

# Advanced Analysis of Stormwater Monitoring Data

Lester McKee and Lisa Sabin  
RMP annual meeting, October 14, 2021



# Problem

- San Francisco Bay is polluted with PCBs
- Peak use period 1975! So these bioaccumulative chemicals are persistent!
- Stormwater agencies are identifying the most polluted catchments, looking for sources, determining the best management response, and treating sources to reduce stormwater loads
- Takes a lot of time and money

**Women (18-49 Years)**  
**Children (1-17 Years)**

**2 TOTAL SERVINGS A WEEK**  
OR  
**1 TOTAL SERVING A WEEK**  
**0 DO NOT EAT**

**A GUIDE TO EATING FISH**  
*from*  
**SAN FRANCISCO BAY**  
(ALAMEDA, CONTRA COSTA, MARIN, NAPA, SAN FRANCISCO, SAN MATEO, SANTA CLARA, SOLANO, SONOMA COUNTIES)

**WOMEN 18 - 49 YEARS AND CHILDREN 1 - 17 YEARS**

**Eat the Good Fish**  
Eating fish that are low in chemicals may provide health benefits to children and adults.

**Avoid the Bad Fish**  
Eating fish with higher levels of chemicals like mercury or PCBs may cause health problems in children and adults.

**Choose the Right Fish**  
Chemicals may be more harmful to unborn babies and children.

**Brown rockfish**  
**Chinook (King) Salmon** High in omega-3s  
**Jackmelt**  
**Red rock crab**

**California halibut**  
**White croaker**

**Sharks**  
**White sturgeon**  
**Surfperches**  
**Striped Bass**

**Serving Size**  
A serving of fish is about the size and thickness of your hand. Give children smaller servings.

**For Adults**  
**For Children**

Some chemicals are higher in the skin, fat, and guts.

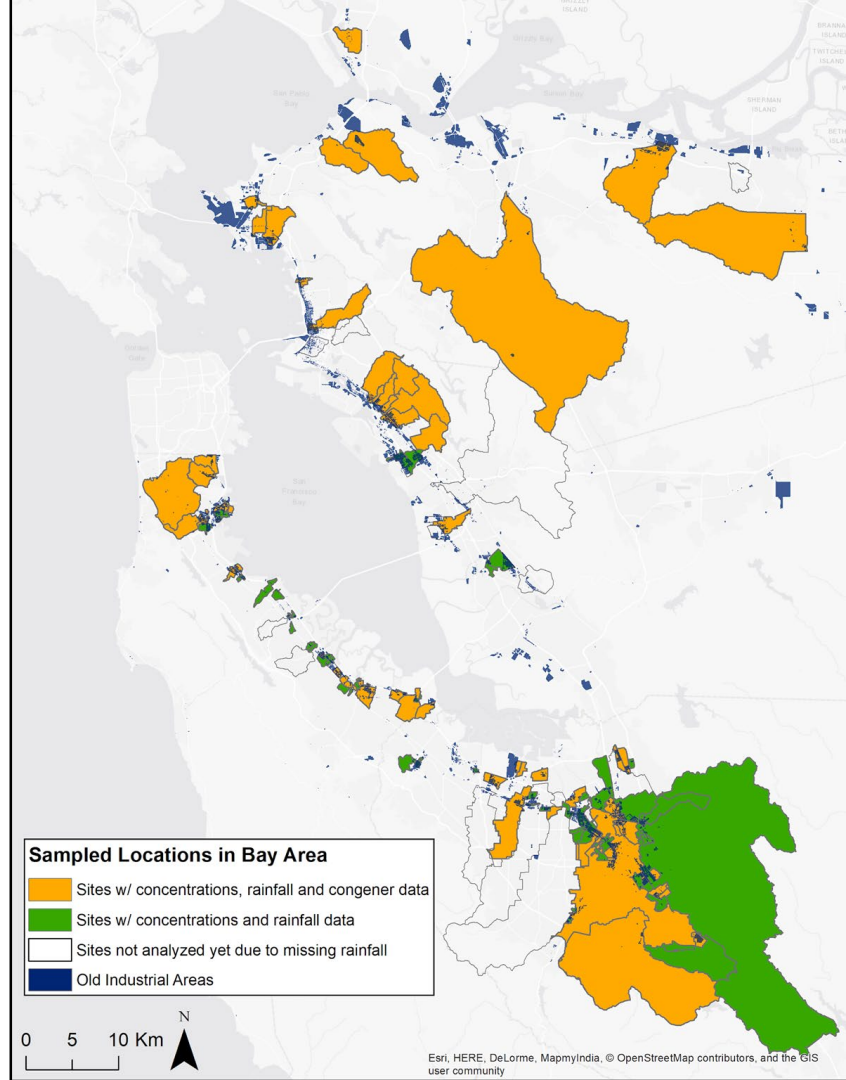
**Eat only the skinless fillet**  
**Eat only the meat**

California Office of Environmental Health Hazard Assessment  
web [www.oehha.ca.gov/fish](http://www.oehha.ca.gov/fish)  
email [fish@oehha.ca.gov](mailto:fish@oehha.ca.gov)  
phone (916) 324-7572



# RMP Support

- Many sites characterized for PCB concentrations in water and on suspended sediment during one storm
- However, catchment prioritization using this data is hampered by variations in flow and sediment erosion
- In addition, even after identifying a catchment of interest, it is difficult to identify source properties upstream



# Methods



## Small Tributaries Pollutants of Concern Reconnaissance Monitoring: Loads and Yields-based Prioritization Methodology Pilot Study

Prepared by:

