

# UP3 Project

A graphic of a city skyline with various skyscrapers in shades of green, located in the top right corner of the slide.

## Pesticides, Water & You: How the Pesticides We Use Affect Water Quality

---

Kelly D. Moran, Ph.D.  
TDC Environmental, LLC



# Acknowledgements

---

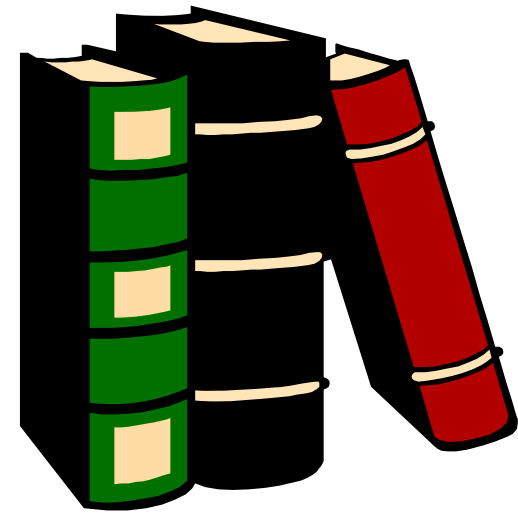
- Funding
  - State Water Resources Control Board Grant
- Project management
  - San Francisco Estuary Project
- UP3 Project report reviewers
  - U.S. EPA
  - California Dept. of Pesticide Regulation
  - SF Bay Regional Water Board
  - Tri-TAC (Wastewater agencies)
  - CASQA (Stormwater agencies)



# Data Sources

---

- Scientific literature
- Government agency reports
- California pesticide databases
  - Pesticide use reports
  - Sales data
  - Product labels
- UP3 Project reports





# Overview

---

- Background
- Urban pesticides of concern
- Why don't pesticide regulators fix problems?
- Recommendations to prevent toxicity

# Where Are More Pesticides Used in California?



Photo courtesy USGS





# Urban Pesticide Facts

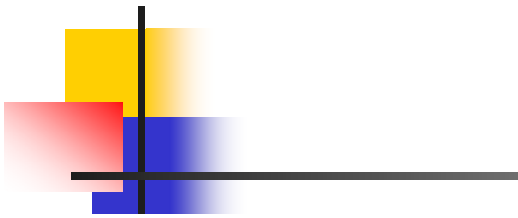
---

- California has >900 registered pesticide active ingredients in >11,000 registered pesticide products
- At least half of California pesticide use is in urban areas

# California's Most Common Urban Pesticide Uses

- Keeping ants out of buildings
  - Structural pest control
- Disinfectants & biocides
  - Drinking water/wastewater
  - Consumer products
  - Pools, spas, fountains, ponds
  - Cooling water





