

# **Biosolids Recycling Relative Risk Discussion**



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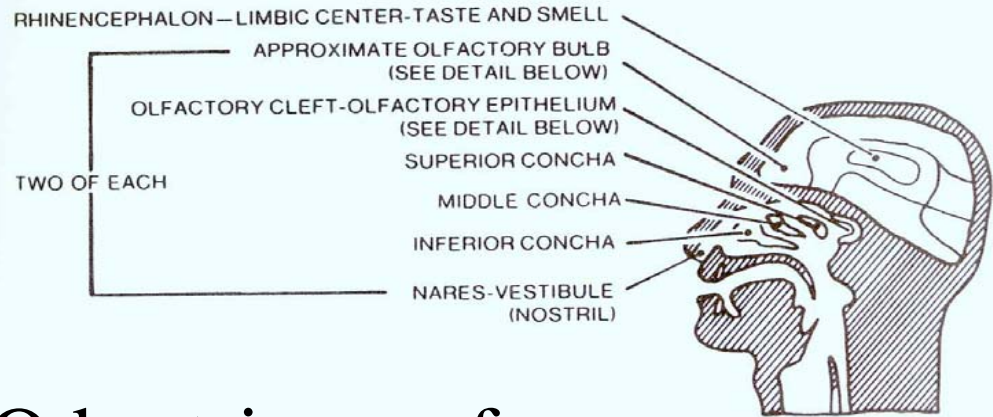
**Washington DC**

The sound of water is relaxing



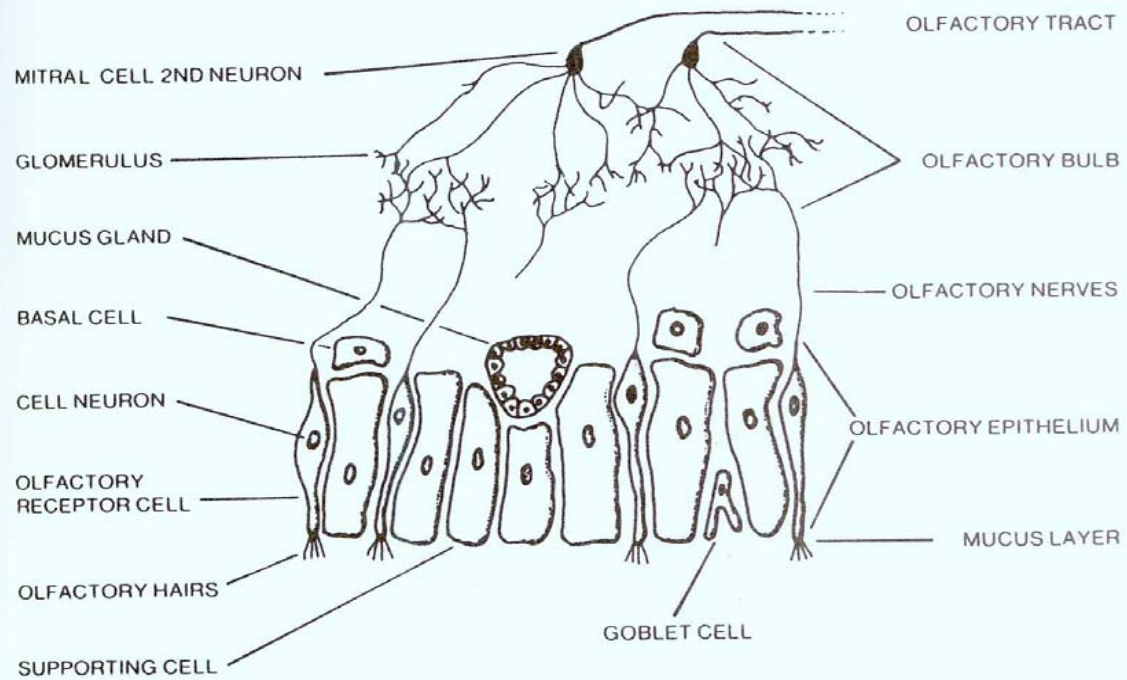
# Biosolids smell for a reason





# Odor triggers fear

(B) OLFACTORY EPITHELIUM



# Health Effects: Citizens become concerned with presence, not level of a pollutant

- odors
- pathogens
- heavy metals
- EDC

# Biosolids do produce odors

- We are programmed to be afraid of our own waste - avoid the oral-fecal cycle
- That fear is triggered by odors
- Odorous compounds are generated from the breakdown of organic matter
- When we reduce/eliminate pathogens at the treatment plant, the odors can still exist