Lester J. McKee, Alicia N. Gilbreath, Jennifer A. Hunt,  
Jing Wu, Don Yee, and Jay A. Davis

San Francisco Estuary Institute

CONTRIBUTION NO. 817 / October 2019



## Small Tributaries Pollutants of Concern Reconnaissance Monitoring: Pilot Evaluation of Source Areas Using PCB Congener Data

Prepared by:

Jay A. Davis and Alicia N. Gilbreath

San Francisco Estuary Institute

CONTRIBUTION NO. 956 / October 2019

# Loads and Yields

- Catchment mass loads of PCBs and yields from the old industrial area in each of the catchments were computed by:
  - Combining rainfall with a modeled estimate of runoff, and PCB concentrations measured during storms
  - Adjusting load to a standard storm size and dividing the load by the area of older industrial land use in each catchment
- Yield computed in this way allows us to directly compare and rank PCB sources areas one to another rather than whole catchments

# The Power of Loads and Yields

	<b>Central Valley Watershed</b>	<b>Bay Area Small Tributaries</b>	<b>Difference</b>
Mean concentration in water (ng/L)	0.46	13	~30x

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Mean concentration on suspended sediment (ng/g)	6.7	14	~2x

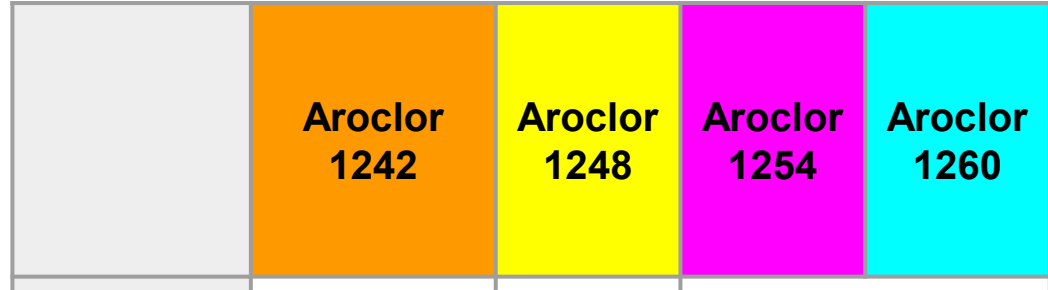
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Yield (mg / person in 1980)	3.6	4.1	~1x



# Aroclors

- Commercial mixtures of PCB congeners



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- Each mixture had slightly different properties making it ideal for certain uses

	<b>Aroclor 1242</b>	<b>Aroclor 1248</b>	<b>Aroclor 1254</b>	<b>Aroclor 1260</b>
Examples of major uses	Capacitors		Transformers	
			Caulk	
	Hydraulic fluids and other lubricants			

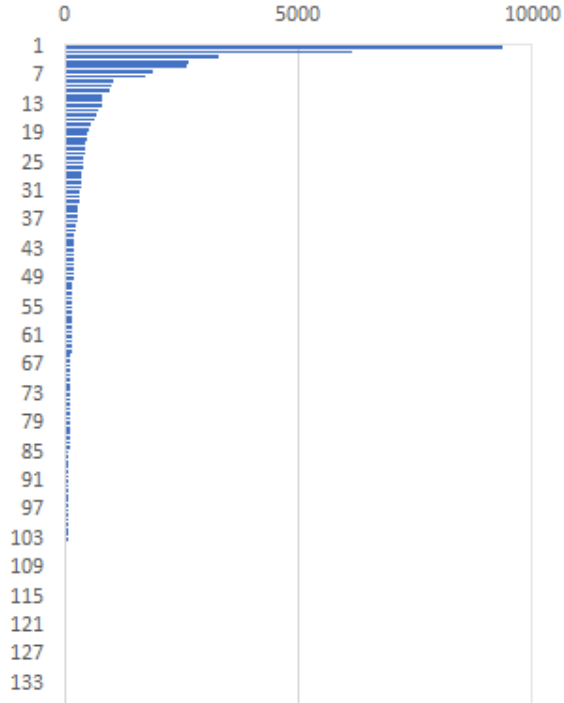
# Aroclors

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- Each mixture had slightly different properties making it ideal for certain uses
- Selected congeners were used to fingerprint our samples and determine the Aroclors present at each watershed sampling site

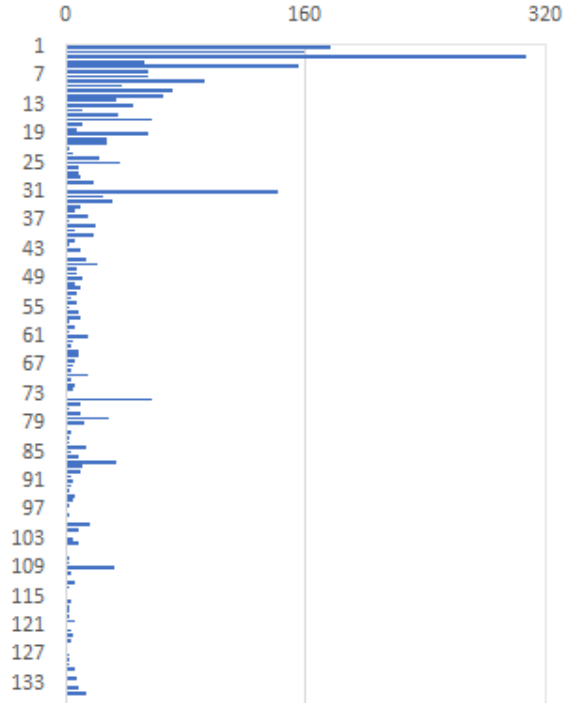
	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Examples of major uses	Capacitors		Transformers	
			Caulk	
	Hydraulic fluids and other lubricants			
Fingerprint congeners	18	44	87	149
	28	49	101	170
	31	66	110	180
	33	70	118	187

