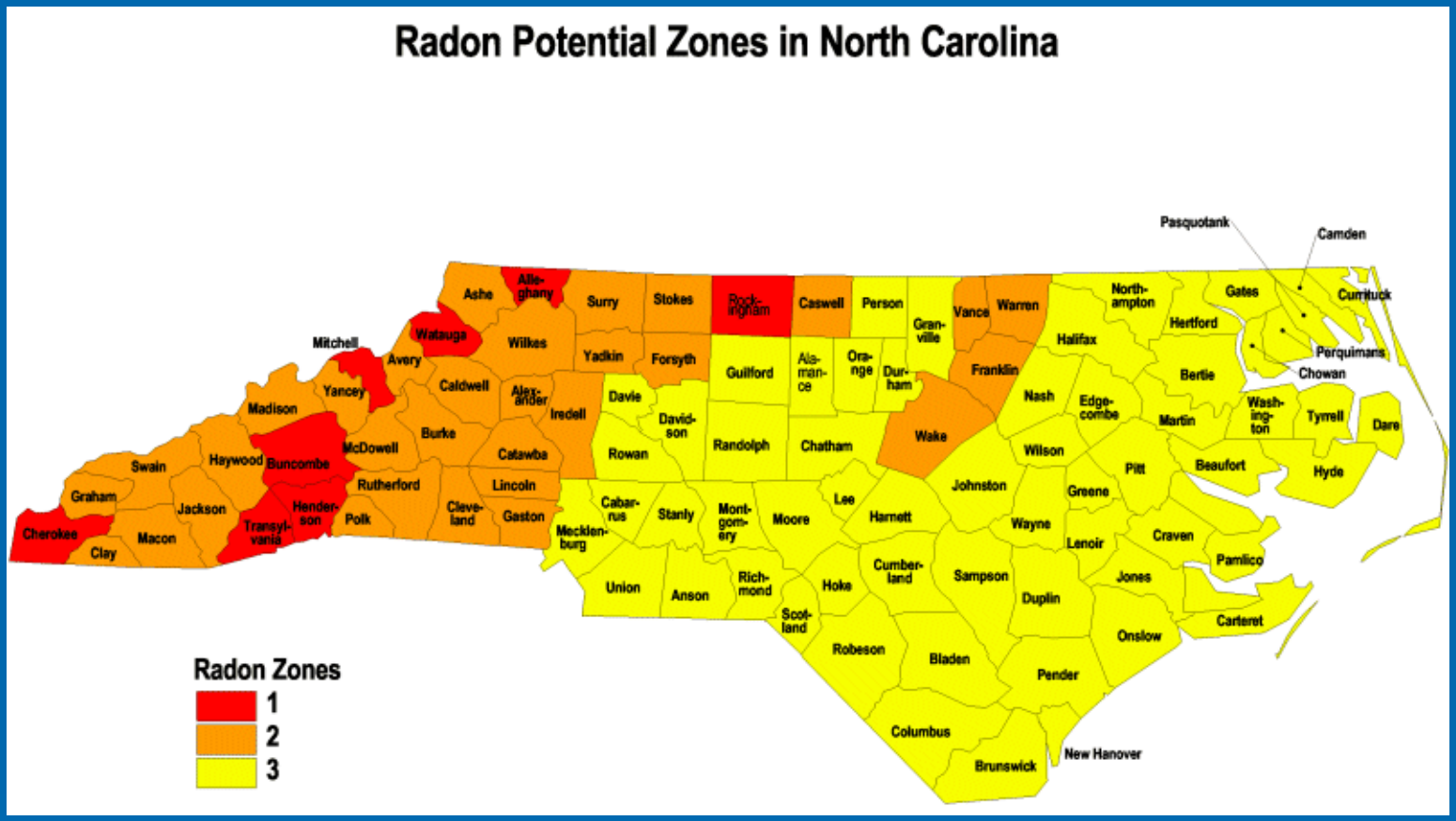
# Geometric Mean Lead Levels: 1976-1994




1999

# North Carolina Childhood Blood Lead Surveillance Data
## Number of Children Tested for Lead Poisoning*

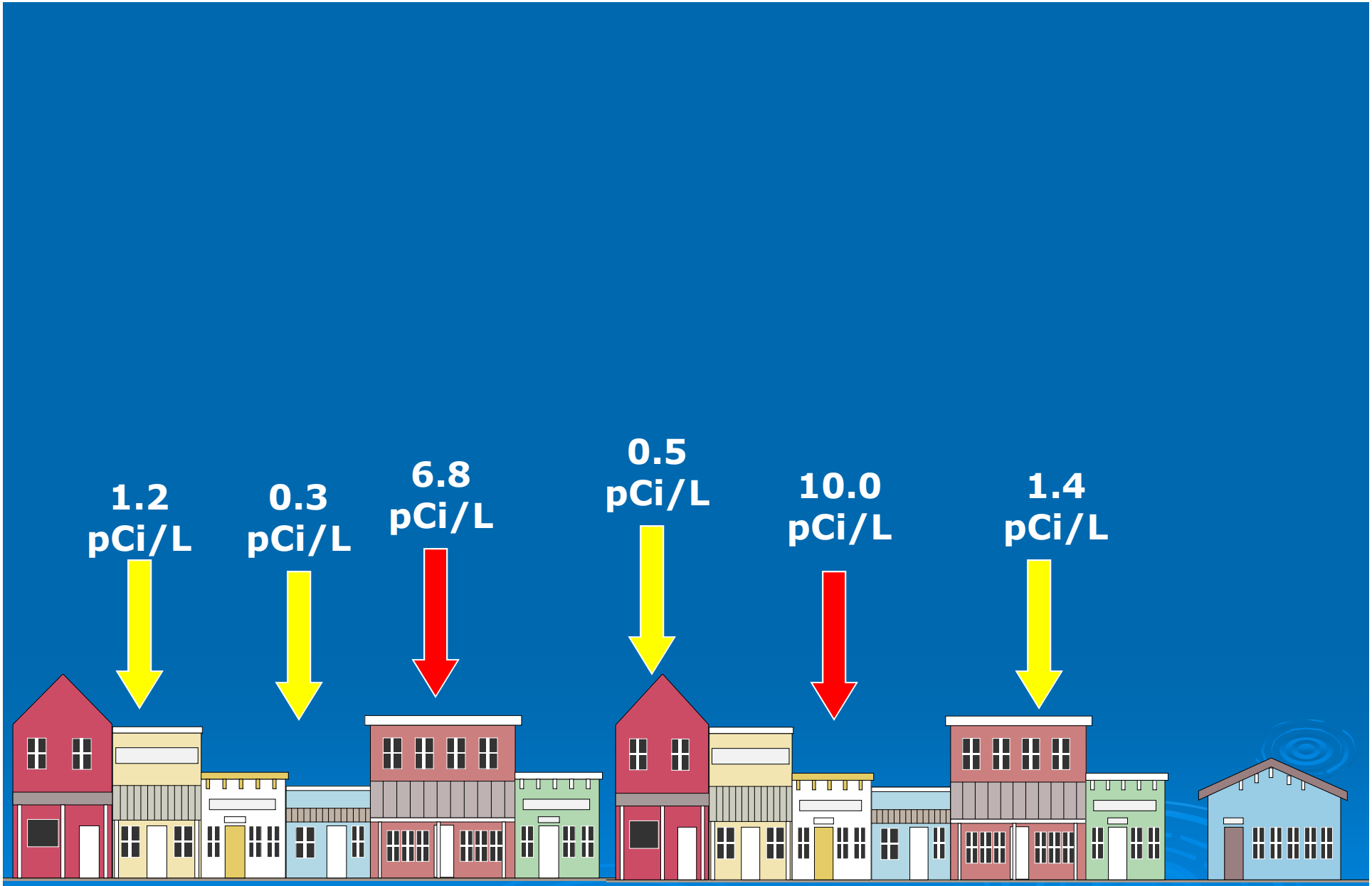





- Radon <u>potential</u>; average concentration (pCi/L) indoor screening level. Based on geology, random residential samples, and environmental sampling.

| Zone 1: Highest Potential | Zone 2: Moderate Potential | Zone 3: Low Potential |
|---|---|---|
| (> 4 pCi/L) | (2-4 pCi/L) | (< 2 pCi/L) |

Source: U.S. EPA 402-R-93-071 September 1993




- **Elevated concentrations of radon has been found in all three zones. The only way to know your risk is to test your home.**

# Radon – Induced Lung Cancer Risk

- Quantity (Concentration of Rn)
  Action level = 4 pCi/L
- Amount of time exposed