# Understanding Odors

- Odors remain our largest problem because of the emotional responses they elicit
- Odors are unregulated, because we know through testing at the plant that the biosolids are safe for reuse
- Different processes and conditions at the plant are favorable to different populations of microbes, provide different food sources, and even produce completely different environments (aerobic vs. anaerobic)

# What can we do regarding odors?

- We need to move beyond the regs and adjust the parameters that affect odors development
- We need to support efforts to research the health effects of odors
- We need to educate and communicate to the public about biosolids recycling benefits vs fears

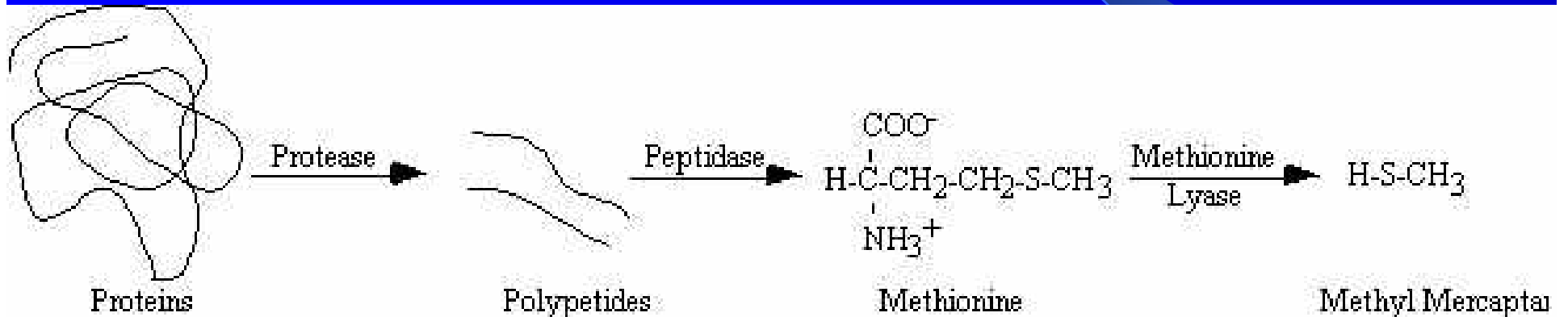
# Programs to Educate ?

- risk communication programs - emphasize empirical evidence
- reassure people about risk for which concerns are high ( odor triggers fear) even though scientific estimates show small risk stress
- presence does not equal danger
- develop examples of risk relative to public experience
- emphasize the value of the biosolids product

# Odors - many naturally occur from breakdown of organic matter

- Methyl Mercaptan
- Dimethyl Disulfide
- Trimethylamine

# Methyl mercaptan from protein



# Trimethylamine from protein

Trimethylamine is recognized as a byproduct gas from decaying marine carcasses (rotting fish). According to the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) trimethylamine is used as an insect attractant, as a warning agent in natural gas, in organic synthesis, in disinfectants, in plastics, as a flotation agent, and in the manufacture of quaternary ammonia compounds. Trimethylamine is a natural degradation product of plant and animal residues, and is the major odor produced from rotting marine animals.<sup>1</sup>

<sup>1</sup> United States Department of Labor - Occupational Safety & Health Administration (OSHA), Partially Validated Method #2060. December, 1993.

# TMA production

## Mechanisms for Trimethylamine (TMA) Production (ppm)

Sample	TMA Concentration
Silica + Polymer + Lime	ND
Silica + Protein + Lime	ND
Silica + Enzyme Liquor + Lime	0.151
Silica + Enzyme Liquor + Polymer + Lime	0.489
Silica + Enzyme Liquor + Protein + Lime	0.537

# Biosolids/Fish TMA production comparison

## Sample Description

## TMA

biosolids, polymer, lime  
fish

5.02 ppmv

5.20 ppmv

# Presence does not necessarily indicate danger

- CO is widely recognized as potentially dangerous, yet we deal with it daily from automobiles
- O<sub>2</sub> is widely recognized as essential for life, yet it also can kill you. The air we breathe is 20.9% O<sub>2</sub>. Pure oxygen is not good for us in certain situations.