# Ranking Catchments by each Indicator

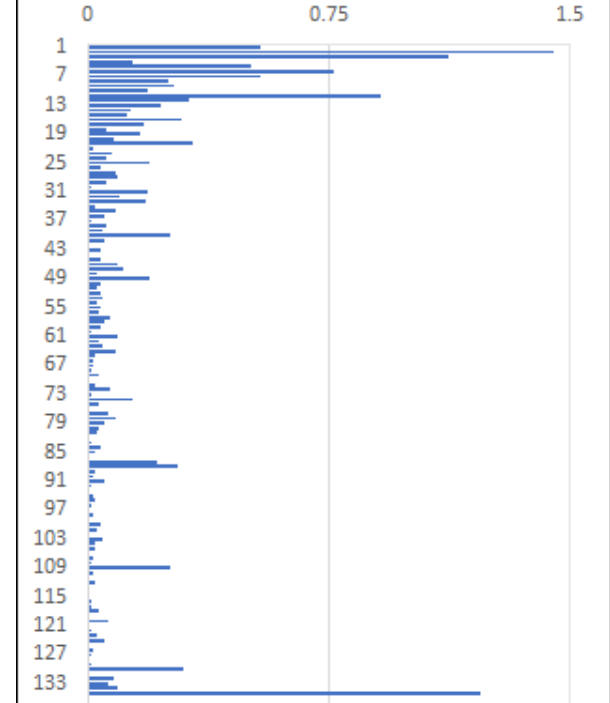
**Concentration on suspended sediment (ng/g)**



**Concentration in stormwater (ng/L)**

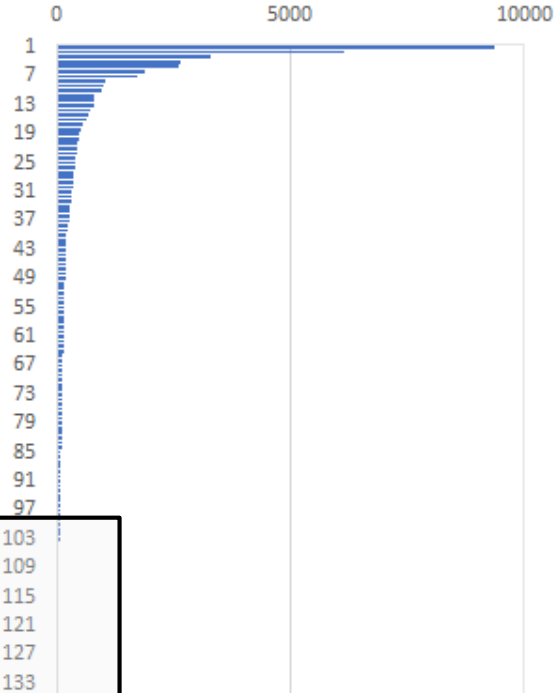


**Yield from older industrial areas (g/km2)**

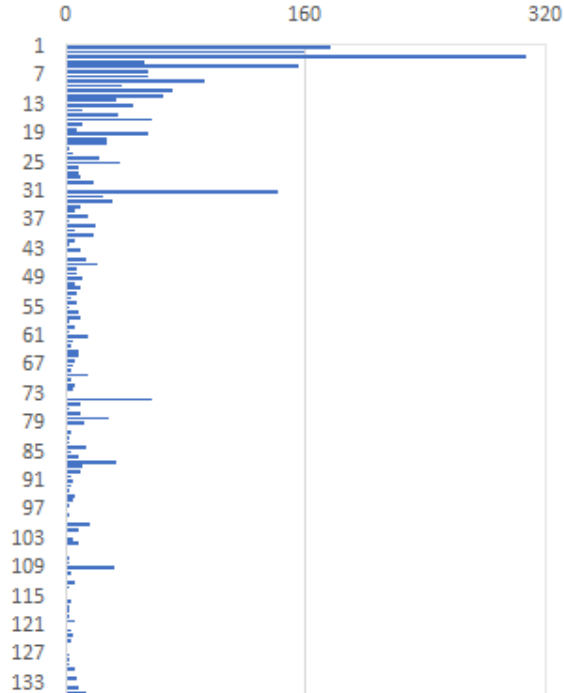


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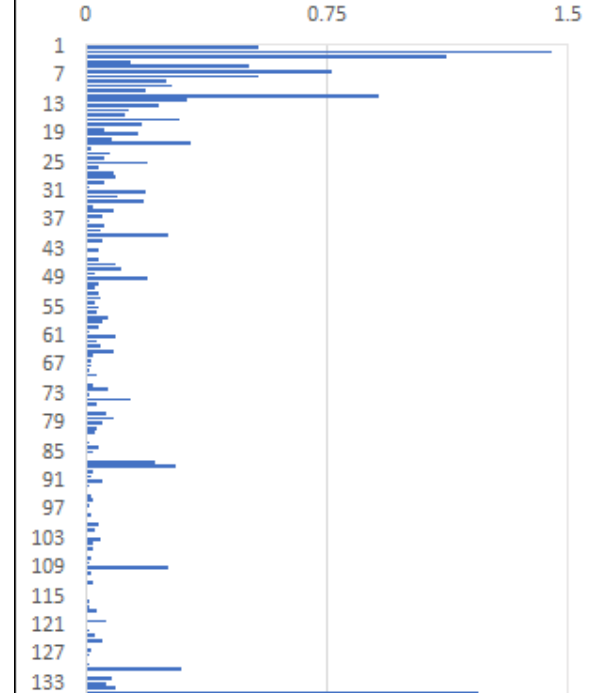
Concentration on suspended sediment (ng/g)