- Smoker vs Non-Smoker

# Smokers…

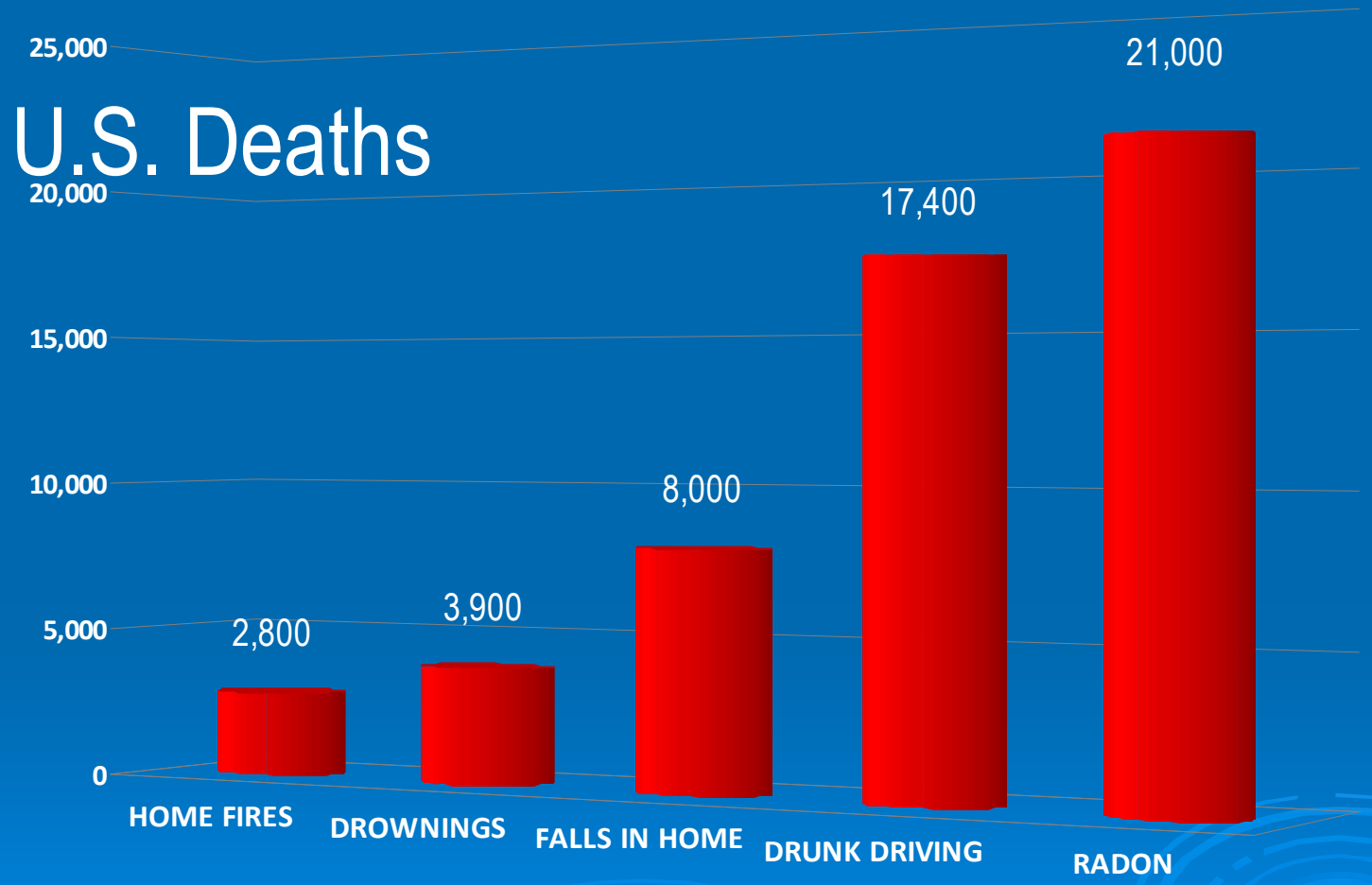
| Radon Level | If 1,000 people who smoked were exposed to this level over a lifetime | The risk of Cancer from radon exposure compares to… | WHAT TO DO: Stop smoking and … |
|---|---|---|---|
| 2.0 pCi/L | ~ 32 people could get lung cancer | 6 times the risk of dying from poison | Consider fixing between 2-4 pCi/L |
| 4 pCi/L | ~ 62 people could get lung cancer | 5 times the risk of dying in a car crash | Fix your home |
| 8 pCi/L | ~ 120 people could get lung cancer | 30 times the risk of dying in a fall | Fix your home |
| 10 pCi/L | ~ 150 people could get lung cancer | 200 times the risk of dying in a home fire | Fix your home |
| 20 pCi/L | ~ 260 people could get lung cancer | 250 times the risk of drowning | Fix your home |