# OSHA CO limits

- 35 ppm TWA (Time Weighted Average)
- 800 ppm death occurs
- total yearly emissions of CO exceed all other atmospheric pollutants combined
- millions of cars on the road daily spewing lethal gasses into the air is considered an acceptable risk
- dispersion of CO alleviates the danger

# Pathogens

- Public hears terms like pathogenic organism, enteric virus, salmonella, and again presence is perceived as danger
- We need to compare the pathogen risk with other activities they are familiar with that pose potential pathogen contamination - cooking meats, eating eggs, etc.

# EPA pathogen limits for Biosolids

## Class B

fecal coliform <2,000,000 MPN/gram total solids

## Class A

fecal coliform <1000 MPN/gram total solids

salmonella <3 MPN/4 grams total solids

enteric viruses <1 CFU/4 grams total solids

helminth ova < 1 CFU/4 grams total solids

# Field reduction of pathogens

EPA Research Data

Microorganism	Depth (cm)	Temp (C)	T90 (days)	T99 (days)
Salmonella	5-15	5	15	30
		15	6	12
fecal coliform	0-5	5	23	44
		15	10	18
viruses	0-15	5	24	47
		15	10	19

# Food - the biggest pathogen culprit

- 9000 deaths annually from food borne illnesses
- Between 6.5 – 33 million illnesses annually

# USDA Food Safety and Inspection Service Recalls for 2001

- Canadian Firm Recalls Ground Beef for Possible E. coli O157:H7 (April 22, 2001)
- Mississippi Grocery Recalls Ground Beef for Possible E. coli O157:H7 Contamination (April 20, 2001)
- Mississippi Firm Recalls Mislabeled Frankfurters (April 19, 2001)
- Oklahoma Firm Recalls Meat and Poultry Products for Possible Listeria Contamination (April 12, 2001)
- California Firm Recalls Burritos for Possible Contamination with Ammonia (April 6, 2001)
- California Firm Recalls Duck Products for Possible Listeria Contamination (April 4, 2001)
- Alabama Firm Recalls Chicken Products Because of Undeclared Allergens (March 30, 2001)
- Arkansas Firm Recalls Chicken Products Because of Undeclared Allergens (March 30, 2001)
- Ohio Firm Recalls Soup for Possible Contamination with Metal (March 30, 2001)
- New York Firm Recalls Beef Sausage for Possible Listeria Contamination (March 28, 2001)
- Illinois Firm Recalls Beef Product For Possible Listeria Contamination (March 22, 2001)
- Georgia Firm Recalls Ground Beef Product for Possible E. coli O157:H7 (March 19, 2001)
- New Jersey Firm Recalls Sausage Product for Possible Salmonella Contamination (March 15, 2001)
- Minnesota Firm Recalls Ground Beef for Possible E. coli O157:H7 (March 14, 2001)
- New Jersey Firm Recalls Salami For Possible Listeria Contamination (February 28, 2001)
- Arkansas Firm Recalls Chicken for Underprocessing (February 19, 2001)
- South Carolina Firm Recalls Chicken Products for Possible Pesticide Contamination (February 16, 2001)
- Ohio Firm Recalls Ham for Underprocessing (February 14, 2001)
- Indiana Firm Recalls Duckling Products For Possible Listeria Contamination (February 9, 2001)
- Arkansas Firm Recalls Chicken Wings Because of Undeclared Allergen (February 1, 2001)
- Additional Distribution Identified for Meat And Poultry Products Recalled by Illinois Firm (January 30, 2001)
- Illinois Firm Recalls Meat And Poultry Products For Possible Listeria Contamination (January 26, 2001)
- New Jersey Firm Recalls Chicken Wings For Possible Listeria Contamination (January 24, 2001)
- Indiana Firm Recalls Duckling Products For Possible Listeria Contamination (January 16, 2001)
- Wisconsin Firm Recalls Chicken Products For Possible Contamination With Plastic (January 11, 2001)
- Cargill Listeria Recall Expanded To Include Another Product (January 2, 2001)