Concentration in stormwater (ng/L)

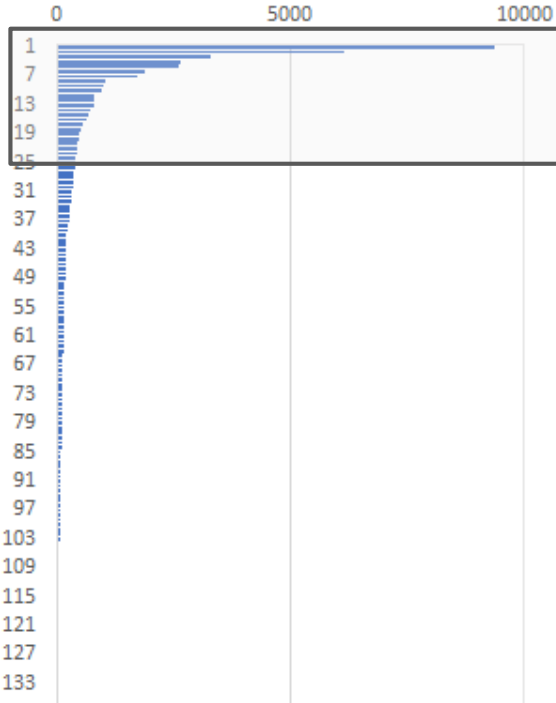


Yield from older industrial areas (g/km<sup>2</sup>)

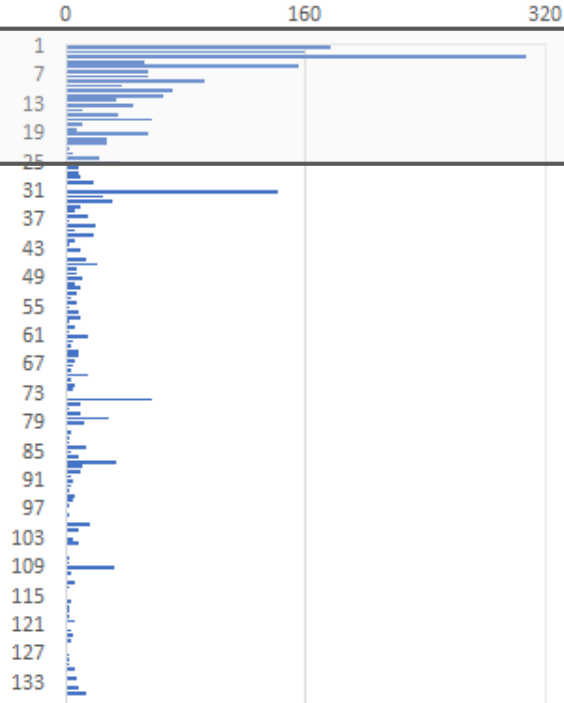


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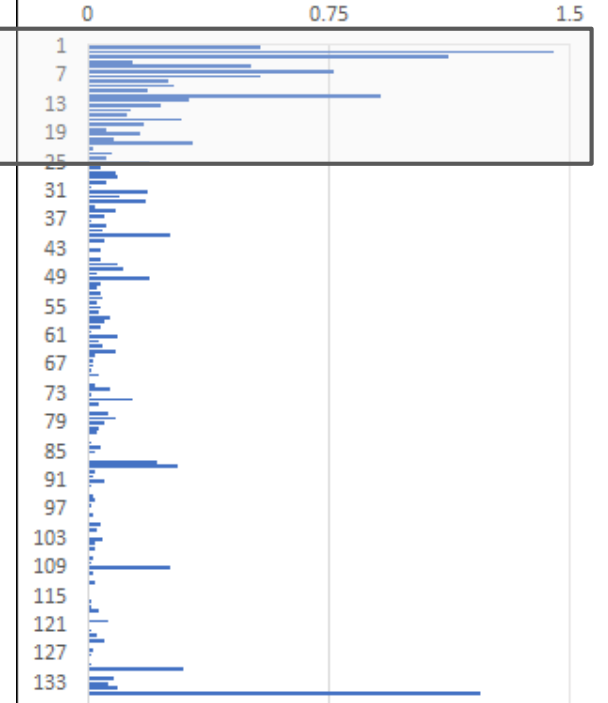
Concentration on suspended sediment (ng/g)