# Non-Smokers…

| Radon Level | If 1,000 people who never smoked were exposed to this level over a lifetime | The risk of Cancer from radon exposure compares to… | WHAT TO DO: Stop smoking and … |
|---|---|---|---|
| 2.0 pCi/L | ~ 4 people could get lung cancer | The risk of dying from poison | Consider fixing between 2-4 pCi/L |
| 4 pCi/L | ~ 7 people could get lung cancer | The risk of dying in a car crash | Fix your home |
| 8 pCi/L | ~ 15 people could get lung cancer | 4 times the risk of dying in a fall | Fix your home |
| 10 pCi/L | ~ 18 people could get lung cancer | 20 times the risk of dying in a home fire | Fix your home |
| 20 pCi/L | ~ 36 people could get lung cancer | 35 times the risk of drowning | Fix your home |

Source: A Citizen's Guide to Radon, EPA, Sept, 2006

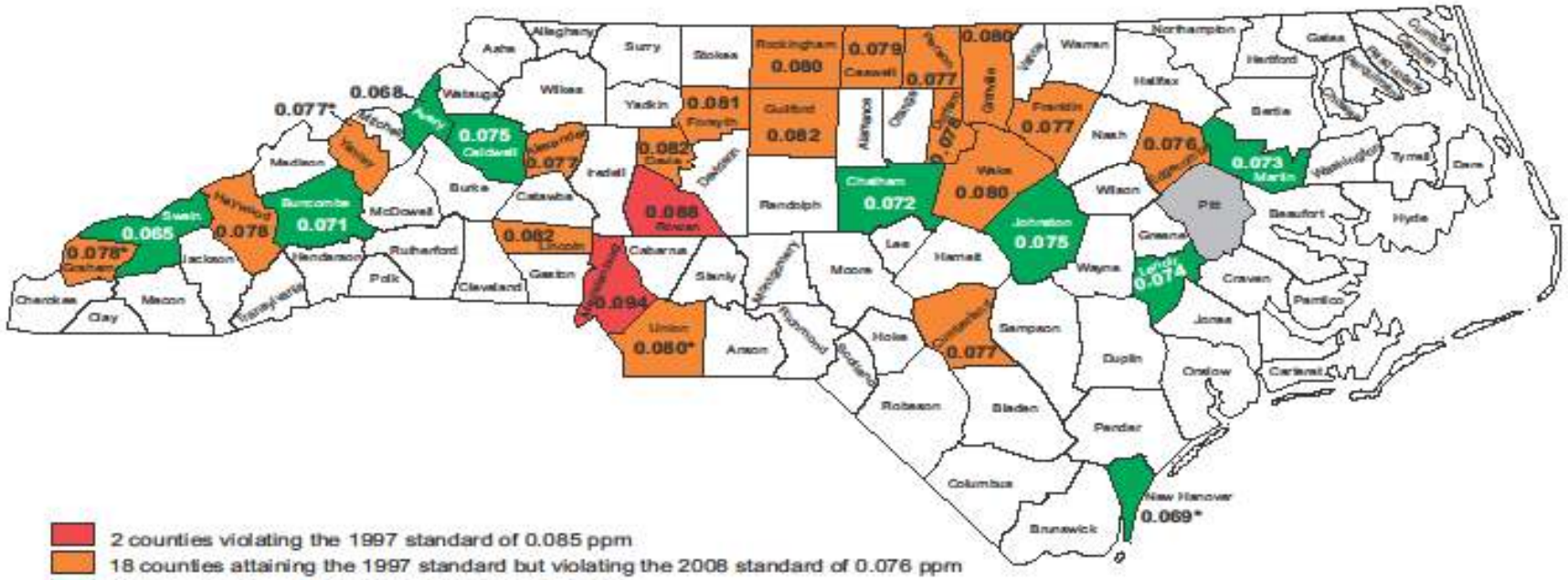
NORTH CAROLINA
RADIATION PROTECTION




Source: "A Citizen's Guide to Radon" EPA, Sept, 2005, Layout – LiveLung.org

| | | |
|---|---|---|
| 1. | Lung and Bronchus | 161,840 |
| 2. | Colon and Rectum | 49,960 |
| 3. | Breast Cancer | 40,930 |
| 4. | Pancreas | 34,290 |
| 5. | Prostate | 28,660 |
| 6. | Leukemia | 21,710 |
| 7. | Radon-Induced Lung Cancer | 21,000 |
| 8. | Non-Hodgkin Lymphoma | 19,160 |
| 9. | Liver and Bile Duct | 18,410 |
| 10. | Ovary | 15,520 |
| 11. | Esophagus | 14,280 |
| 12. | Urinary Bladder | 14,100 |
| 13. | Kidney and Renal Pelvis | 13,010 |
| 14. | Stomach | 10,880 |
| 15. | Myeloma | 10,690 |
| 16. | Melanoma | 8,420 |

