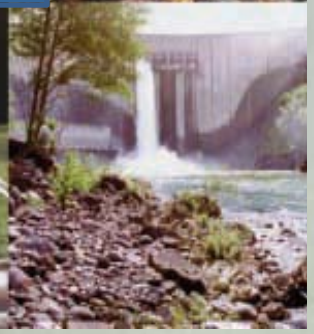
Ecotoxicology, Areawide Contamination and Regulatory Choices

Jim Pendowski
Washington State Department of Ecology
Toxics Cleanup Program, February 2010

Overview of Today's Presentation

- Background on the cleanup regulatory structures
- Standards for protecting human health under Washington State and Federal cleanup laws
- Description of one cleanup problem and the regulatory dilemma facing Ecology
- How toxicology principles frame the regulatory strategies being used to reduce exposure to contaminated soils
- Policy choices that resulted from these principles
- Examples of implementation of these choices

Managing Our Water Successfully



Reducing Toxic Threats

Mitigation that works

Program Goals and Mission

Preamble to the Model Toxics Control Act

"Each person has a fundamental and inalienable right to a healthful environment, and each person has a responsibility to preserve and enhance that right. The beneficial stewardship of the land, air, and waters of the state is a solemn obligation of the present generation for the benefit of future generations."

The goals and mission of the Toxics Cleanup Program is to **get contaminants from the environment and keep them out.**

Cleanup Authorities

Cleanups in Washington are conducted under two main authorities:

State: **Model Toxics Control Act** (MTCA)
Chapter 70.105D RCW

Federal: **Comprehensive Environmental Response, Compensation, Liability Act** (CERCLA)

These two Laws are based on common principles and share many common features.

Common Features

- **Washington cleanup law is modeled on Federal Superfund law.**
- **Common principles and features include:**
  - **Polluters are held liable for cleaning up the properties they own and pollution they caused.**
  - **Both laws establish tax on hazardous substances that pays for cleanup of orphaned sites and sites where owners/operators refuse to conduct cleanup.**
  - **State and federal programs include similar processes for investigations and cleanup actions.**
  - **Cleanup standards must comply with other environmental standards (for example, drinking water standards.**

Key Distinctions

MTCA:

Department of Ecology

- Hazardous Substances
  (includes petroleum)
- Most cleanups done voluntarily or through a legally binding order or decree.
- Many big and small sites
- Cleanup actions must comply with:
- All applicable laws and regulations
- Maximum cancer risk =

1 in 100,000

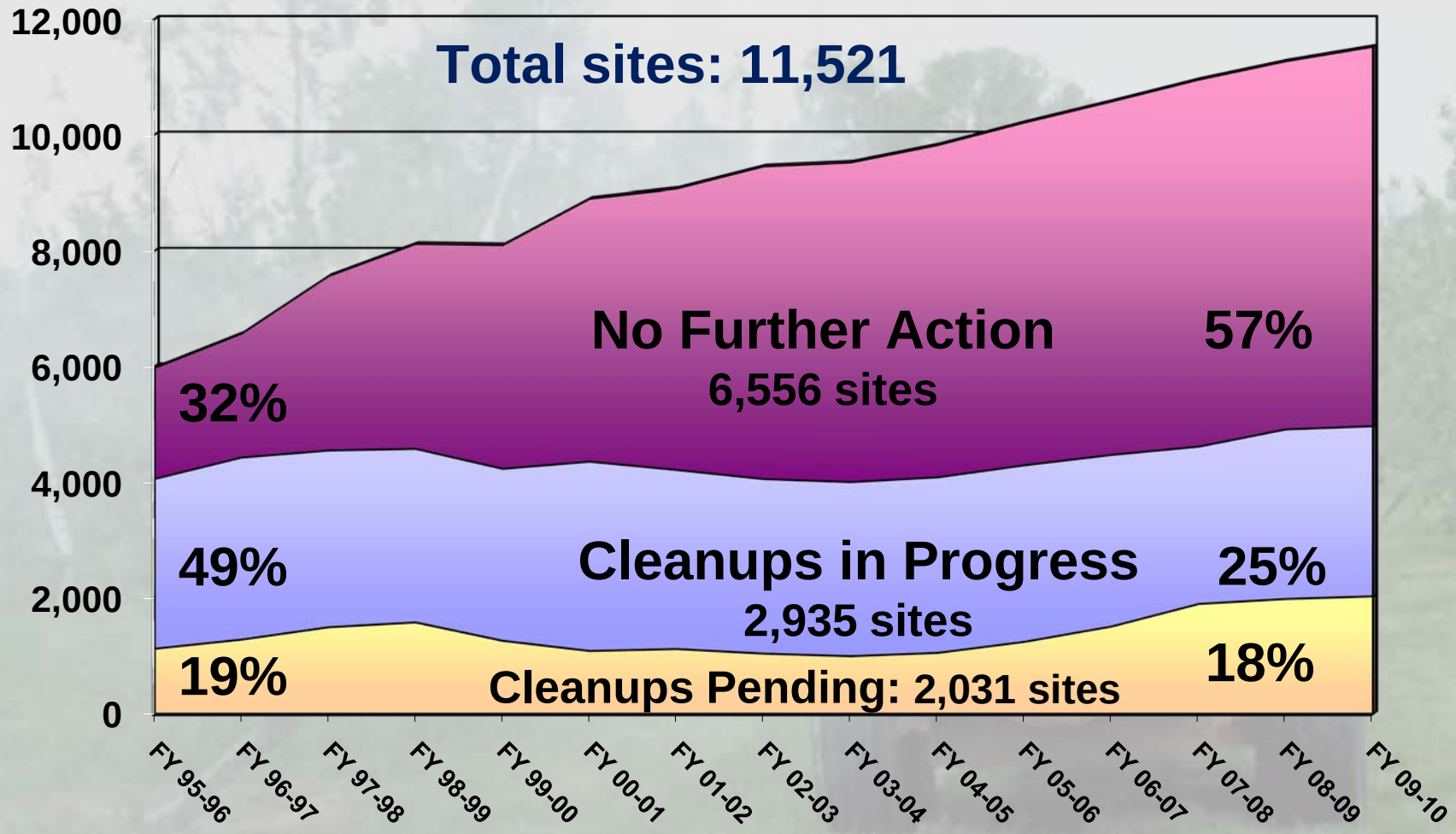
CERCLA:

Environmental Protection Agency

- Hazardous substances
  (excludes petroleum)
- Formal agency oversight of cleanups with legally binding agreements.
- Limited number of big sites
- Cleanup actions must comply with:
- All applicable laws and regulations
- Maximum cancer risk =

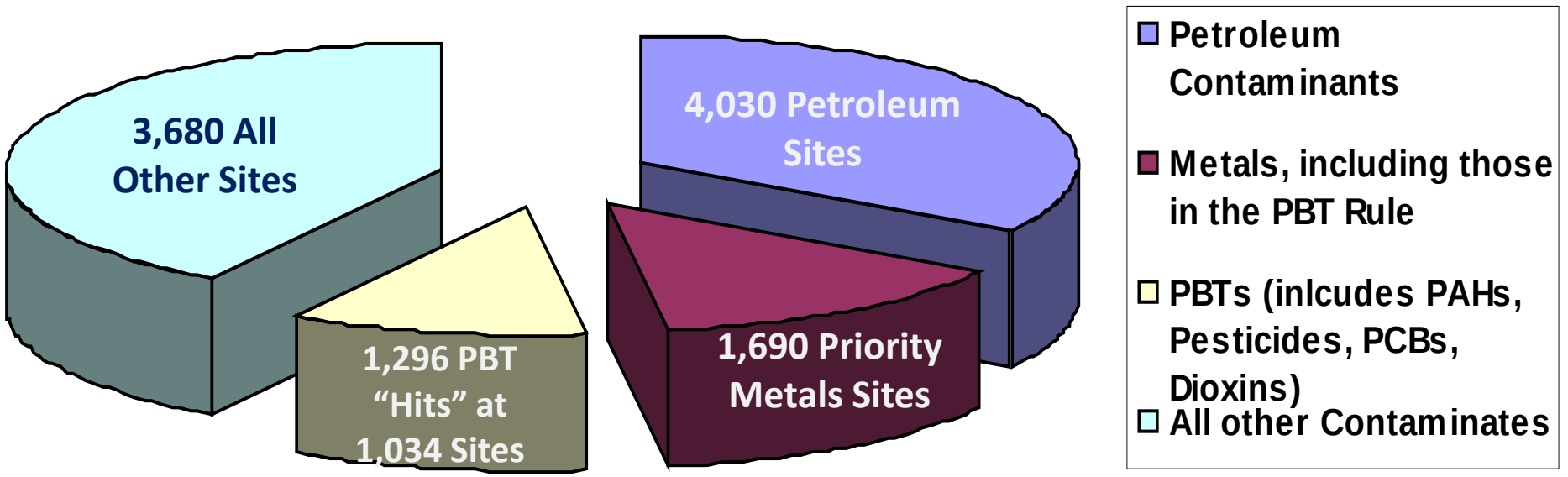
1 in 10,000

Contaminated Sites in Washington



Each year: 300-400 sites are reported to the program.
200 to 300 sites are cleaned up.

Contaminants at Sites



Petroleum, 4,030
Halogenated Organic Compounds, 987
Non-Halogenated Solvents, 958
PCBs, 483
Conventional Contaminants, Organic, 289
Compounds, 213
Corrosive Wastes, 125
Dioxins, 54
Asbestos, 42
MTBE, 19

Priority Metals, 1,690
Other Metals, 448
PAHs, 569
Pesticides, 297
Conventional Contaminants, Inorganic, 225
Base Neutral Organics, 196
Arsenic, 112
Reactive Wastes, 43
Radioactive Wastes, 22
UXO, 1