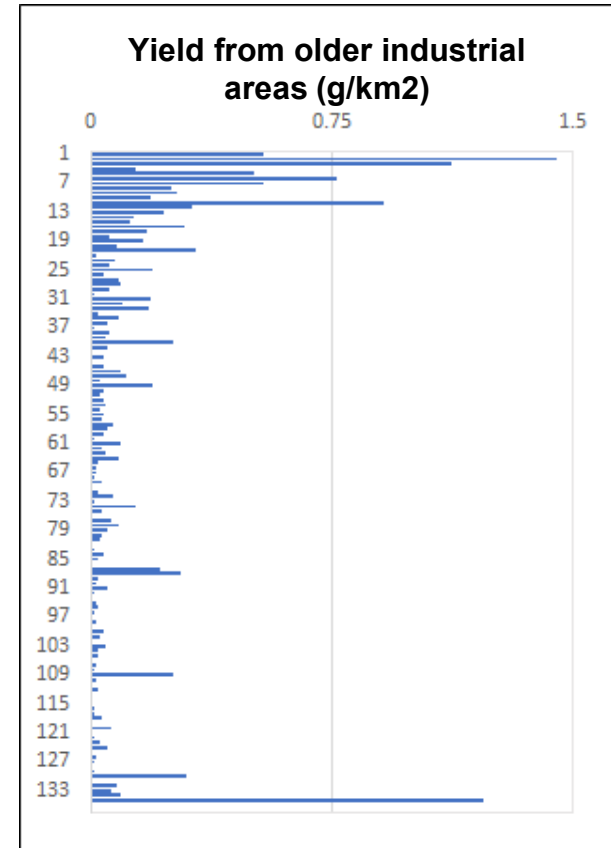
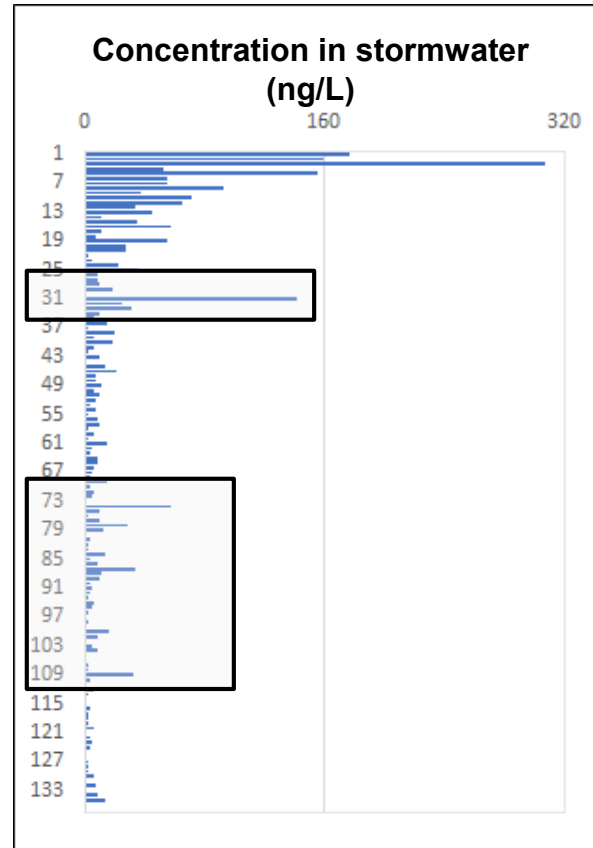
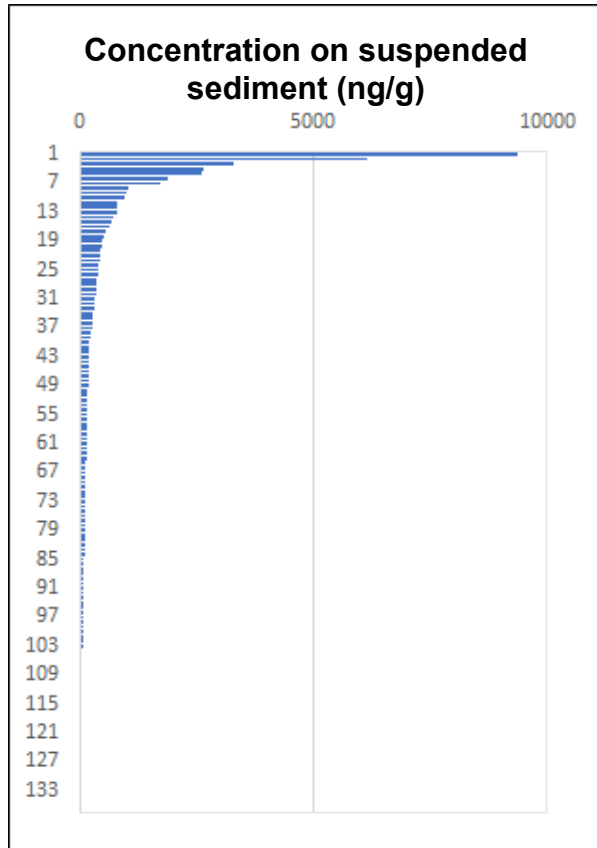
Concentration in stormwater (ng/L)



Yield from older industrial areas (g/km2)