# Food Borne Illnesses - annual tolls

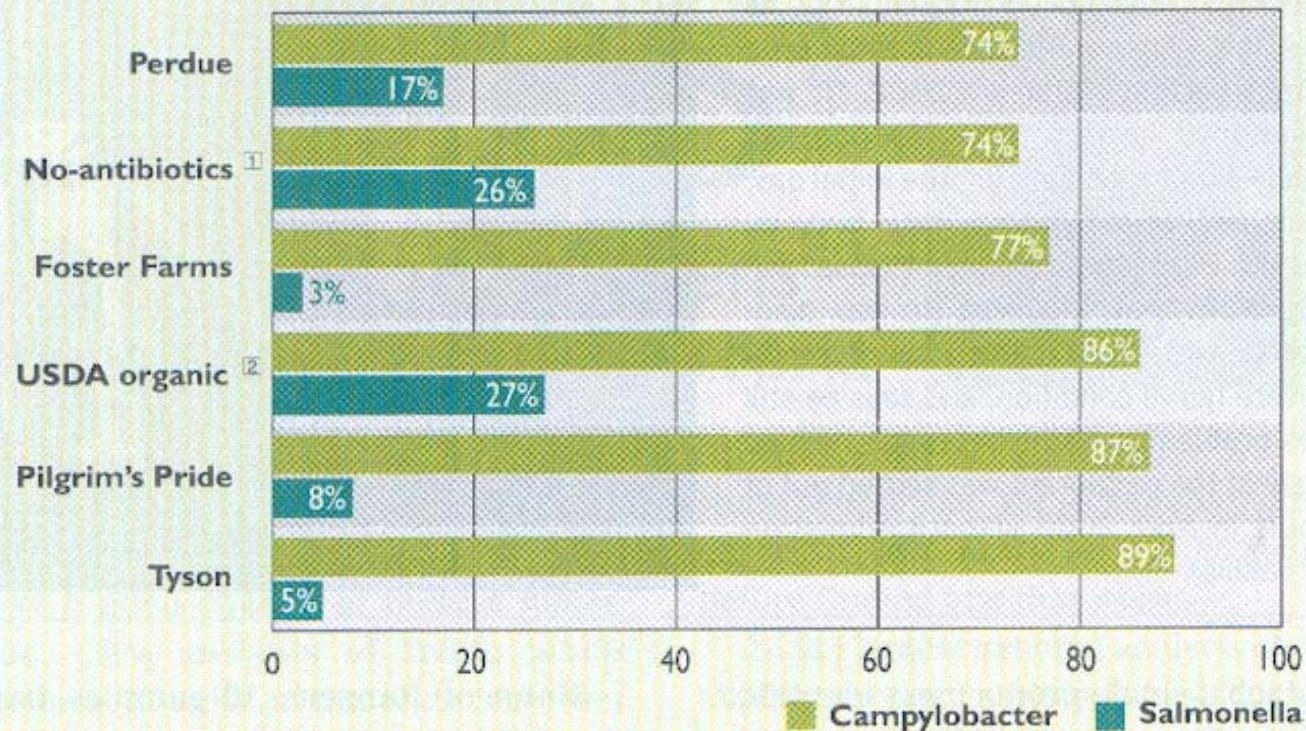
Pathogen	Deaths	Illnesses	Source
E. coli	100	25,000	1 in 500 burgers
Salmonella	70	800,000 - 4 million	1 in 20,000 eggs 10% of chickens
Campylobacter	360	2 - 4 million	70% of chickens
Listeria monocytogenes	15	hundreds	1 in 40 pre- packaged meats

# Contamination of Chicken

## GERM COUNT

### Levels of contamination

Below, the percentages of tested broilers that harbored campylobacter or salmonella. We analyzed 78 chickens for each major brand and a total of 86 chickens for USDA organic brands and 125 for no-antibiotics brands. Figures are averages for brands and types. Ranking is based on contamination with campylobacter, more prevalent than salmonella.