# North Carolina Counties with 8-Hour Ozone Violations, 2006-2008

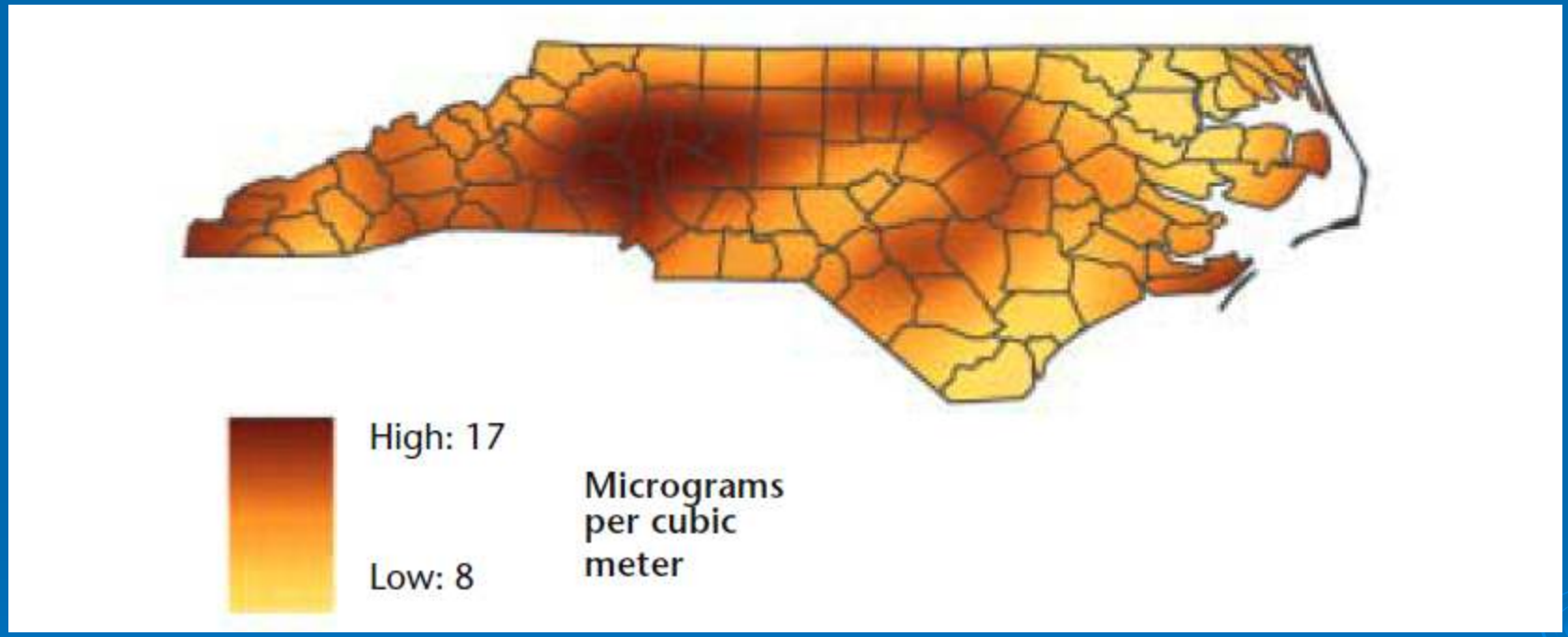



*sampling did not satisfy EPA summary criteria; design value shown is provisional

NOTE:
– additional counties may be involved in emission reduction strategies
– nonattainment designations may differ from county boundaries

N.C. DENR
DAQ/Statistical Services
using TIBCO Spotfire S+®
Not To Scale
Mon Mar 23 13:45:23 EDT 2009