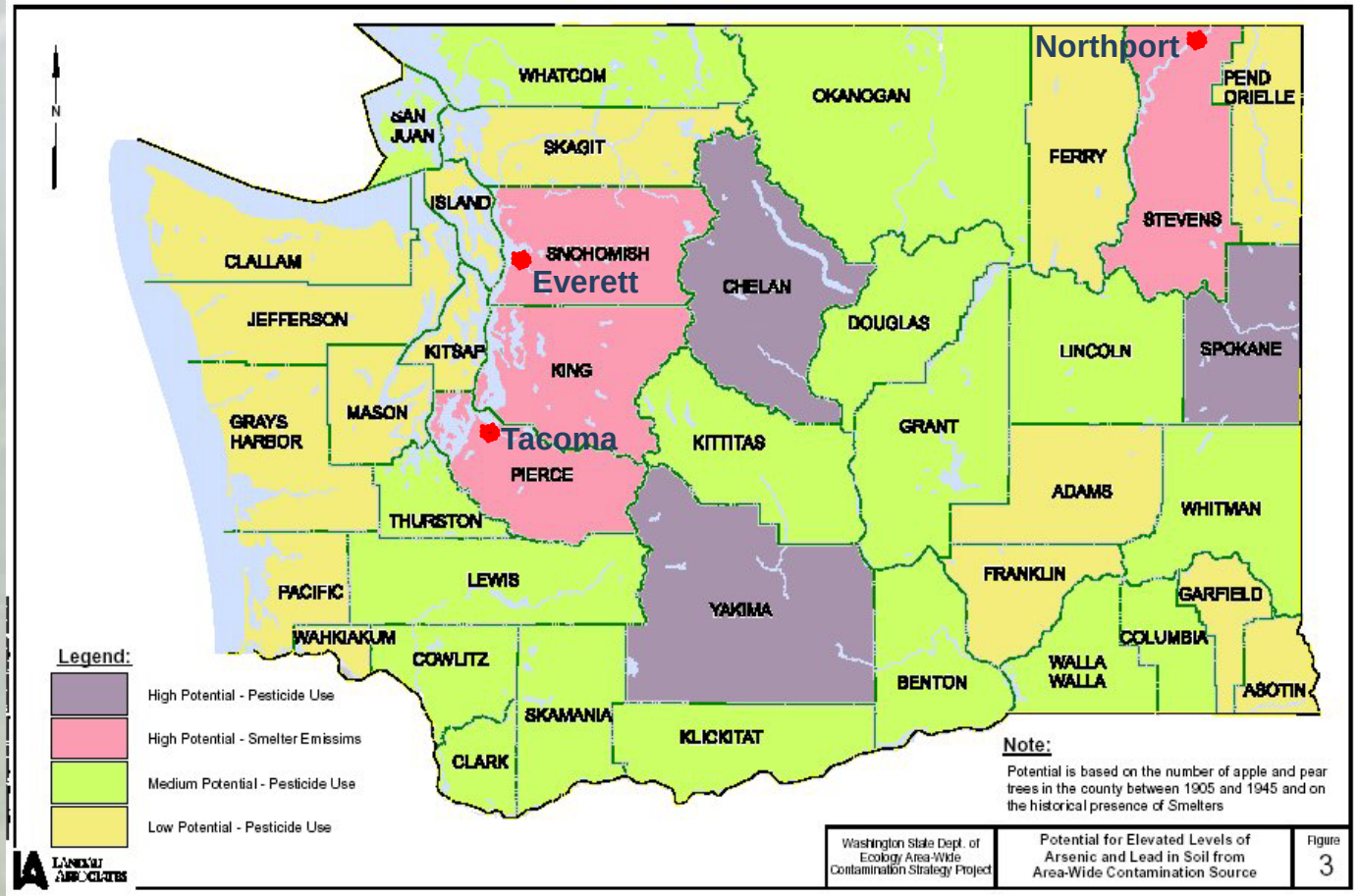
Phenolic

Historic Arsenic and Lead Soil Contamination

Large areas of Washington have elevated levels of arsenic and lead.

Historic sources include:

- Smelters
- Past use of lead-arsenate pesticides



The Regulatory Dilemma – Lead and Arsenic in Soils

- What should be spent, required, changed or provided in order to improve efforts to prevent health, equity and financial problems associated with soils containing arsenic and/or lead at levels given:
  - The potential health consequences and the uncertainties surrounding those consequences;
  - The variability in exposures and susceptibility;
  - Multiple sources of lead and arsenic exposure;
  - The financial costs associated with implementing measures to reduce exposure.

Policy Choices Underlying Our Regulatory Strategy

- Who are we trying to protect?
- How much human health and ecological risk is acceptable?
- What can we do to reduce health risks?
  - Tiered response
  - Integration with community/economic land use decisions
  - Education and community awareness
- What is the appropriate balance between publicly-mandated and privately-initiated actions?