# Urban Runoff Carries Pesticides to Creeks

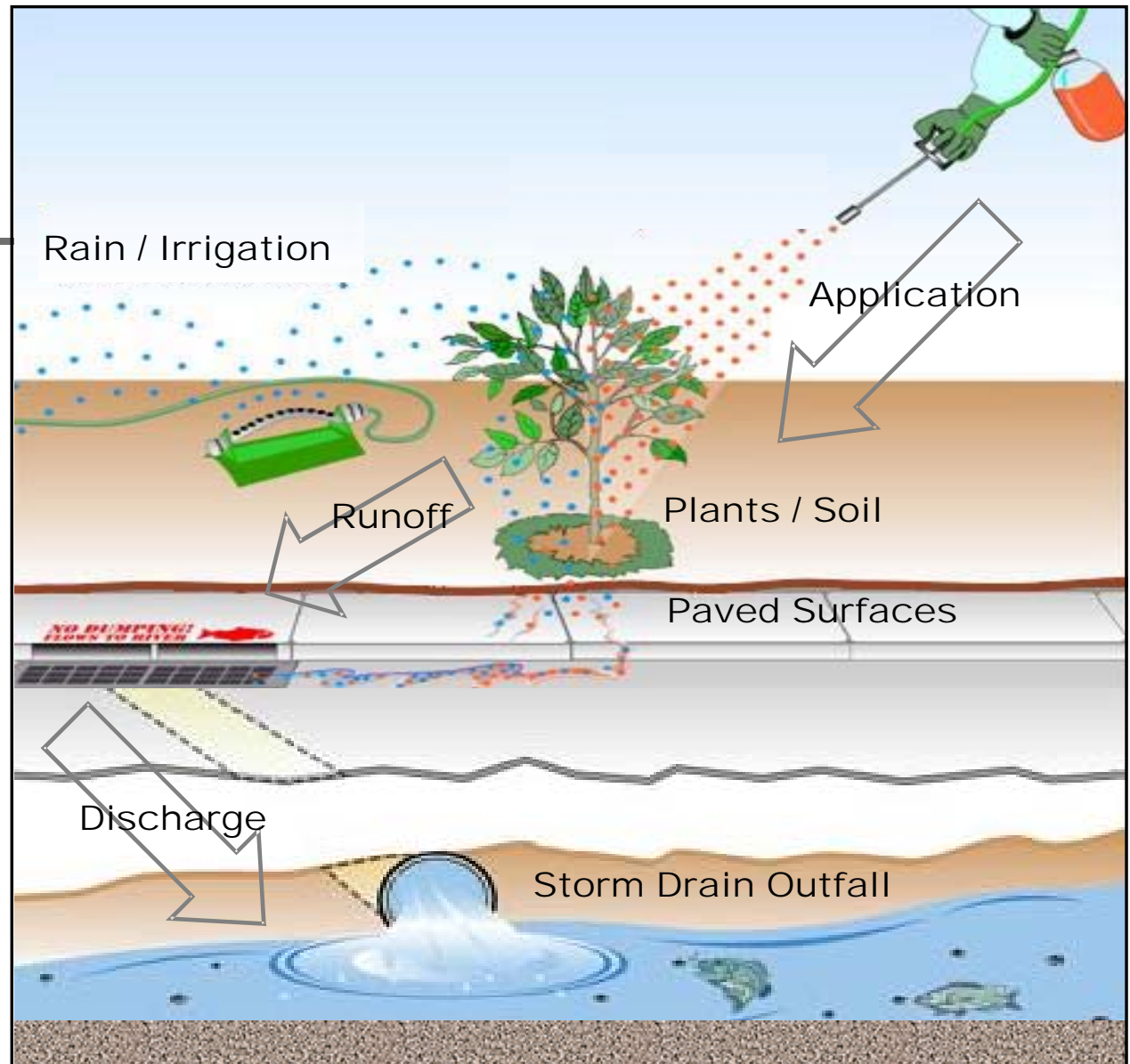


Figure courtesy SF Bay Regional Water Board, based on U.C. IPM Project drawing

# Wastewater Carries Pesticides to Treatment, Sludge, & Surface Water

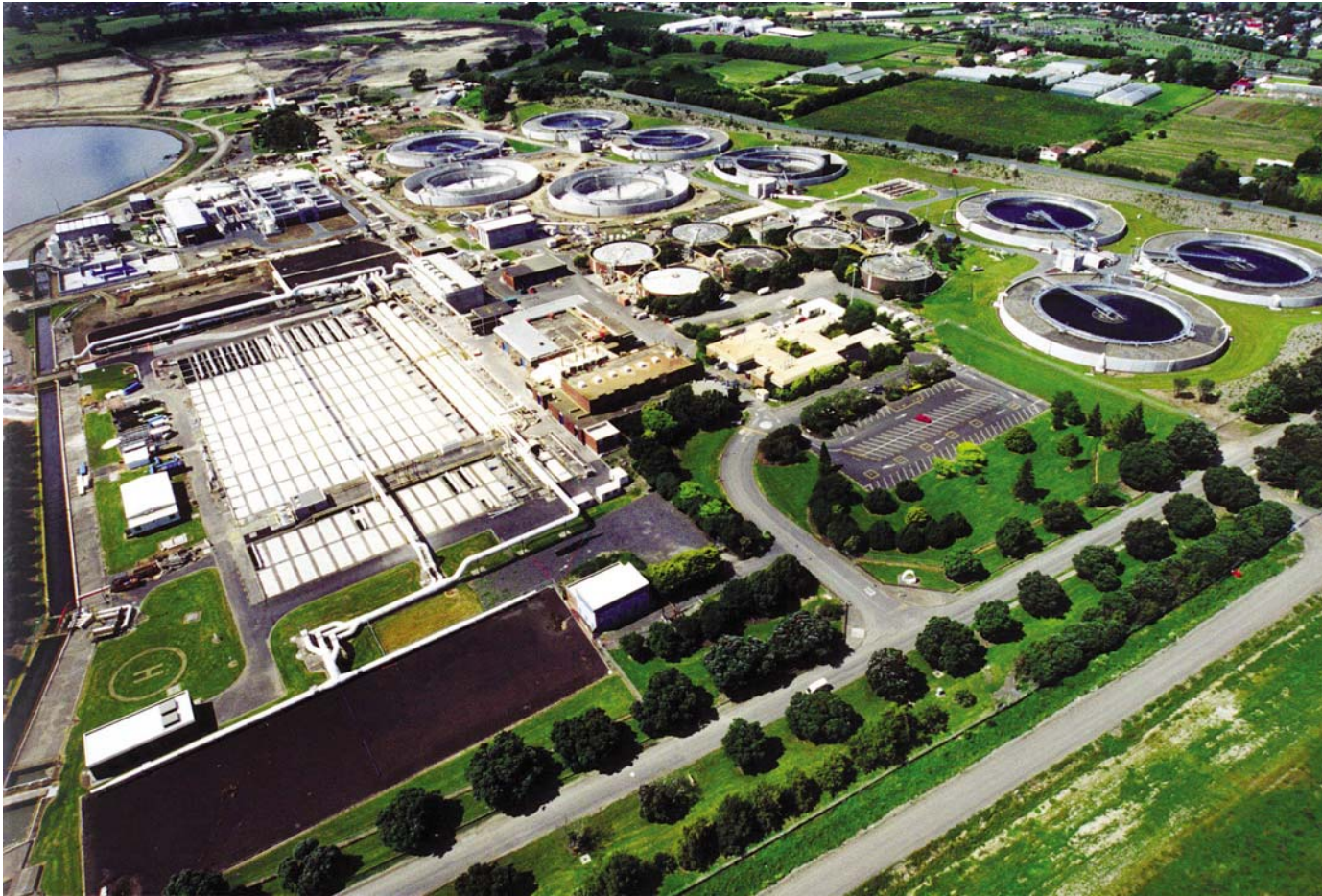


Photo courtesy WaterCare Services, Ltd.

# Clean Water Act Sets Tough Requirements for Municipalities

- NPDES permits give municipalities full responsibility for:
  - Everything that flows to a sewer
  - Everything that flows through a storm drain
- California mandatory minimum penalties
- Citizen lawsuits