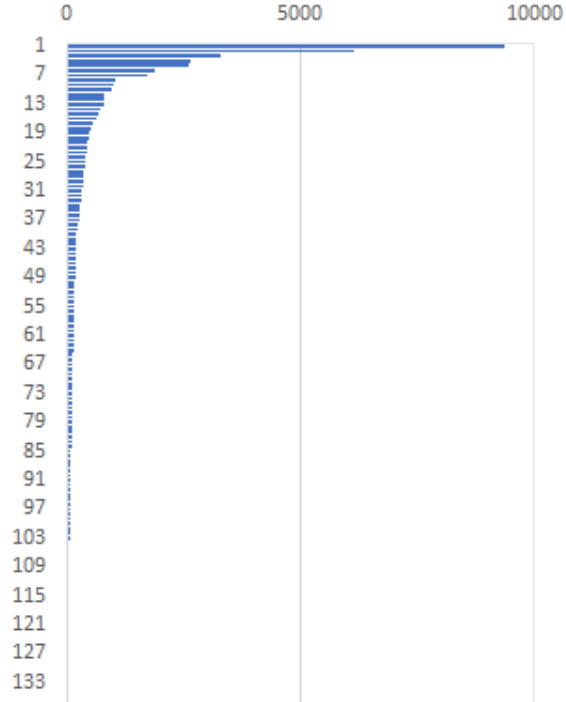


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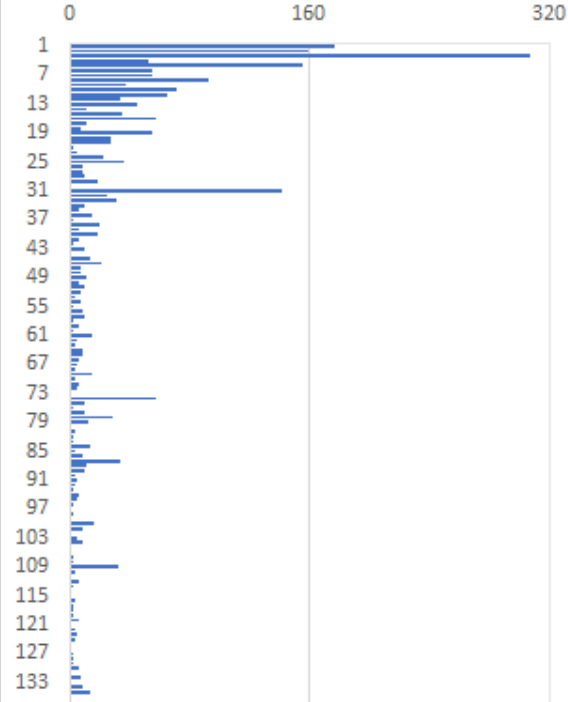


# Ranking watersheds by yields

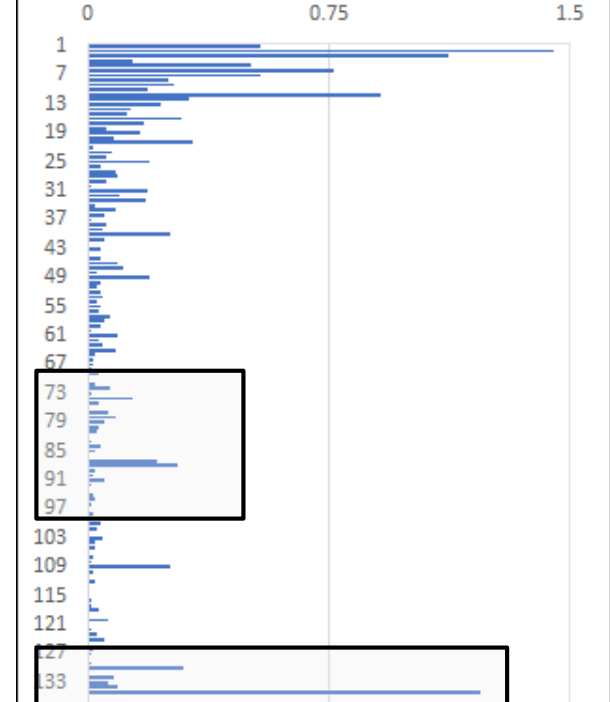
Concentration on suspended sediment (ng/g)



Concentration in stormwater (ng/L)



Yield from older industrial areas (g/km<sup>2</sup>)



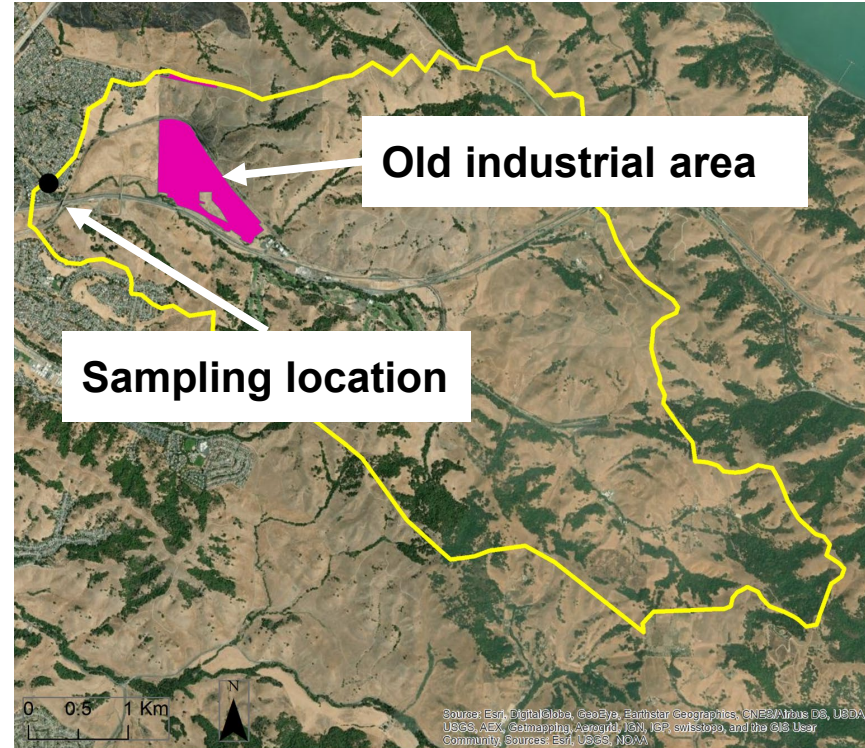


# Yields and Aroclors

## Case 1: Rodeo Creek (CCC)

- 4% old industrial
- 14 ng/L (Rank = 37)
- 5 ng/g (Rank = 135)
- 1.2 g/km<sup>2</sup> (Rank = 2)
- Primary Aroclors: 1260, 1242