Decision Framework

Health-Based Cleanup Standards

Health Risk = *f(Toxicity, Exposure)*

Exposure = ***f*** *(levels, pathways, behavior)*

$$\text{Soil Cleanup Level mg/kg} = \frac{\text{Acceptable RISK}}{\text{[Contact Rate] x [Toxicity]}}$$

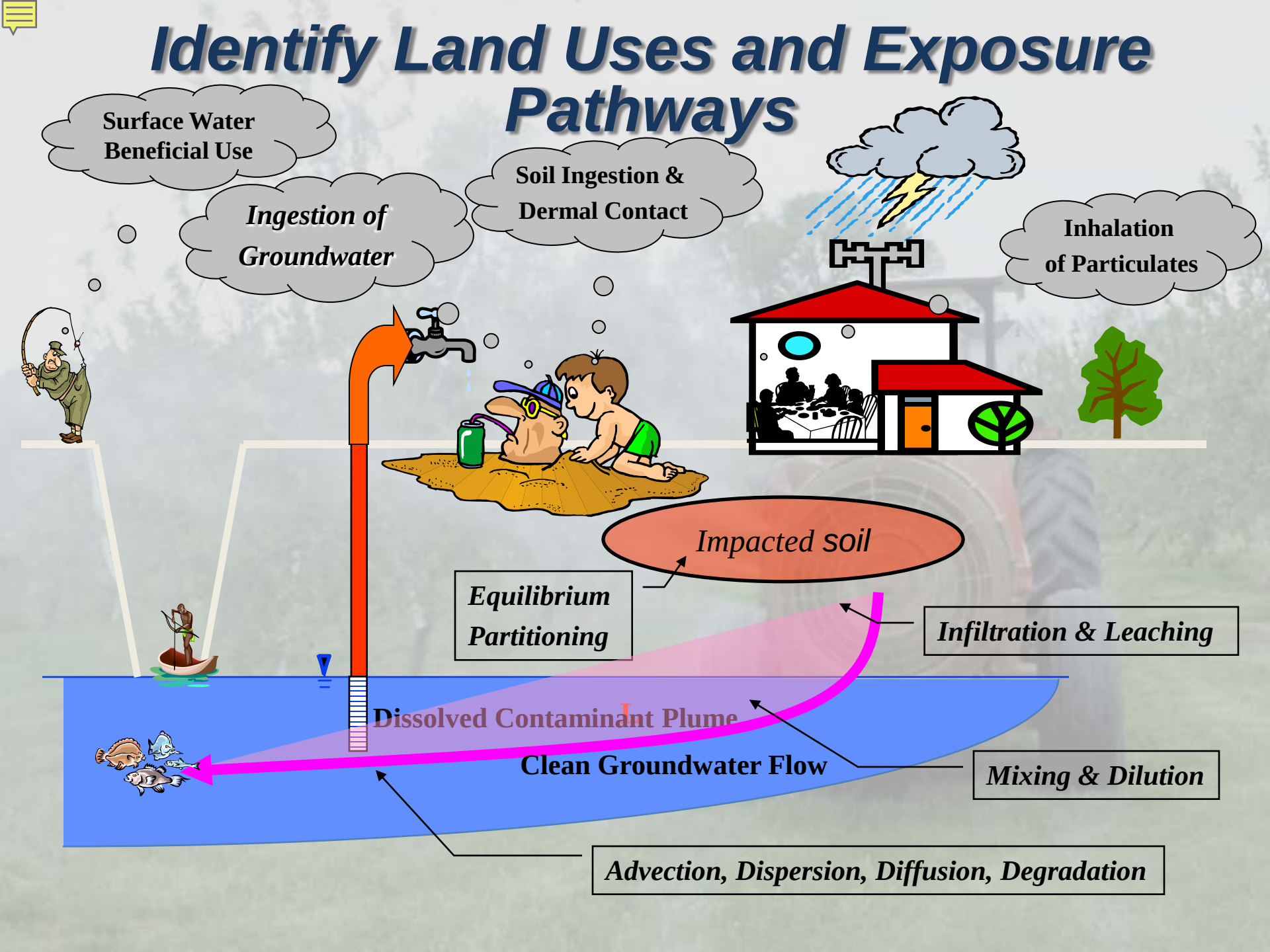
Exposure Determines Cleanup Levels

Exposure Potential

Cleanup Levels

Exposure Frequency
Exposure Duration
Soil Ingestion Rates
Soil Concentrations
Dermal Contact Rates
Bioavailability
Body Weight

Identify Land Uses and Exposure Pathways



Toxicity Determines Cleanup Levels

Toxicity & Carcinogenicity

Cleanup Levels

Risk of Developing Cancer
Non-Cancer Health Effects
Lead Poisoning

Acceptable Risks Determine Cleanup Levels

Acceptable Level

Cleanup Levels

Acceptable Cancer Risk
Hazard Quotient/Margin of Exposure
Acceptable Blood Lead Concentrations

Policy Choice #1: Who are we trying to protect?

- Elevated levels of arsenic and lead in soils where kids play.
- People were concerned
  - Children's health
  - Own health
  - Financial health
- Most Susceptible / Exposed
- They were seeking information and solutions.

Arsenic and Lead Toxicity

Arsenic

- Exposure to inorganic arsenic is associated with wide range of health effects.
- Elevated arsenic levels are also associated with several types of ecological impacts.