# Federal Law Drives Water Quality Requirements in California

---

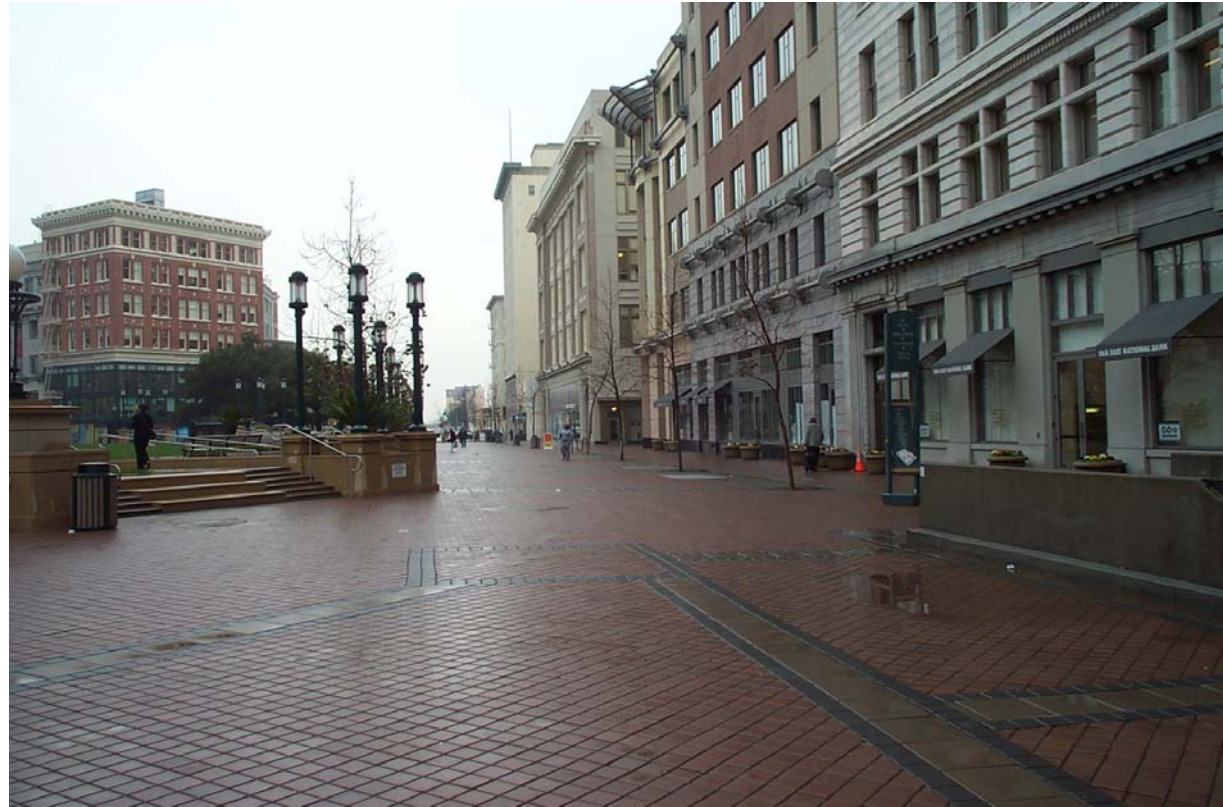
- Water Quality Standards
  - Required by Clean Water Act
  - Enforceable in permits
  - Numerical and narrative
- Numerical standards exist for about 20 pesticides
  - Toxicity is the compliance key for most pesticides
- Compliance test methods set by U.S. EPA
- Total Maximum Daily Loads (TMDLs)
  - Establish water quality targets and cleanup plans



---

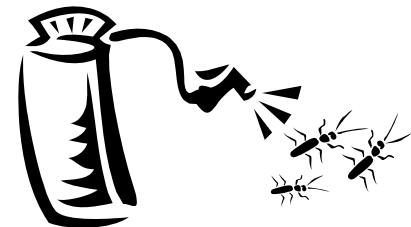
# Pesticides of Concern for Urban Surface Water Quality

# Which Pesticide Uses Are Most Important for Water Quality?



# Which Pesticide Uses Are Most Important for Water Quality?

- Applications to and near water
- Applications involving discharges to drains
- Applications on outdoor impervious surfaces
- Using large quantities of active ingredient



# Past Urban Pesticide Water Quality Compliance Problems

- DDT/Chlordane runoff
- Diazinon runoff
- Copper-based root killers
- Tributyltin cooling water additives
- Lindane lice and scabies treatments
- Dursban (chlorpyrifos) pet shampoos



# Pesticides of Concern - 2005

- Diazinon & Chlorpyrifos
  - Most urban uses are phasing out
- Pyrethroids
  - Primary replacements for Diazinon & Chlorpyrifos
- Carbaryl & Malathion