## Rodeo Creek Watershed



# Part II: Practical Uses and Benefits of the Stormwater Monitoring Data Advanced Analysis Methods

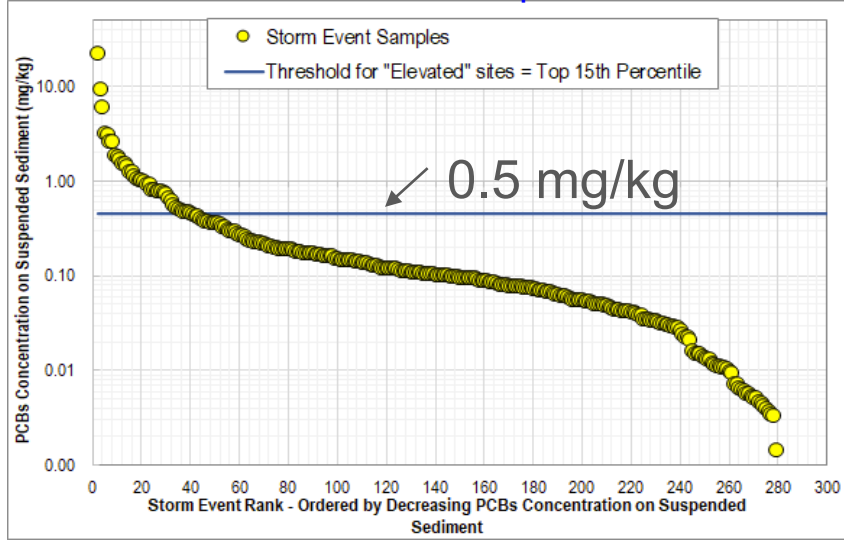
Support for PCBs Source  
Investigations



# Stormwater Programs Current Method for Prioritizing Areas for Source Investigation

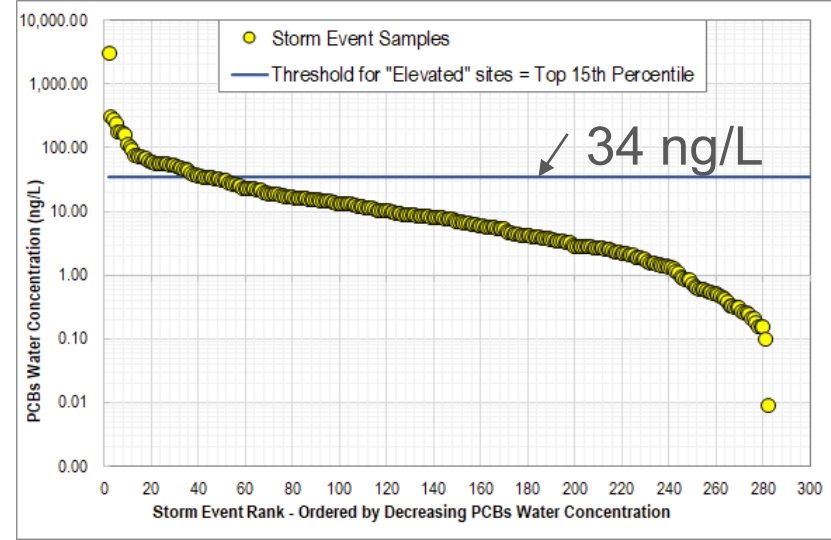
- Collect screening-level stormwater samples at catchment outlets
- Apply thresholds to identify catchments for source investigation

PCBs Concentrations on Suspended Sediment



OR

PCBs Concentrations in Water



# Stormwater Program Data Needs:

1. Identify High Priority Catchments  
= Areas contributing to elevated stormwater loads

- i.e., above urban background

2. Identify low priority catchments  
= Areas not contributing to elevated stormwater loads

Normalized Yields provide another metric to prioritize catchments for management actions