Lead

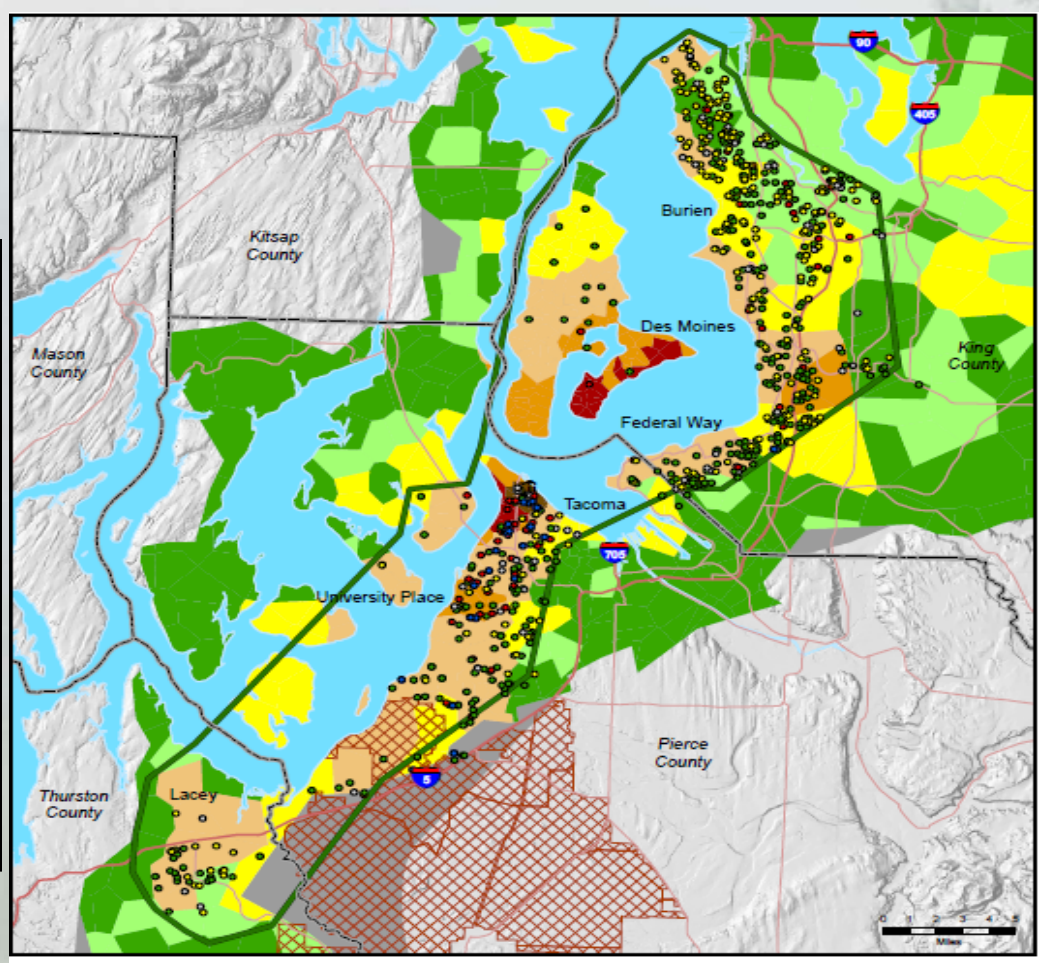
- Exposure to lead is also linked to a wide range of health affects for children and for adults.
- Elevated lead levels have also been associated with a wide range of ecological impacts.

Policy Choice #2: How much risk is acceptable?

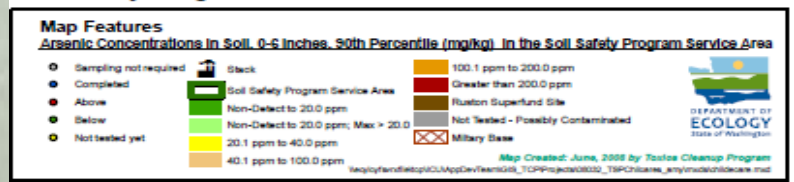
- **Cancer Risks:**
  - MTCA cleanup levels based on a 1 in 1 million cancer risk.
- **Non-Cancer Risks** (Human Health and Ecological Risks):
  - MTCA cleanup levels based on a hazard quotient of 1.
- **Lead Contamination:**
  - MTCA cleanup levels based on preventing blood lead levels above 10 ug/dL.

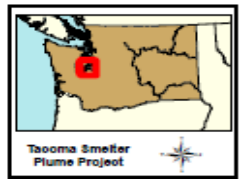
Many areas have soil levels above cleanup levels

	Unrestricted Site Use	Industrial Site Use
Lead	**250 ppm**	**1000 ppm**
Arsenic	**20 ppm**	**20 ppm**



Soil Safety Program Service Area and Childcares





Policy Choice #3: What can we do to reduce risks?