# Average Soot Levels in North Carolina, 2003 ($PM_{2.5}$)



# Average Smog Levels in North Carolina, April to October 2003

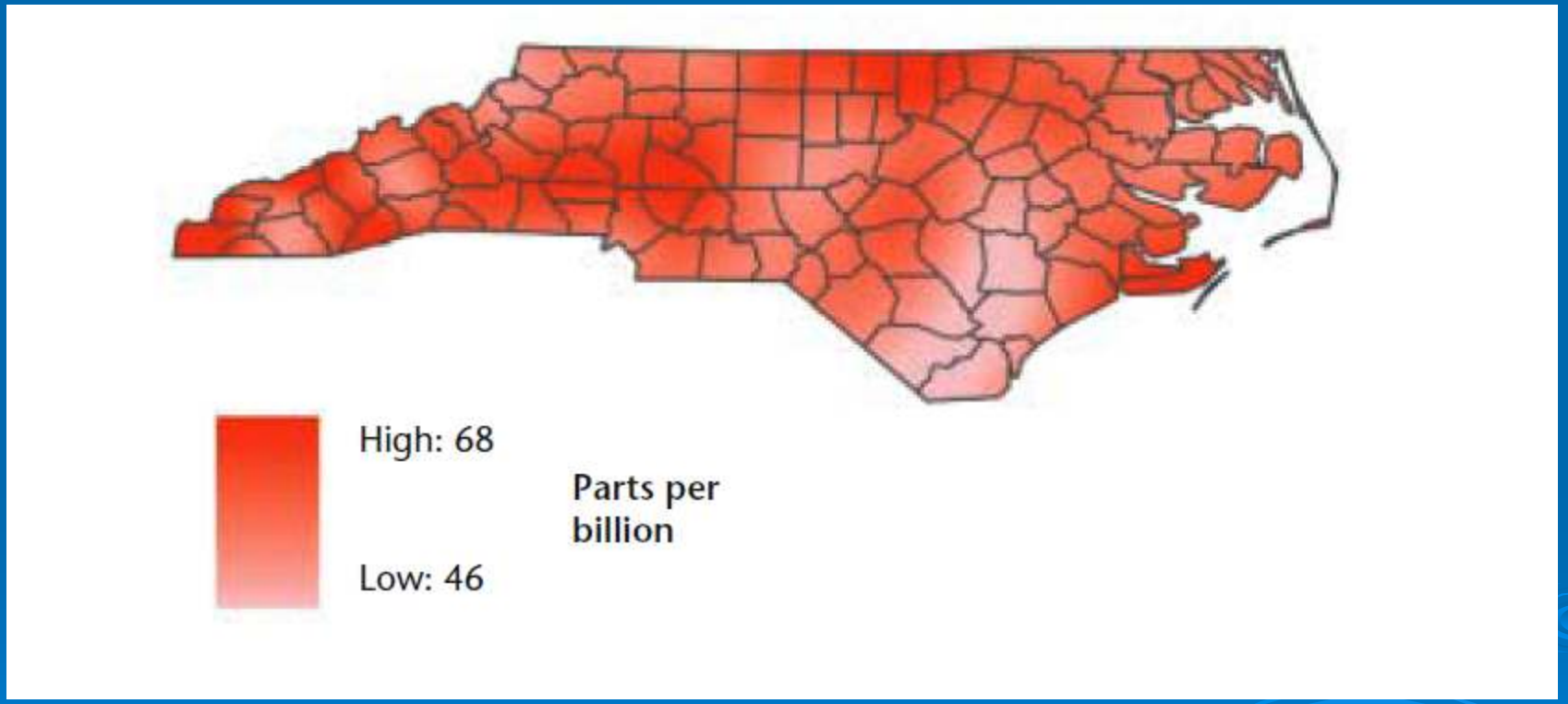
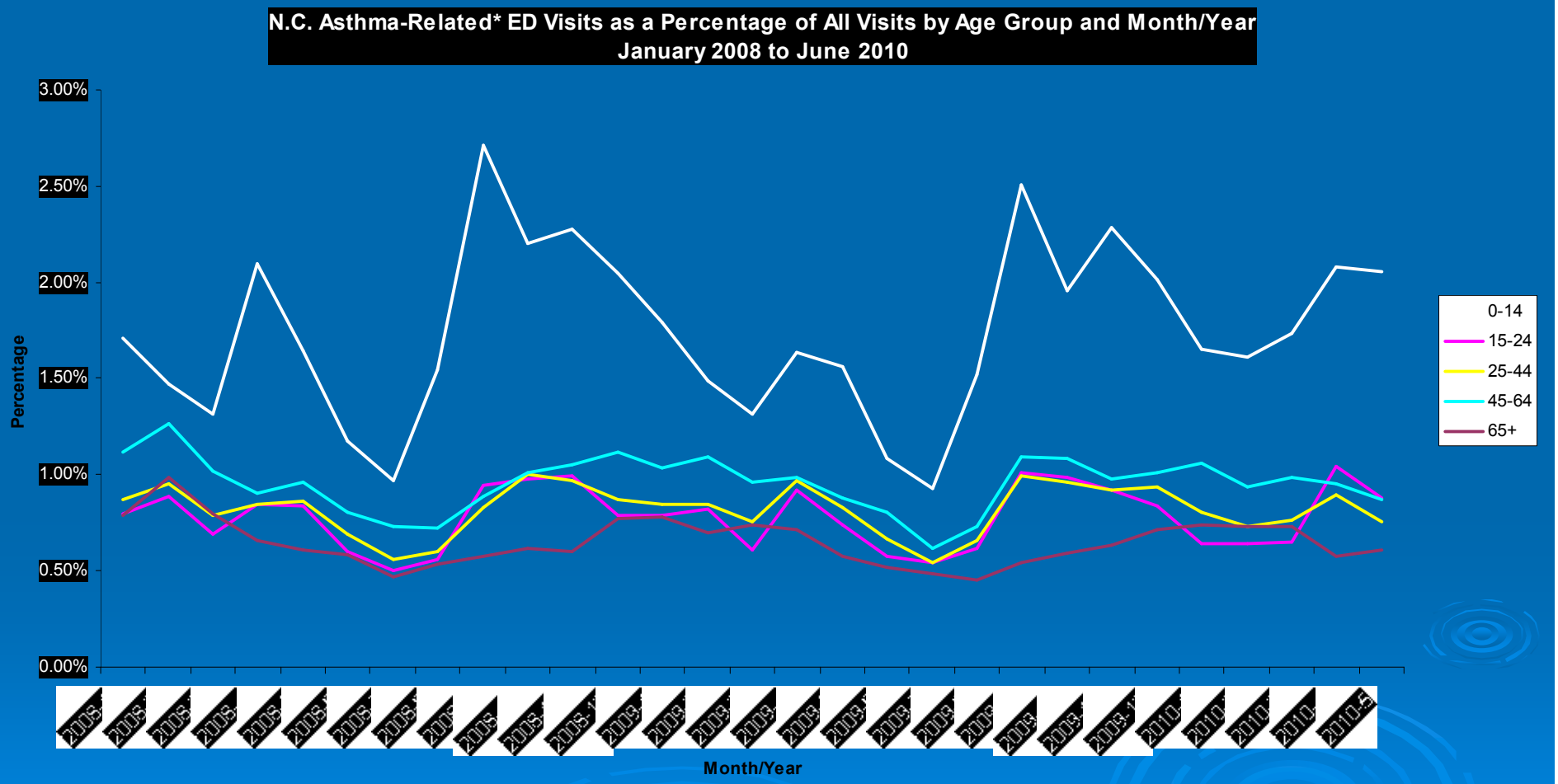