Allows direct comparison of source area loads across catchments

Reduces risk of false negatives

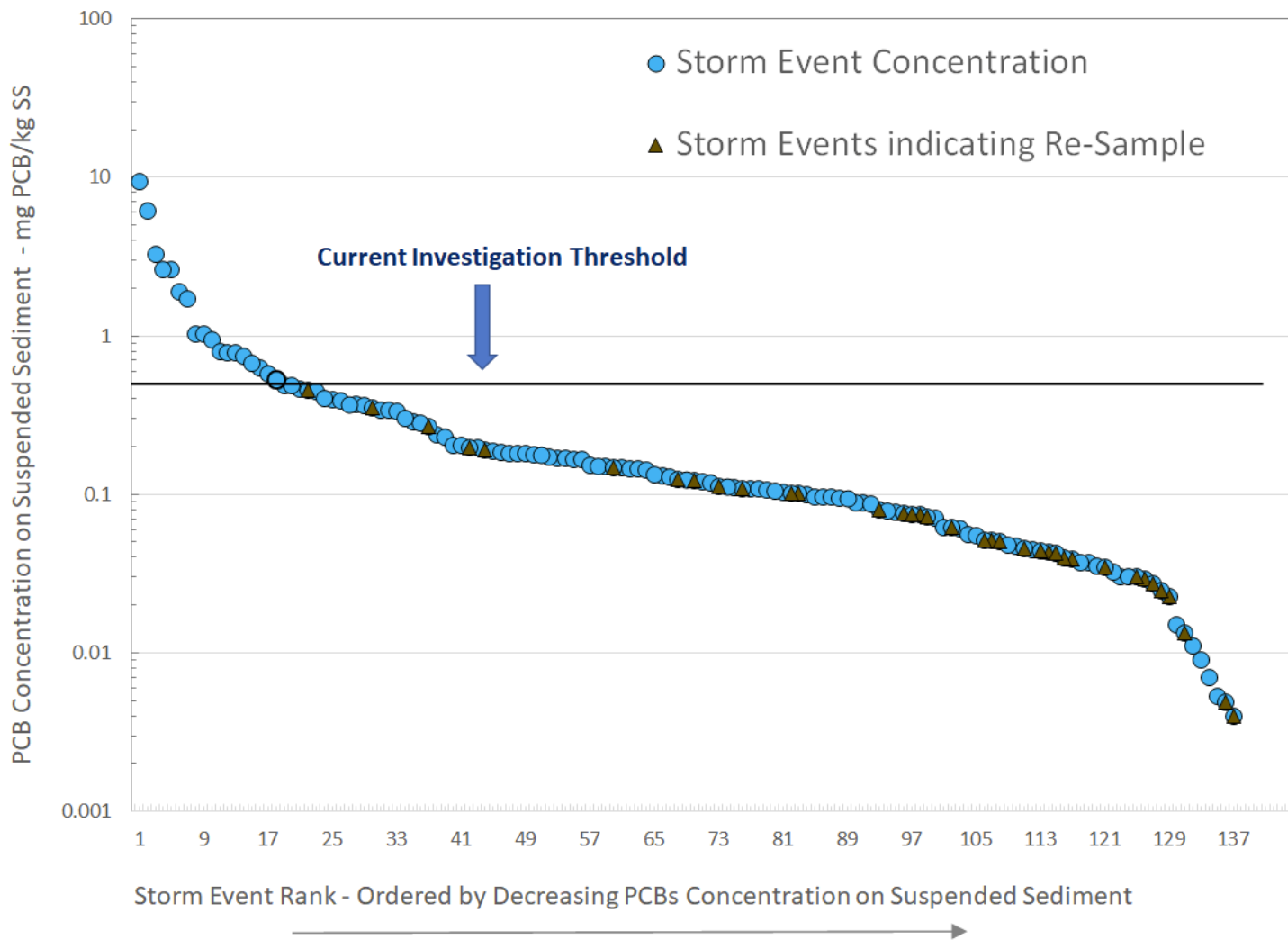
Identifies sites that require re-sampling

Aroclor Indicators can hint at potential sources within a catchment

Supports Source Identification!

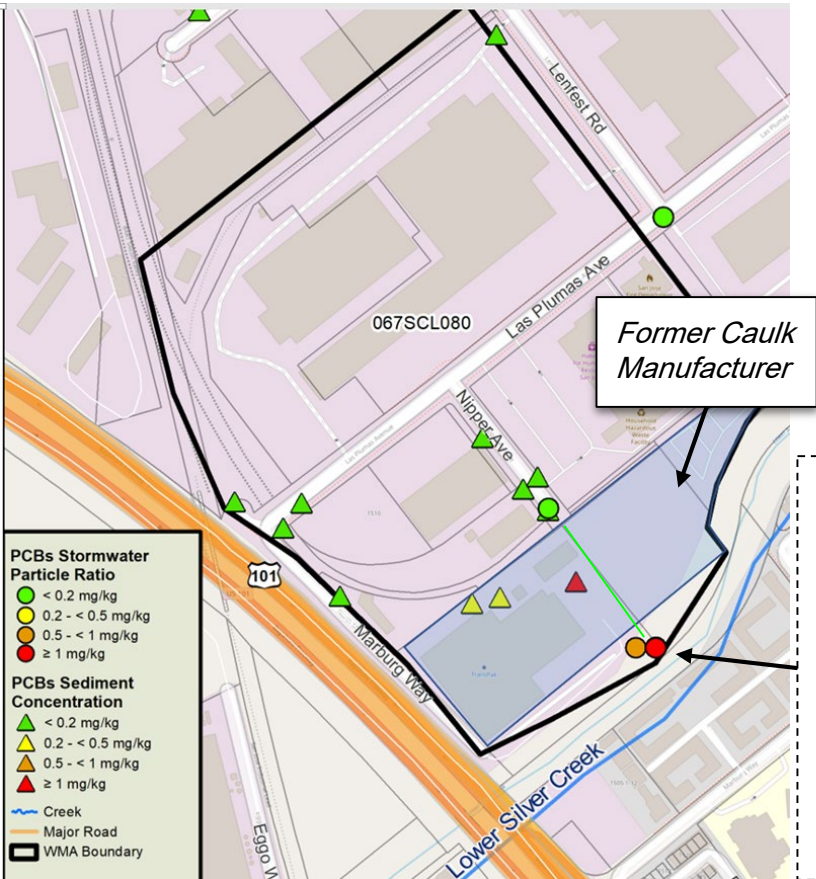


# Example: Re-Sample





# Aroclor Indicator Hints at Catchment Sources



Commercial use in the United States		1242	1248	1254	1260
Major uses (>20,000 metric t)	Capacitors (large, small, light ballasts)	X		minor	
	Transformers	minor		X	X
	Caulk and joint sealants			X	
	Hydraulic fluids and other lubricants	X	X	X	X

Stormwater sample collected downstream of a former caulk manufacturer:

- High PCB concentrations
- Catchment has high PCBs yield, indicating a source.
- Congener data show Aroclor 1254 is the primary Aroclor in the sample.

**Caulk was a major use of Aroclor 1254!!**



# Summary

- The RMP has developed new methods for stormwater monitoring data analysis to gain insights about pollution sources and locations where management actions can have greater water quality benefit
- The old methods of ranking based on concentration only allowed us to make comparisons at the scale of whole watersheds. Now, **by estimating yields, we are able to directly compare PCB loads coming from older industrial areas - the actual scale at which management effort occurs**
- By fingerprinting Aroclors, we can get further hints about the possible sources in these older industrial areas
- The methods are starting to be put into practical use