# Common Pathway – Ingestion

- the public knows how to avoid these things
- thorough cooking
- wash vegetables
- wash hands
- don't cut veggies on the chicken cutting board
- clean your platter of raw juices before using for serving cooked meats
- biosolids - don't eat them and wash your hands

# Pharmaceutical Risks

- New drugs put onto the market can be tested on as few as 2500 individuals, which calculates to an acceptable risk of  $4 \times 10^{-4}$ .
- The 503 risk assessment is based on a cancer risk of 1 in 10,000 for the most Highly Exposed Individual (HEI) and 1 in 1,000,000 for the average exposed individual.

# Endocrine Disrupting Compound (EDC)

- flame retardants are used in everyday items from computer casings to carpet pads to foam cushions in couches to reduce their ability to catch fire.
- flame retardants called PBDEs (polybrominated diphenyl ethers) have been detected in people's bodies
- Penta-BDE and Octa-BDE have been shown to cause brain and thyroid problems in rodents. Deca-PBE appears to be less toxic than Penta-BDE and Octa-BDE, but may break down to more toxic forms of PBDEs in the environment.

# Endocrine Disrupting Compound (EDC)

- high rate of human exposure to Deca-BDE possibly from dryer dust, interior foam cushions, carpet etc.
- the levels of PBDEs in people's bodies are doubling every 2 to 5 years, 40 times higher in North America than on other continents.
- Washington State Legislature prohibit the manufacture, distribution and sale of new consumer electronics, upholstered fabric products containing Deca-BDE as of July 2008

# Endocrine Disrupting Compound (EDC)

- ingesting 1180 ng of PBDEs from dust each day in the home may be particularly capable of disrupting thyroid hormone ?
- levels of BDEs found in biosolids ranged from 1,100-2,290 micrograms per kg dry weigh
- death due to fire / smoke 1 per 1,113
- little known about fate and persistence in soil

# Heavy Metals

- Arsenic
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Selenium
- Zinc

# Inorganic Fertilizers

	cadmium (ppm)	lead (ppm)	arsenic (ppm)	zinc (ppm)
US fertilizer limits	no limit	no limit	no limit	no limit
Canadian fertilizer limits	20	500	75	1850
EPA 503 biosolids limits	39	300	41	2800
Fertilizers (N-P-K)				
11-18-25	56	300	2	3640
14-15-21	34	346	0	3730
18-8-0	25	0	2	366
5-23-23-6 (S)	15	0	4	6800
16-20-0-14 (S)	13	24	0	5430
4-15-34	6	313	9	6270

# Background consumption of heavy metals (mg/day)

Chemical	Air	Diet	Water	Total
Arsenic	0.005	0.006	0.001	0.012
Cadmium	0.00014	0.012	0.004	0.01614
Mercury	0.0002	0.002	0.001	0.0032
Nickel	0.001	0.162	0.01	0.173
Selenium	0.001	0.104	0.01	0.115
Zinc	negligible	13.0	0.42	13.42

# Heavy Metals or Micronutrients?

Centrum vitamins contain:

Selenium	20 ug	29% RDV
Copper	2 mg	100% RDV
Chromium	120 ug	100% RDV
Molybdenum	75 ug	100% RDV
Nickel	5 ug	*

\*RDV not established

# Biosolids as Dietary Supplement

In order to obtain these levels of essential micronutrients, an individual would need to eat the following quantities of Blue Plains biosolids (based on most recent metals data):