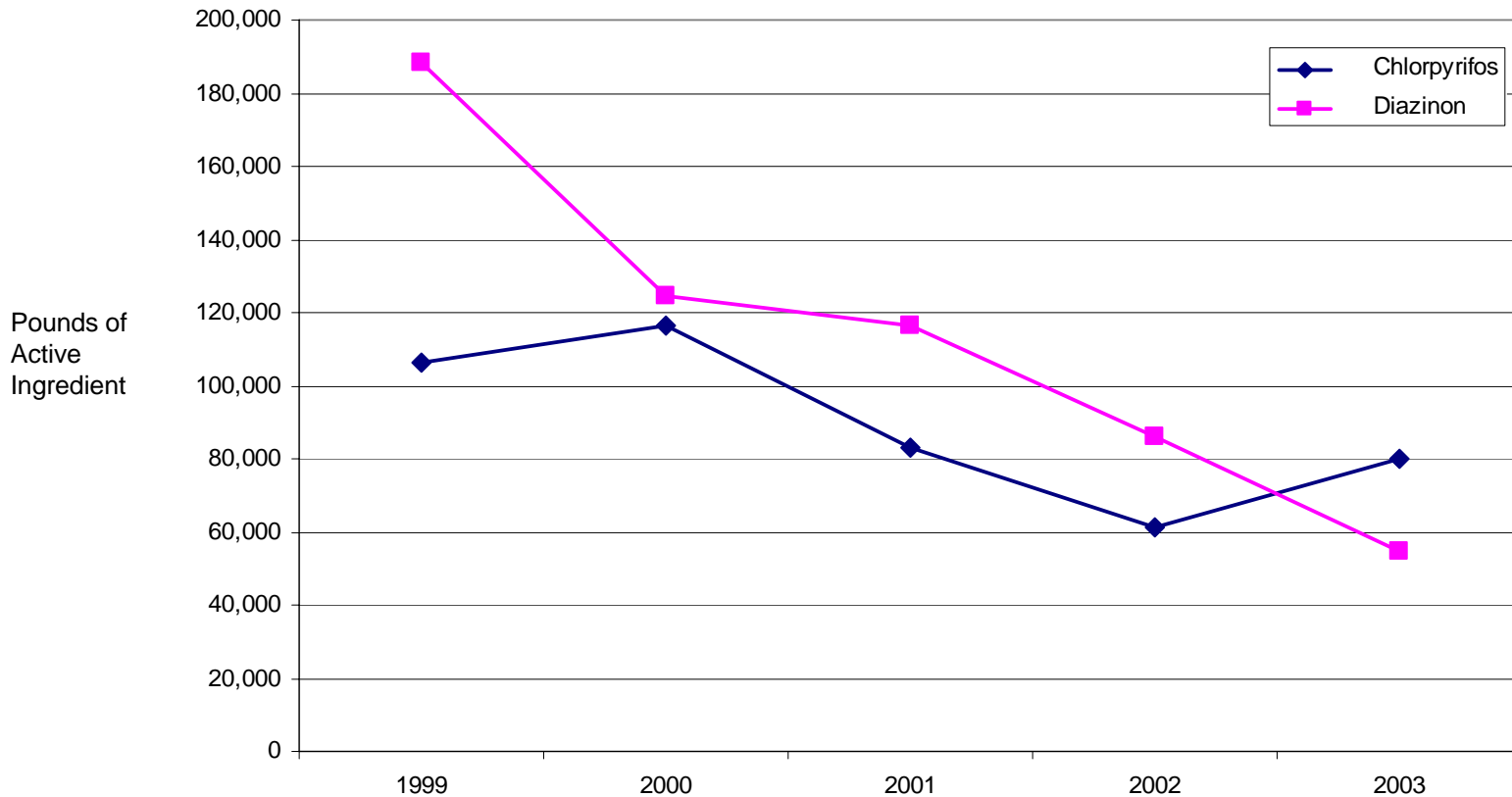


# Pesticides of Concern - 2005

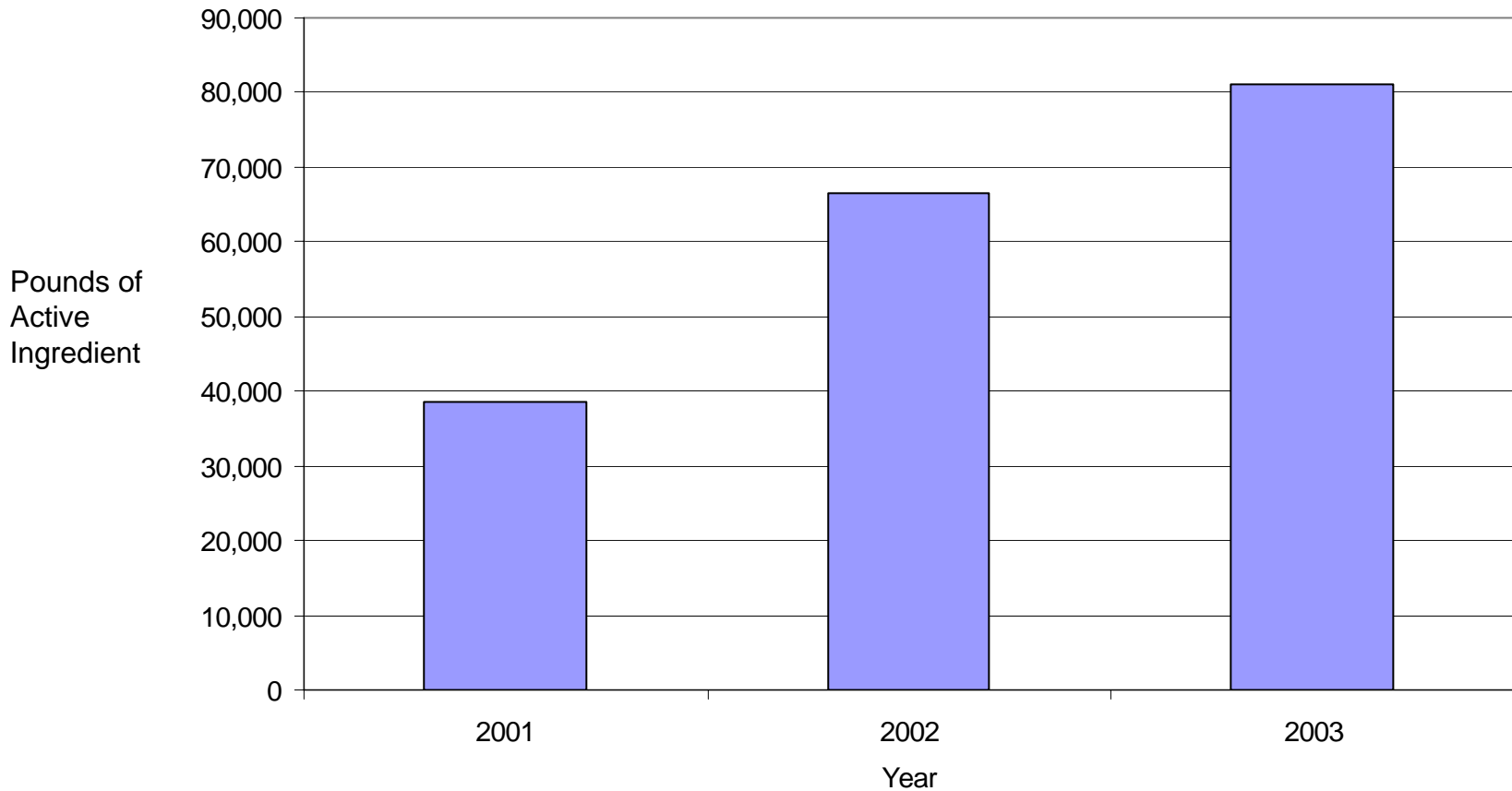
- PHMB
  - Swimming pool and spa biocide
- Copper
  - Algaecides
  - Marine antifouling paints
- Metam sodium root killers
  - Contain NDMA