**Table 1: Public Health Damage from Soot in North Carolina ($PM_{10}$)**

| Health Effect | Estimated Cases | Range |
|---|---|---|
| Premature Death (Adults) | 3,000 | 2,000 – 4,600 |
| Respiratory Hospital Admissions | 2,000 | 1,700 – 2,600 |
| Cardiovascular Hospital Admissions | 2,000 | 900 – 2,500 |
| New Cases of Chronic Bronchitis | 2,500 | 260 – 4,400 |
| Asthma Attacks | 200,000 | 100,000 – 390,000 |
| Missed Work Days | 500,000 | 440,000 – 520,000 |
| Restricted Activity Days | 5 million | 4.1 million – 5.5 million |
| Increased Symptom Days | 15 million | 7 million – 23 million |

**Table 2: Public Health Damage from Smog in North Carolina (Ground-level $Ozone_0$)**

| Health Effect | Estimated Cases | Range |
|---|---|---|
| Adult Onset Asthma (Males, 25+) | 1,500 | 900 –1,900 |
| Respiratory Hospital Admissions | 4,000 | 3,000 – 5,000 |
| Asthma Attacks | 200,000 | 100,000 – 300,000 |
| Restricted Activity Days | 1 million | 800,000 – 1.4 million |
| Increased Symptom Days | 4 million | 2 million – 6 million |



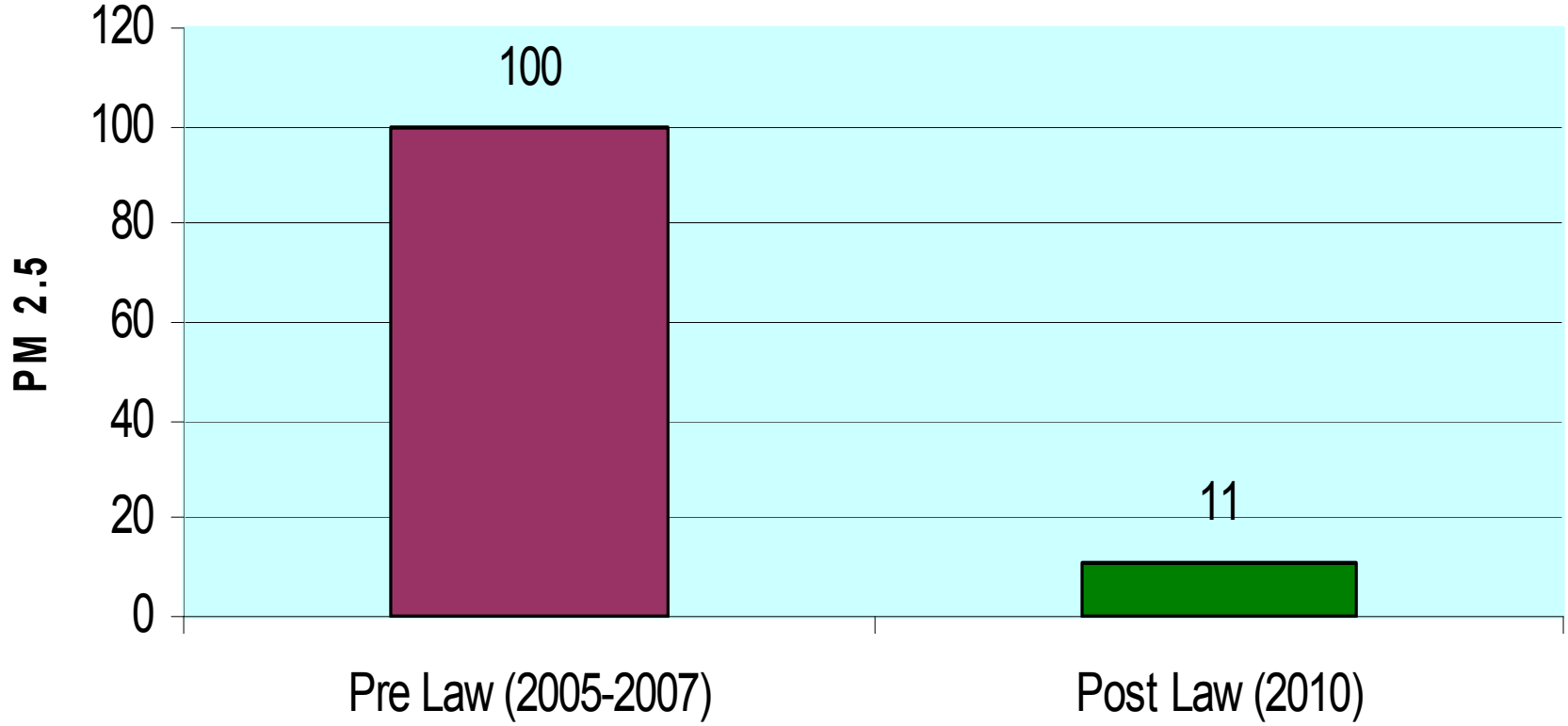

*Emercency Department visits with a ICD-9-CM Code of 493.01, 493.02, 493.11, 493.12,

# North Carolina's 2010 smokefree restaurant and bars law:  signing Was A Celebration!

Photo Credit: Ted Richardson
News and Observer

# Comparison of Particulate Matter Concentrations

## Before And After the Implementation of Smoke Free Restaurants And Bar Law



# A growing body of literature supports positive health effects of smoking bans

**MYOCARDIAL INFARCTION**

- Studies from Helena, Montana; Italy; Pueblo, Colorado; Monroe County, Indiana; Bowling Green, Ohio; New York state; Saskatoon, Canada; Scotland; Arizona; Toronto