- Utility of traditional cleanup approach
- Tiered response based on potential for exposure and level of contamination
- Integration with local land use planning and economic development
- Education and Increased Community Awareness

Traditional Cleanup Approach not the Answer

- Everett Smelter Cleanup
- Asarco Smelter Cleanup in Ruston
- Common Features
  - Soil removal
  - Large Amounts of Money
  - Long Time Periods

Policy Choice
Tiered Response

High Soil Concentrations > 100 ppm

- Traditional Cleanup Measures (e.g. removal and containment)
- Institutional Controls and Periodic Review of cleanup effectiveness

Public Settings

Low-to-Moderate Soil Concentrations 20 -100 ppm

- Opportunistic cleanup actions integrated with new construction
- Increased Community Awareness
  - Individual Protection Measures
  - Simple Containment Measures
  - Institutional Controls
- Periodic Review of Program effectiveness

Quasi-Public Settings

Low Soil Concentrations < 20 ppm

- No Required Actions

Private Settings

Policy Choice
Integrated Cleanups

- **Wide range of measures to reduce exposure**
- **Large scale soil removal is not feasible**
- **Opportunities to integrate cleanup measures with other activities**


Preschool Cleanup


2007 4 5


2007 5 16

Status of efforts in Eastern Washington

Historical Lead and Arsenic Pesticide Contamination

Orchard lands are being converted into schools and residential areas.

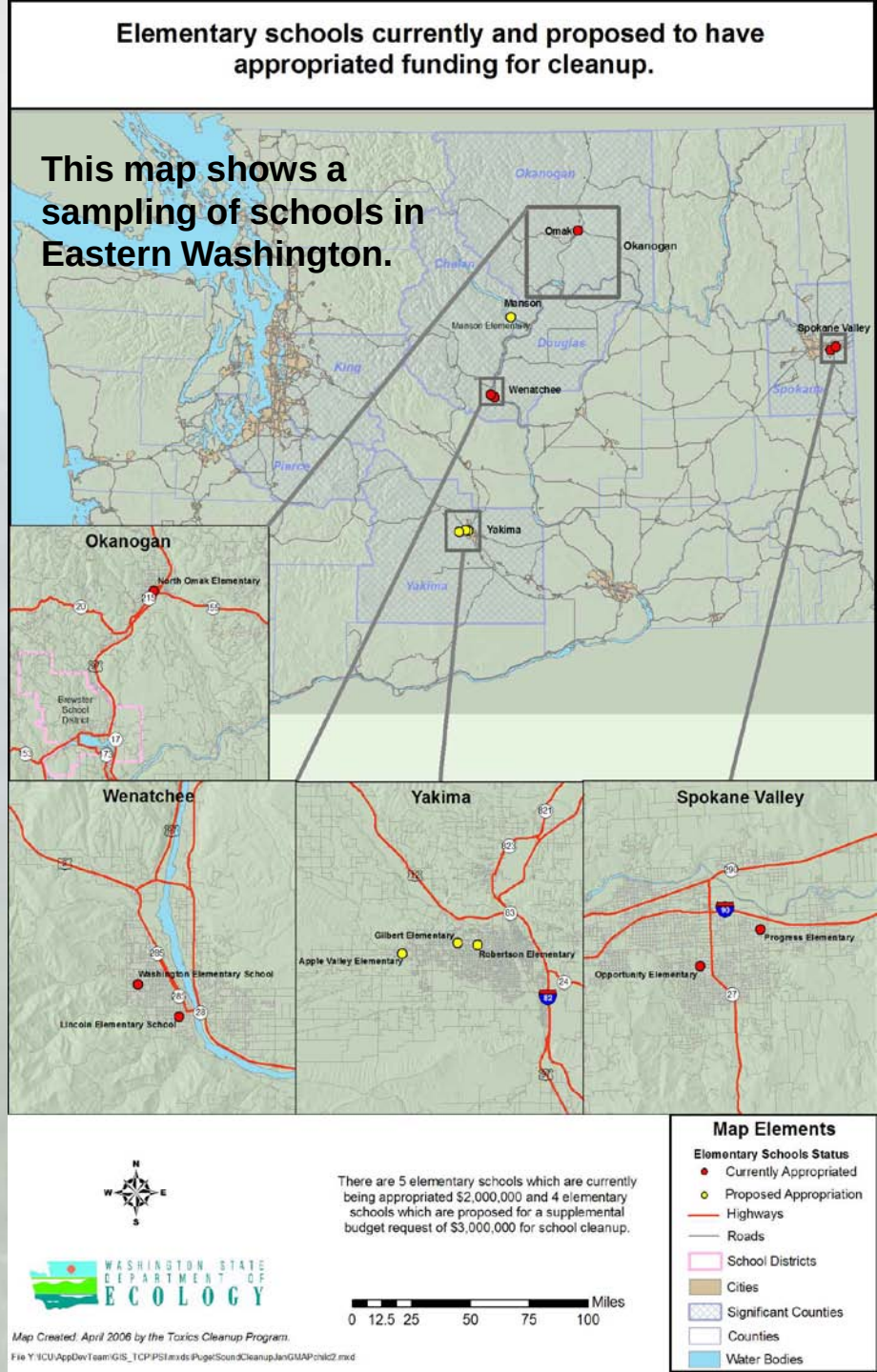
Every public school in Okanogan, Chelan, Douglas and Yakima County has been sampled.

Current Status:
39 of 118 schools sampled need cleanup actions.