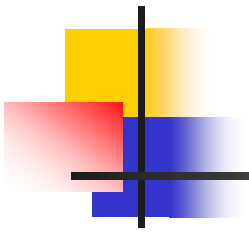


# Bay Area Diazinon & Chlorpyrifos Use Decreased from 1999-2003



# Bay Area Pyrethroid Use Doubled Between 2001 and 2003





# Pyrethroids

# Pyrethroids Are Causing Toxicity in California Waters

- Most incidents involve organisms living in sediments
- Toxicity found in California rivers and streams
  - Standard aquatic toxicity test methods
  - Test organism resides in California
  - Multiple pyrethroids contribute
  - No data for salt water yet



*Hyalella azteca* (amphipod)

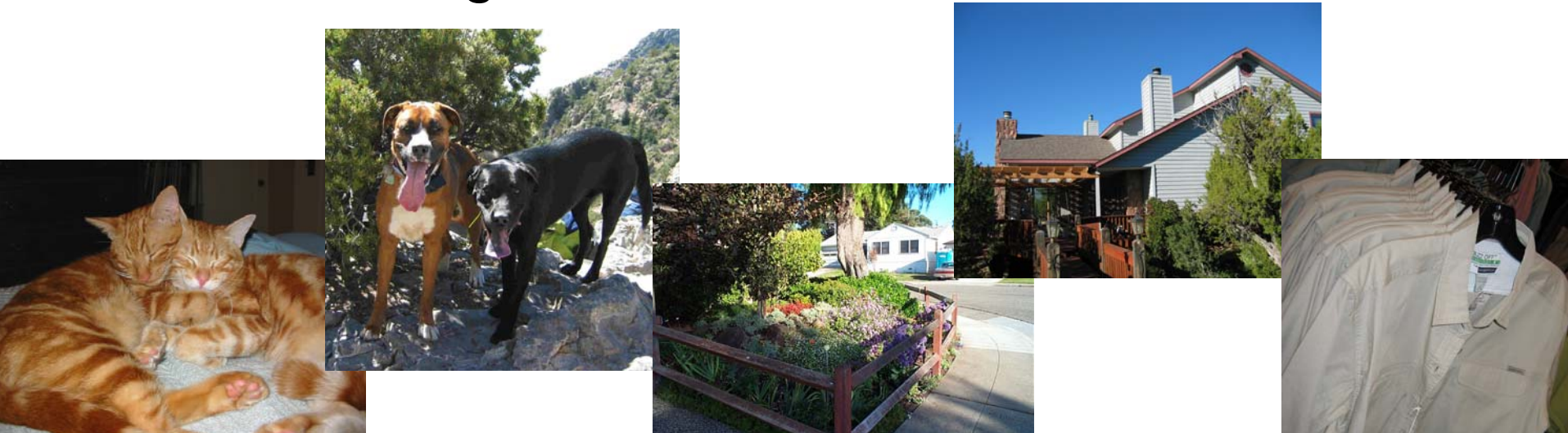
# Future Is a Big Concern

- Is toxicity occurring in urban areas?
- Is there more toxicity in creeks than in the lab? (Toxicity↑ as T↓)
- Can pyrethroids build up in sediments?
- Affects on municipal wastewater and sludge?



# Pyrethroids Have Many Uses

- Keeping insects out of buildings
- Underground termites
- Lawn/garden insects
- Pet fleas
- Clothing





# Priority Pyrethroids for Water Quality (based on use patterns)

---

- Bifenthrin
- Cyfluthrin and Beta-Cyfluthrin
- Cypermethrin
- Deltamethrin
- Esfenvalerate
- Lambda-Cyhalothrin
- Permethrin
- Tralomethrin