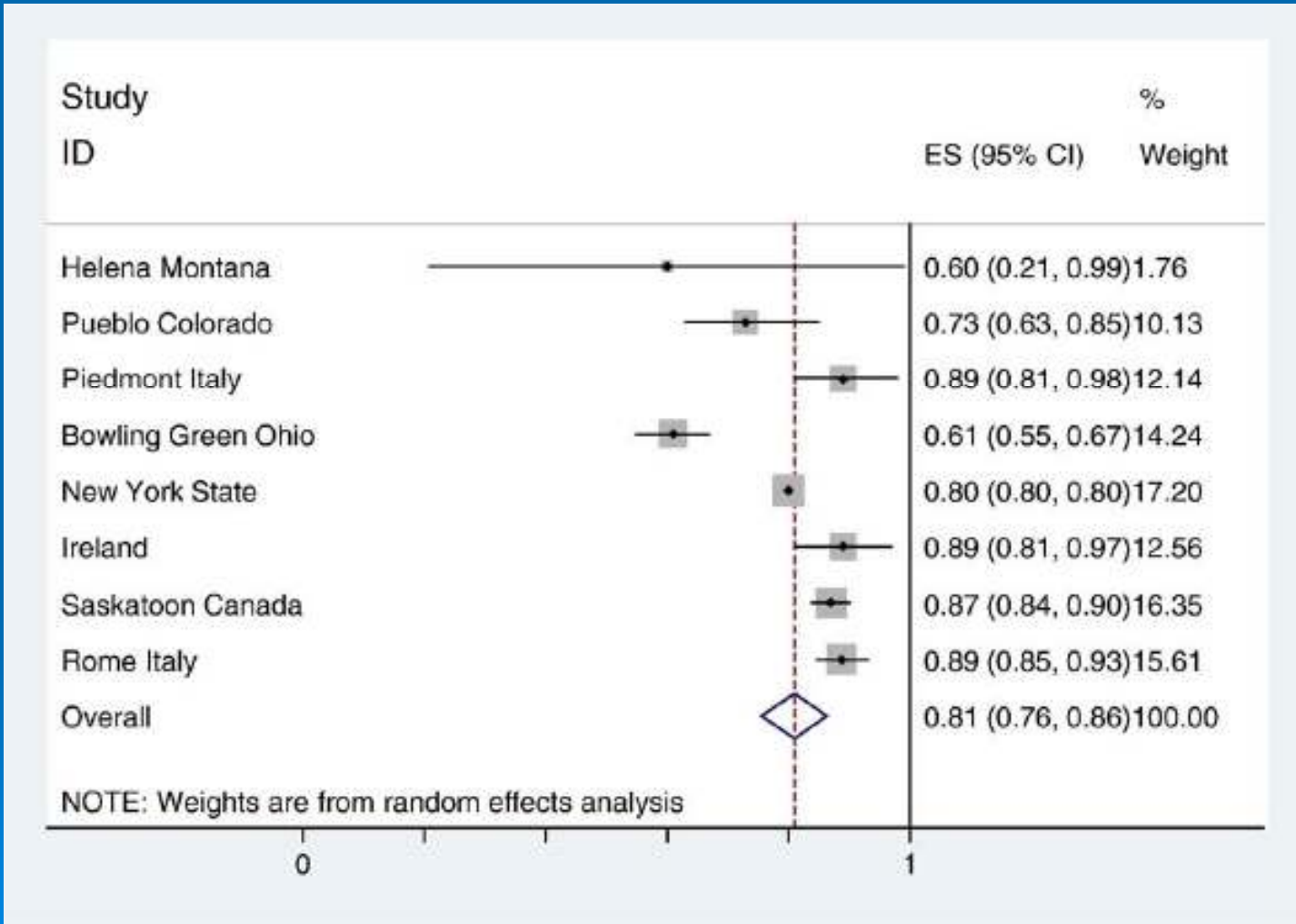
**Stroke & Angina**

- Studies from Arizona; Toronto

**Asthma**

- Studies from Arizona; Toronto; Lexington, Kentucky

# Effect of smoke-free policies on heart attacks – Results of a 2008 meta-analysis




Glantz SA. Preventive Medicine 47 (2008) 452–453.

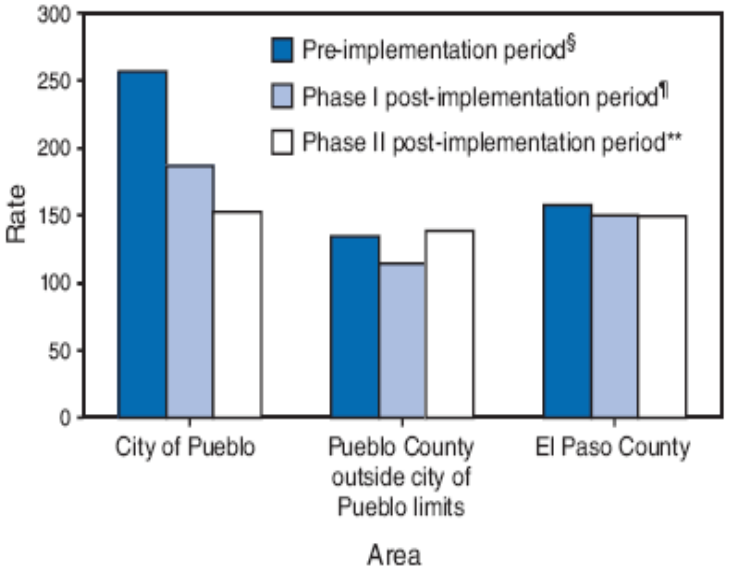
# Arizona Smoking Ban Leads to Fewer Hospital Admissions for AMI, Angina, Stroke, & Asthma