18 out of 39 schools that need action have been cleaned up.

An innovative soil mixing technology was evaluated brought the cost of some school cleanups down.

Relationship building has been the key to getting schools cleaned up.
Cleanups occur in the brief windows during summer vacation.




CAT

Policy Choice: Reliance on Education/Behavior Changes

- **Many steps that individuals can take to reduce exposure**
- **Public awareness is key to reducing exposure**
- **Greater reliance on individual responsibility**

How the Soil Safety Program Works

Allow health dept. access for soil testing

Low levels of arsenic and lead → Certified "Soil Smart" Child care

Elevated arsenic and/or lead → Soil Safety Actions by Ecology → Certified "Soil Smart" Child care

ABC Childcare

…is a **Soil Smart** childcare!

The Washington Department of Ecology certifies this childcare:

- Tested its soil for arsenic & lead in May 2006
- Soil tested at this childcare meets state standards

Jay J. Manning, Director
Washington Department of Ecology

Soil Safety Program, Washington Department of Ecology: 360.407.6300
http://www.ecy.wa.gov/programs/sites/tacoma_smelter/ts_hp.htm

WASHINGTON STATE DEPARTMENT OF ECOLOGY

ABC Childcare

…is a Soil Smart childcare!

The Washington Department of Ecology certifies this childcare tested its soil, and is taking the following actions to protect children and staff from arsenic and lead.

- ✓ Informing employees, children and parents.
- ✓ Keeping children from eating dirt.
- ✓ Washing hands/face with soap and water after playing in soil, and before eating.
- ✓ Using scrub brushes to clean nails.
- ✓ Using doormats at every door.
- ✓ Washing children's toys, bedding, and pacifiers frequently.
- ✓ Damp mopping floors and dusting with damp cloth to control dust.
- ✓ Washing outside toys and play equipment.
- ✓ Covered contaminated soil.
- ✓ Maintaining soil cover material.

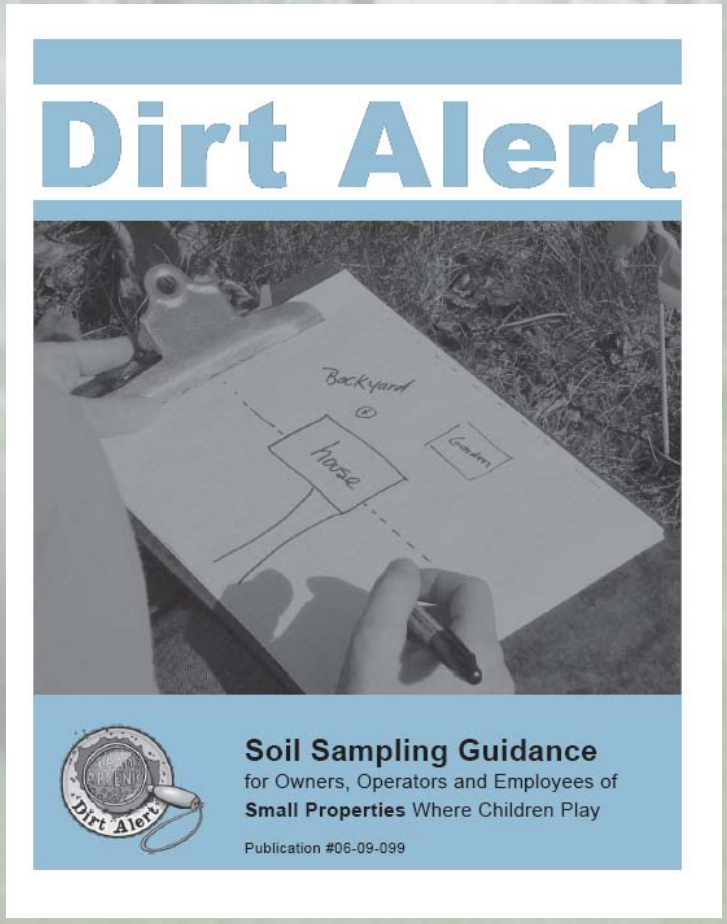
Name Xxx, Childcare Director
ABC Childcare

Jay Manning, Director
Washington Department of Ecology

Soil Safety Program, Washington Department of Ecology: 360.407.6300
http://www.ecy.wa.gov/programs/sites/tacoma_smelter/ts_hp.htm

What if I'm outside the Service Area?