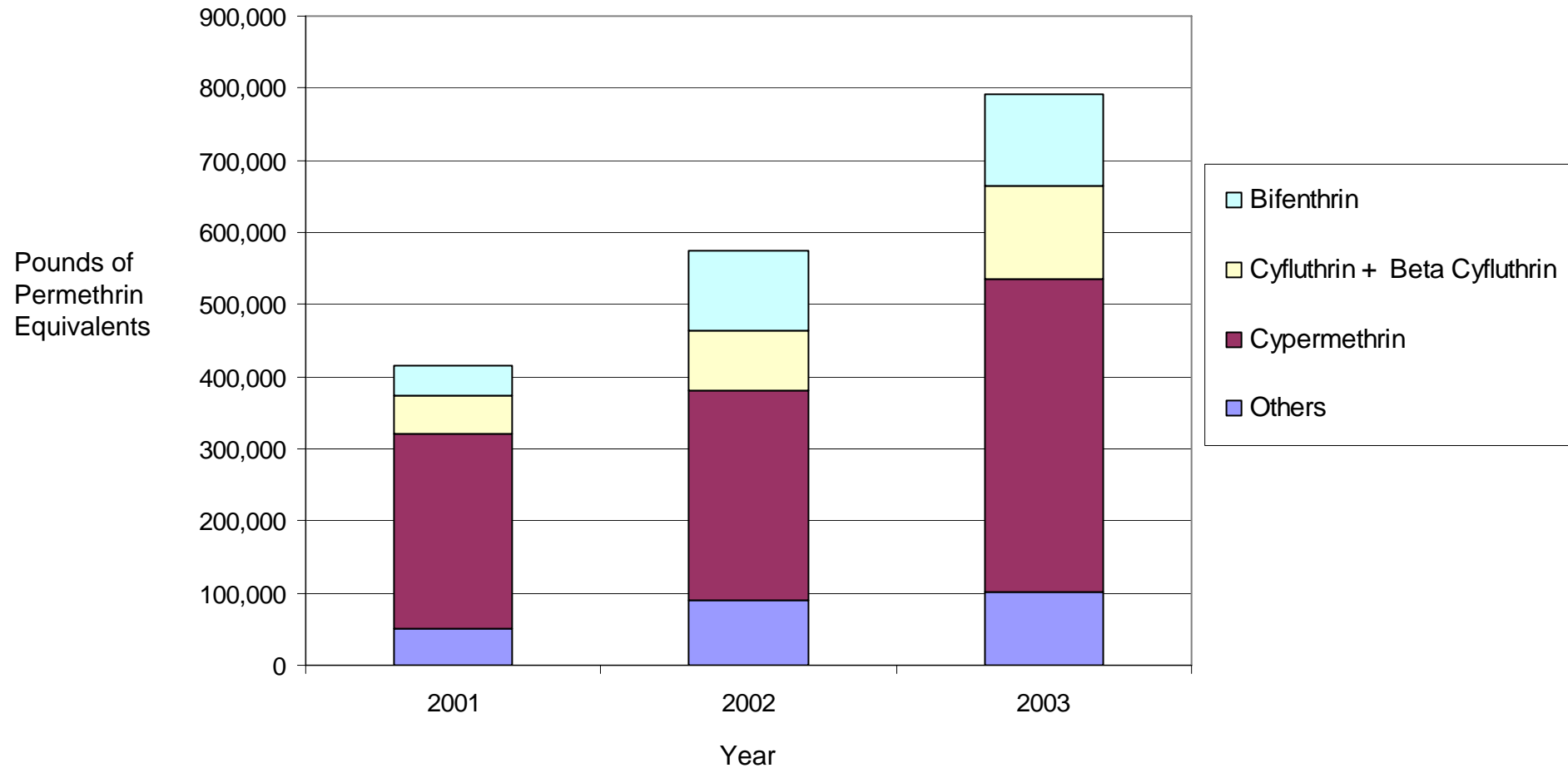
# All Pyrethroids Are Not Equal

## Pyrethroid Toxicity to *Hyalella azteca*

Pyrethroid	Number of Times More Toxic than Permethrin
Bifenthrin	21
Cyfluthrin	10
Beta-Cyfluthrin	10
Cypermethrin	29
Deltamethrin	14
Esfenvalerate	7
Lambda-Cyhalothrin	24
Permethrin	1
Tralomethrin	Assume ~1

Source: Ratio of each compound's 10-Day LC50 ( $\mu\text{g/g}$  organic carbon) for sediment toxicity to *Hyalella azteca* to permethrin's LC50 (Amweg et al. 2005; Maund et al. 2002)

# Three Pyrethroids Account for Most of the Toxic Equivalents Applied





# Could Switching Pyrethroids Help? Maybe—But Which Ones?

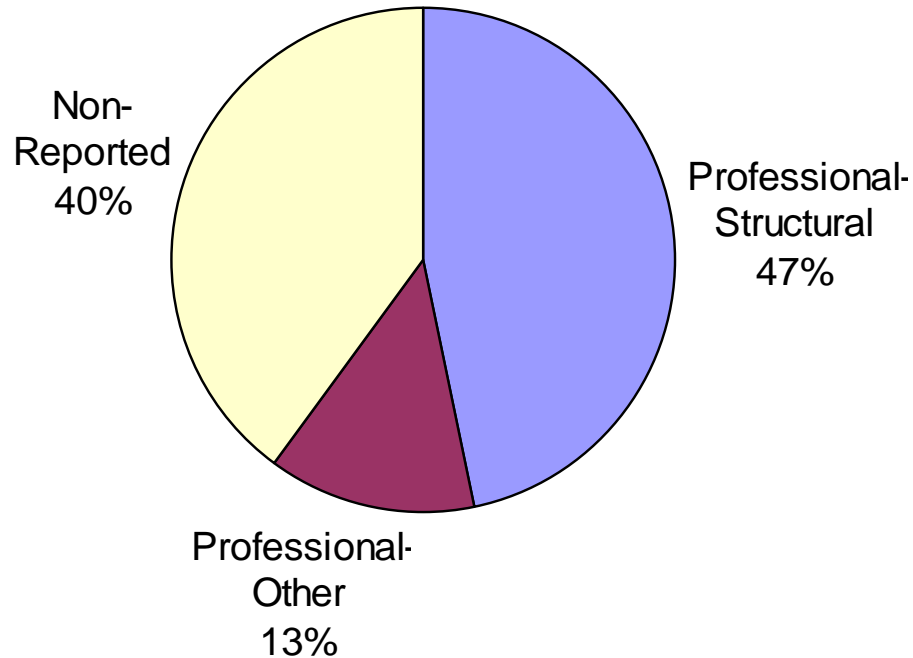
## Outdoor Application Rates

<b>Pyrethroid</b>	<b>Quantity Applied per 1000 sq. ft. (grams of Permethrin Equivalents)</b>
Bifenthrin	46 to 91
Beta-Cyfluthrin	10 to 20
Cyfluthrin	1 to 13
Cypermethrin	266 to 532
Deltamethrin	12 to 18
Esfenvalerate	2 to 14
Permethrin	4 to 74

Persistence in creeks also matters—but we have little creek fate data  
Bifenthrin >> Permethrin (Gan et al. 2005)