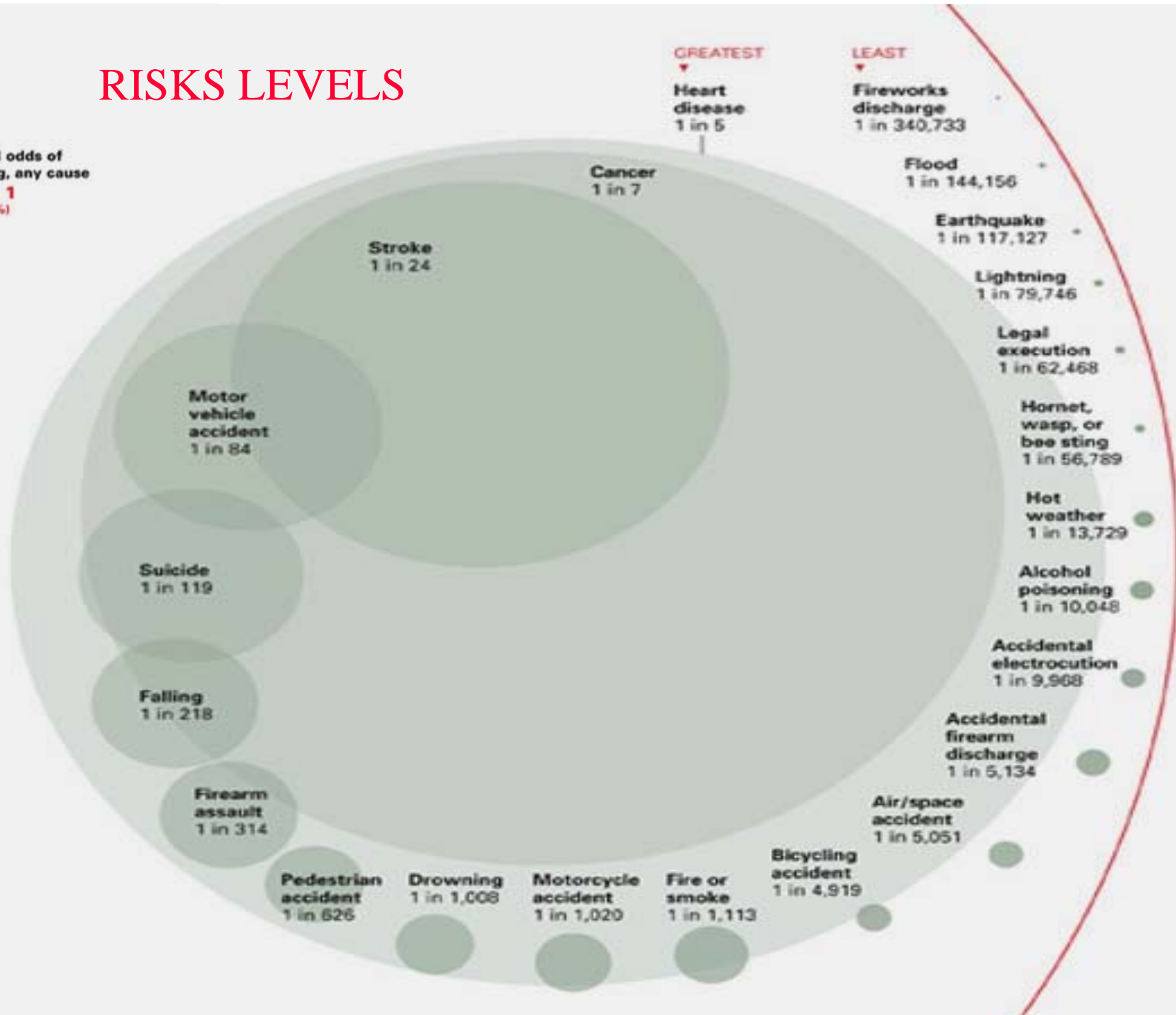
Micronutrient	weight (lb/yr)	volume (cups/yr)
Chromium	4.9	9.3
Copper	20.1	38.1
Molybdenum	13.8	26.2
Nickel	0.5	0.8
Selenium	194	368
Zinc	113	214

# Common activities with acceptable levels of public risk

	Deaths		Injuries	
	number	risk	number	risk
Food	9000	4 in 100,000	6.5 - 33 million	3 - 13%
Automobiles	41345	2 in 10,000	3.2 million	1.3%
Pedestrians	4695	2 in 100,000	*	*
Rail crossings	425	2 in 1,000,000	1,396	6 in 1,000,000
Amusement rides	6	$2.5 \times 10^{-8}$	10,400	4 in 100,000
Trampolines	11	$4.4 \times 10^{-8}$	98,889	4 in 10,000

# RISKS LEVELS

— Total odds of dying, any cause  
**1 in 1**  
(100%)



# Conclusions

- Present information on biosolids value and emphasize supply/demand economics
- Supply public with information on relative risks
- Stress the wealth of empirical evidence we have
- Support research on odor control and health effects
- Presence of “pollutants” does not mean biosolids are dangerous
- Wash your hands