- Study Period: January 2004-May 2008 (Ban Implemented: May 2007)
- Compared # of admissions in counties that already had bans in place to those that did not
- Used 4 unrelated diagnoses as control (acute appendicitis, kidney stones, acute cholecystitis, & ulcer)
- In counties without previous bans, significant reductions: 13% AMI, 33% angina, 14% stroke, 22% asthma
- No significant change in 4 unrelated diagnoses
- Estimated cost savings of ban: $16.8 million over first 13 months ($2.3 of which would have been Medicaid)

*Source: Herman & Walsh; AJPH; 2010.*

# Three-year follow-up study shows continued effects of Smoking Ban

**FIGURE 2. Rate* of hospitalizations for acute myocardial infarction before and after smoking ordinance, by area and period — city of Pueblo, Pueblo County outside city of Pueblo limits, and El Paso County, Pueblo Heart Study, January 2002–June 2006†**




* Per 100,000 person-years. Based on U.S. Census Bureau population data for 2006.

† Because of receipt of routinely amended coding data from the Colorado Hospital Association, certain data points for the pre-implementation and Phase I post-implementation periods differ from those published previously (Bartecchi C, Alsever RN, Nevin-Woods C, et al. Reduction in the incidence of acute myocardial infarction associated with a citywide smoking ordinance. Circulation 2006;114:1490–6).

§ January 2002–June 2003.

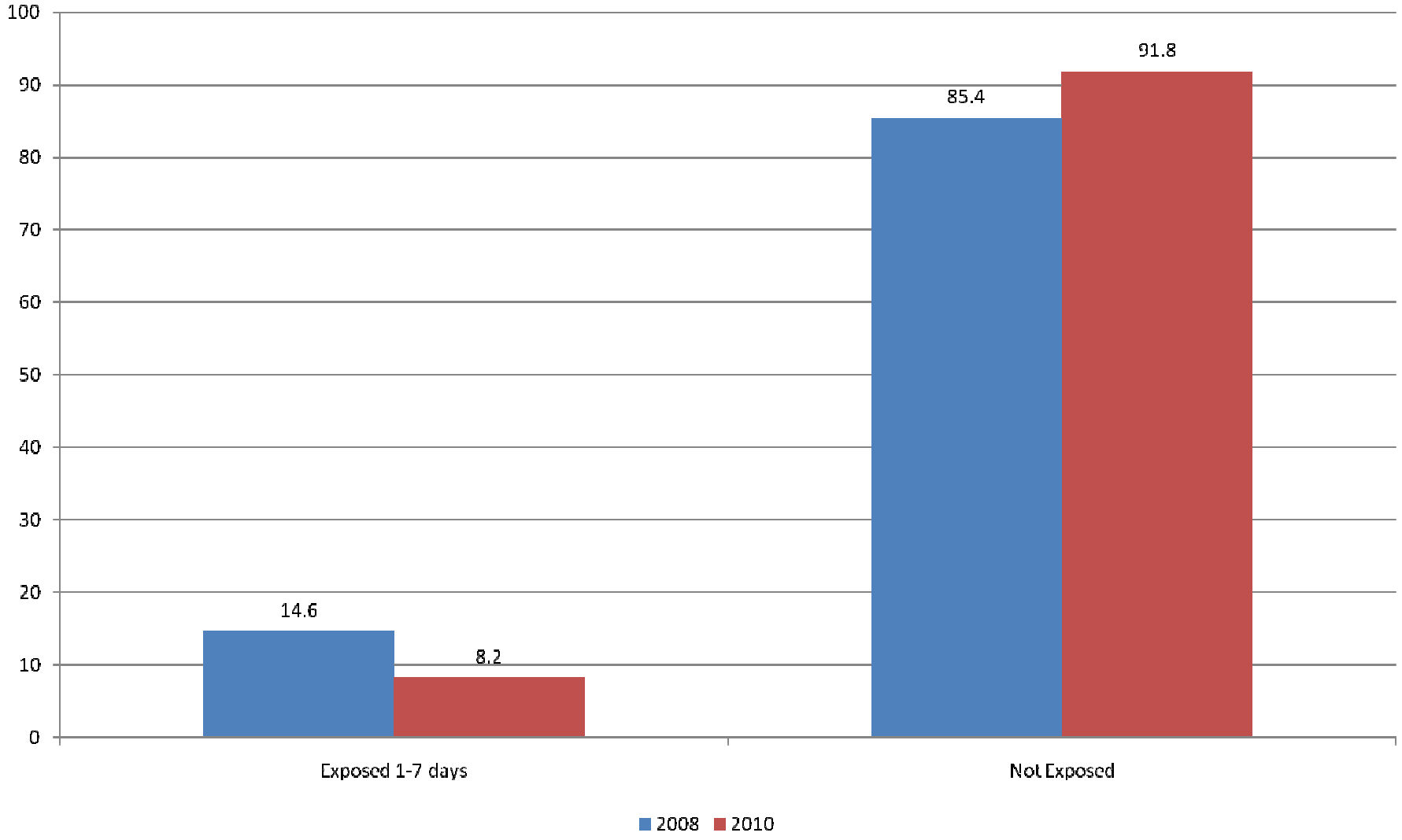
¶ July 2003–December 2004.

** January 2005–June 2006.

**Source:** *MMWR 2009;57:1373-7*

# Past 7-day Secondhand Smoke Exposure at Work
# NC BRFSS 2008, 2010 *

*Based on preliminary data Jan-Jun 2010



The Charlotte Observer

FRIDAY ■ August 13, 2010 ■

# Smoking down, business up


Photo Credit – T. Ortega Gaines
The Charlotte Observer

# Protecting Health

- Indoor Air Policies
- Private Wells to Public Supply
- Childhood Lead Program
- Risk-based Sampling
- Surveillance