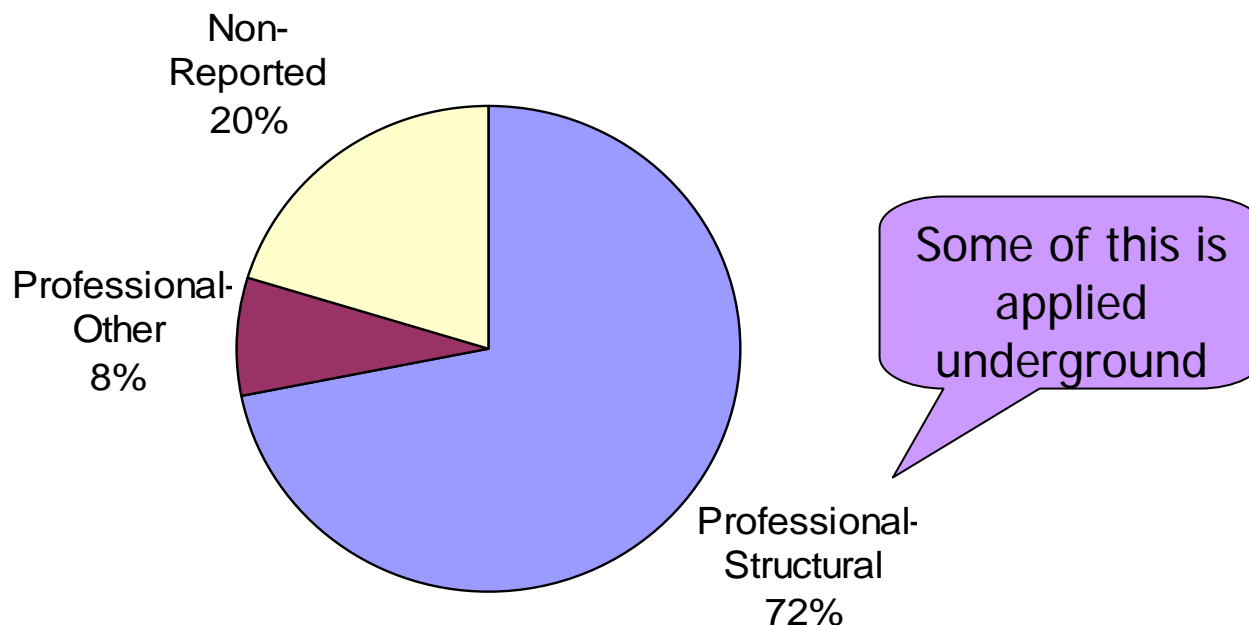
# Most Urban Pyrethroid Use Is by Professionals

San Francisco Bay Area Study List  
Pyrethroids Urban Uses, 2003 (Lb. A.I.)



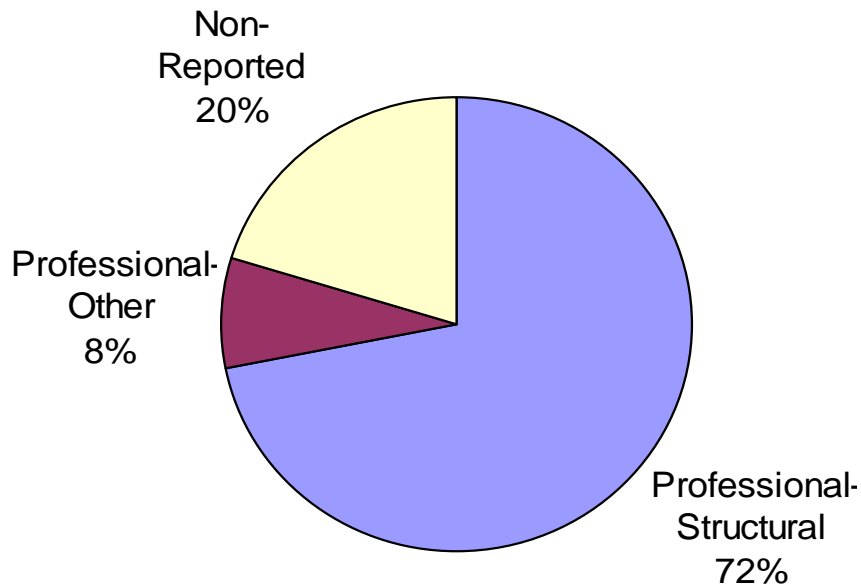
# Most Urban Pyrethroid Toxicity Is Applied by Professionals for Structural Pest Control

San Francisco Bay Area Study List Pyrethroids  
Urban Uses, 2003 (Permethrin Equivalents)



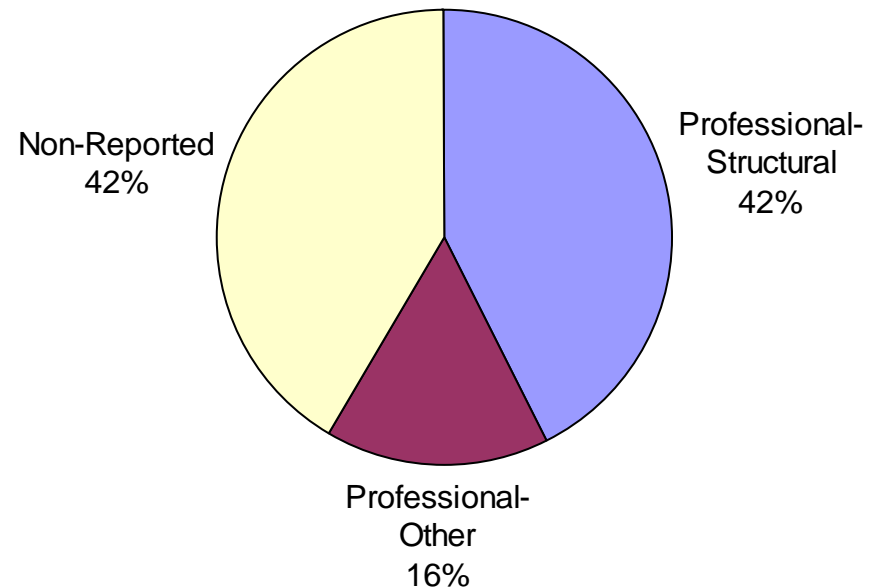
# What If We Excluded All Structural Applications of Products Labeled for Underground Injection?