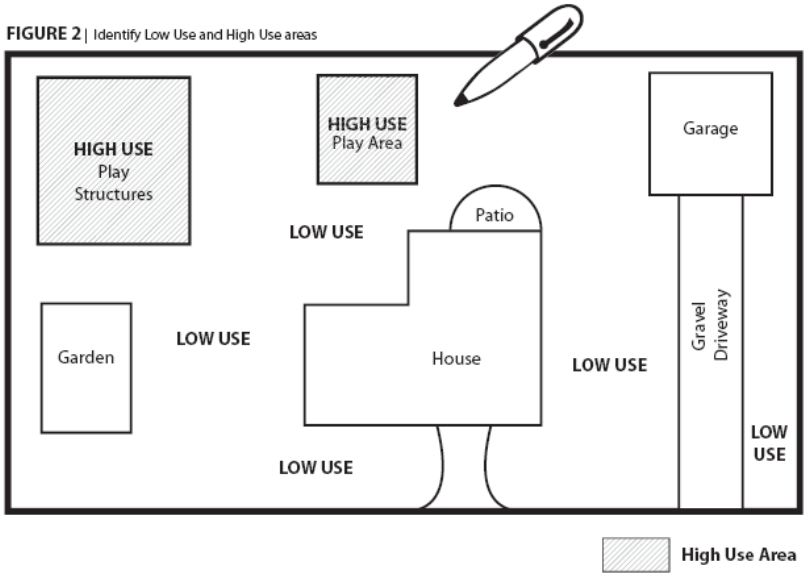
- Sampling your own soil
- Making your yard safer
- Healthy actions



Step 1

Figure 2 shows an example of a small property divided into high-use and low-use areas for soil sampling.

FIGURE 2 | Identify Low Use and High Use areas

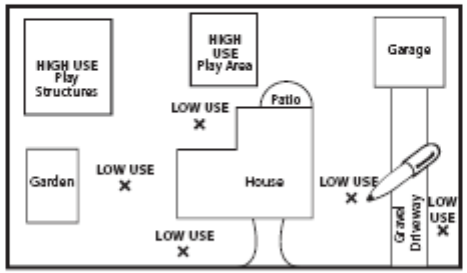


Step 2

Figure 4 shows an example of how a composite sample is collected.

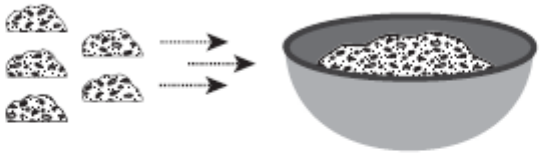
FIGURE 4 | COMPOSITE SAMPLING | A step-by-step approach

1 | Set composite sampling areas



2 | Gather soil from each sampling location

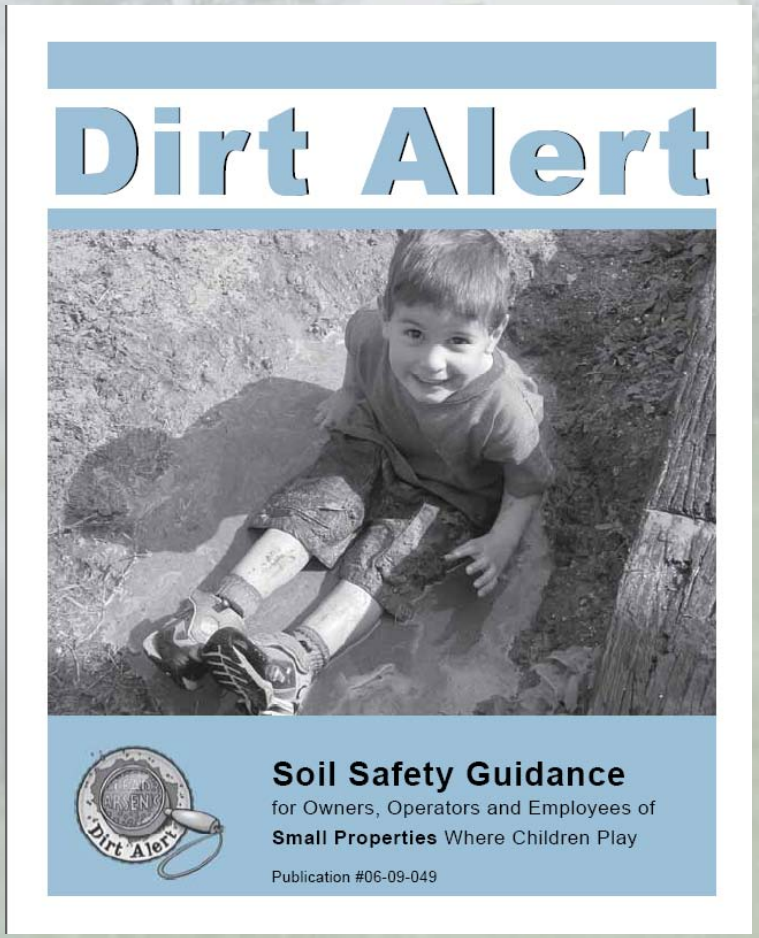
3 | Soil from each location is combined and mixed



4 | Soil sample is taken from mixture and prepared for lab analysis

Making Your Yard Safer

- Removing soil
- Covering soil
  - Sod
  - Bark
  - Gravel/pavement



Summary

- Cleanup decisions require numerous scientific, technical, policy and ethical choices.
- We are increasingly finding that cleanup measures need to be integrated with ongoing community and economic development.
- There are numerous challenges associated with implementing measures on a statewide basis.

Washington State Department of Ecology

Toxics Cleanup **Program:**

http://**www.ecy.wa.gov**/cleanup.html

Dirt Alert Home Page:
http://www.ecy.wa.gov/programs/tcp/sites/dirt_alert/dirt_alert_hp.html