All Applications



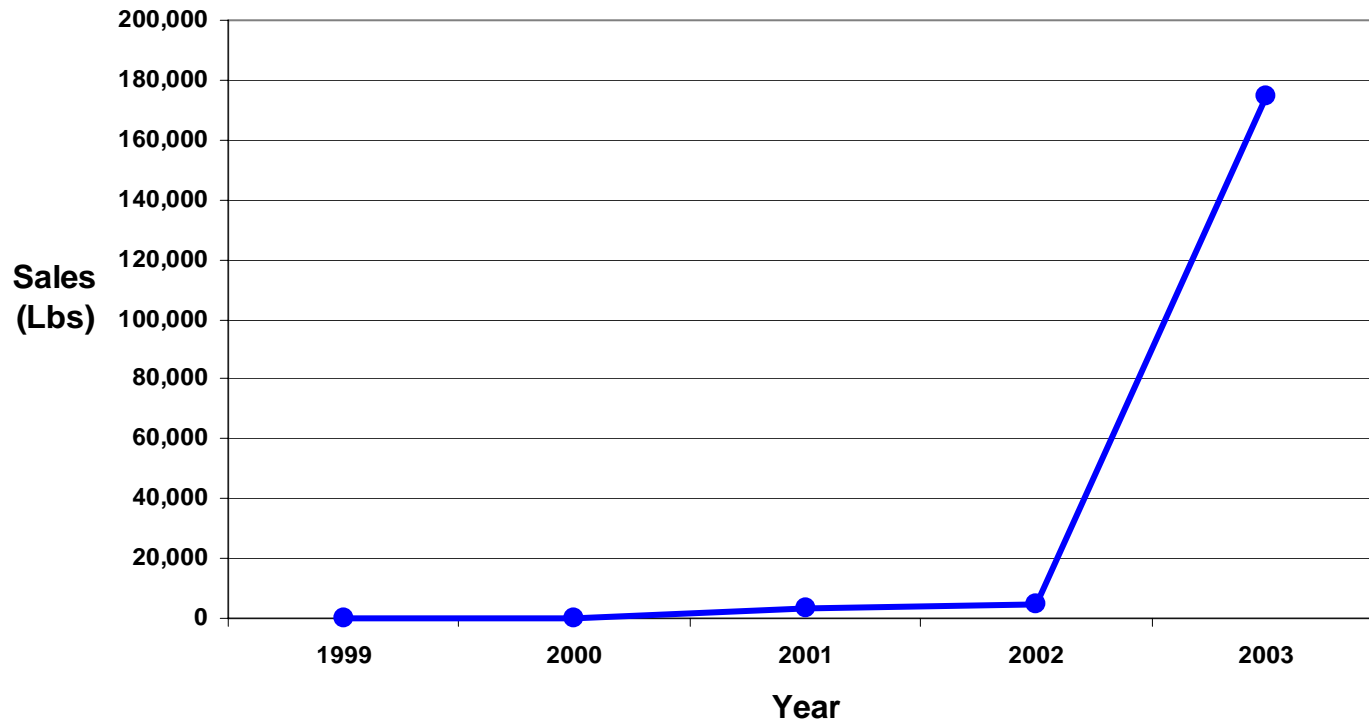
Does not account for indoor use.

Excluding Structural Applications of Products Labeled for Underground Injection



Does not account for runoff fraction.

# What's Next? Fipronil



Highly toxic to  
aquatic organisms



Recently approved for  
keeping ants out of buildings



---

# Why Don't Pesticide Regulators Prevent These Problems?

# Pesticide/Water Quality Regulatory Gaps

- Clean Water Act and pesticide registration not coordinated
  - Pesticides registered for uses that will cause Clean Water Act violations & municipal compliance problems
  - Pesticide registration rarely considers urban surface water releases



# Pesticide/Water Quality Regulatory Gaps

- No process to prevent replacing one problem with another
- No process to screen for and address newly identified water quality impacts





---

# Action Plan: Preventing Surface Water Toxicity from Urban Pesticide Use



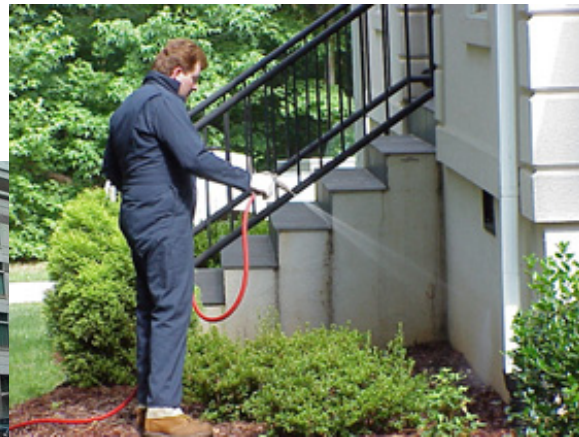
# General Approach

---

- Shift from reacting to problems to proactively preventing pesticide-related toxicity and compliance problems
  - Monitoring—get information on problems
  - Regulatory—U.S. EPA and DPR need to protect water quality
  - Outreach/Education—Promote least toxic pest control methods

# Priority Actions

- Target outdoor use of pyrethroids
  - Structural applications are the priority
  - Both business & residential
  - Lawn & garden a lower priority



Applicator photos courtesy North Carolina Cooperative Extension



# Priority Actions

---

- Change the way ants are kept out of buildings
  - IPM methods—baits and exclusion
  - Switching pesticides may create new problems (we need to learn from history)



# Priority Actions

- Don't ban a pesticide without promoting a substitute pest control approach
  - Simply banning pyrethroids is not the answer
  - We need to change the way we control pests



# Priority Actions

- Recognize that widespread use of any pesticide in an urban watershed can have significant adverse cumulative impacts on surface waters and POTWs



# Recommendations— Outreach & Education

- Discourage use of pyrethroids, carbaryl and malathion
- Exercise discretion re: alternative pesticides for outdoor use
  - Particularly fipronil
  - Avoid widespread use of imidacloprid, pyrethrins & PBO
- Promote baits, pest prevention & pest exclusion



# UP3 Project



For more information:

[www.UP3Project.org](http://www.UP3Project.org)



# Approach to Estimating Bay Area Urban Pesticide Use

---

$$\text{Statewide Unreported Use} = \text{Statewide Sales} - \text{Statewide Reported Use}$$

$$\text{County Unreported Use} = \text{Statewide Unreported Use} \times \frac{\text{County Population}}{\text{State Population}}$$

$$\text{Urban Use in a County} = \text{Reported Urban Use} + \text{County Unreported Use}$$

- *All unreported use is assumed to occur in urban areas*
- *Sales data is only available statewide*