Water Column Status and Trend Analysis

Objective

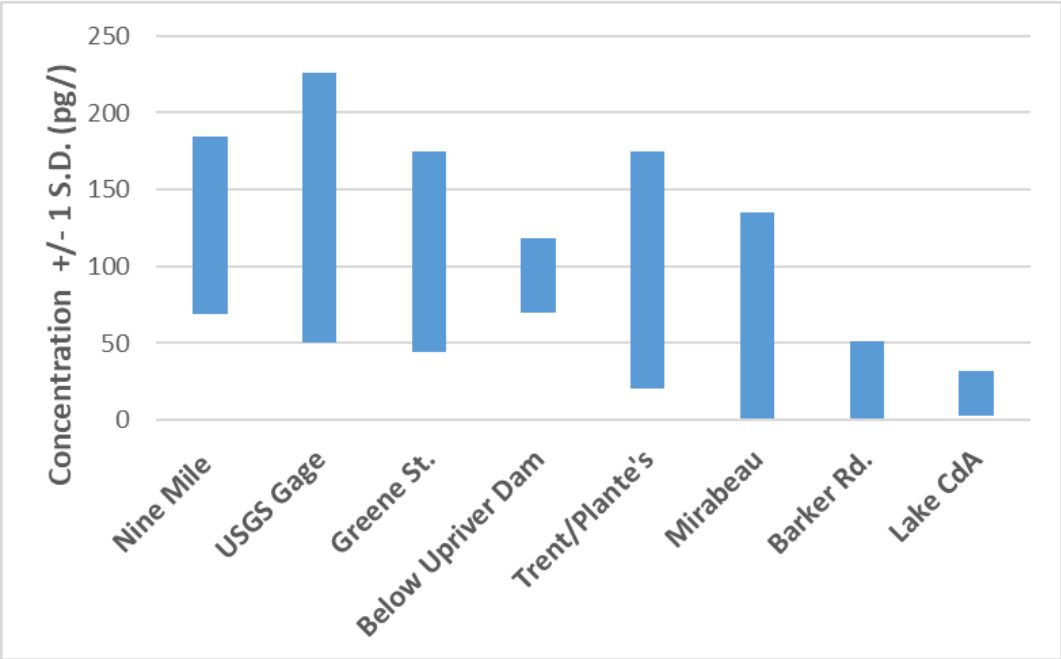
- Status
  - Determine current water column concentration and variability
- Trends
  - Determine whether PCB concentrations are decreasing over time
  - Assess the amount of the data required to estimate future trends with confidence

Task Description

- Considered all Task Force Data 2014-2018
- Status
  - Assess averages, variance, factors contributing to variance
- Trends
  - Data analyzed at four sites
    - Barker, Trent, USGS gage, Nine Mile
  - Two standard statistical tests
    - Linear regression
    - Mann-Kendall non-parametric

Water Column Status

- Average concentration by station, +/- one standard deviation



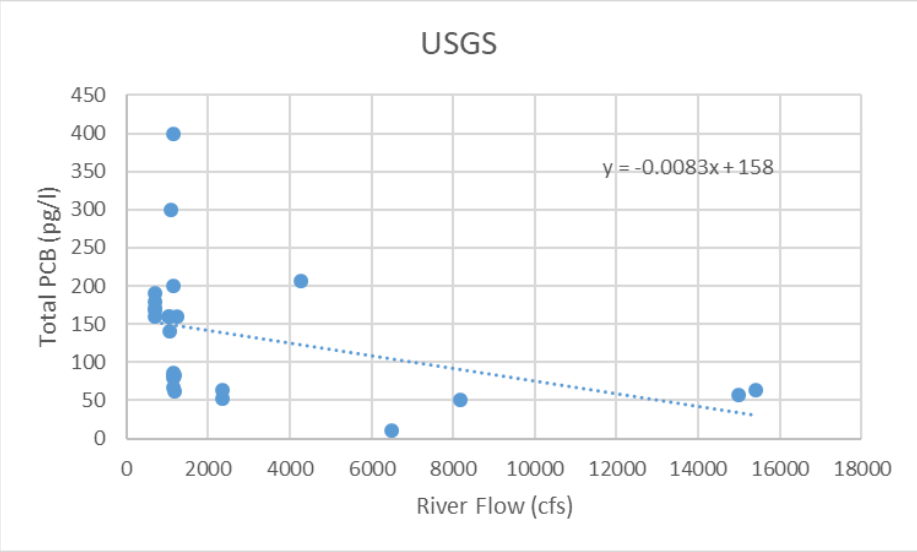
Station	Avg. Conc. (pg/l)	Std. Dev. (pg/l)	Coeff. of Variation
Nine Mile	126.9	57.8	0.5
USGS Gage	138.2	87.7	0.6
Greene St.	109.1	65.3	0.6
Below Upriver Dam	93.9	24.4	0.3
Trent/Plante's	97.4	77.1	0.8
Mirabeau	27.6	67.7	2.5
Barker Rd.	20.9	25.5	1.2
Lake CdA	17.2	14.7	0.9

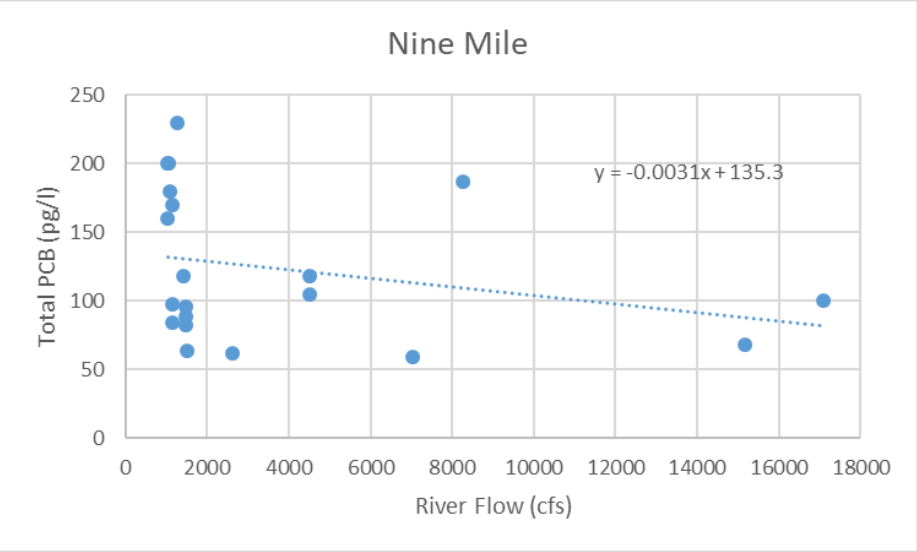
Factors Contributing to Variance

- Measurement uncertainty
  - Inherent when ambient concentrations are a similar order of magnitude as laboratory blank contamination
- Variability in loading
- Variability in upstream flow

Relationship of Concentration to River Flow

- Concentrations at downstream locations are negatively correlated to river flow

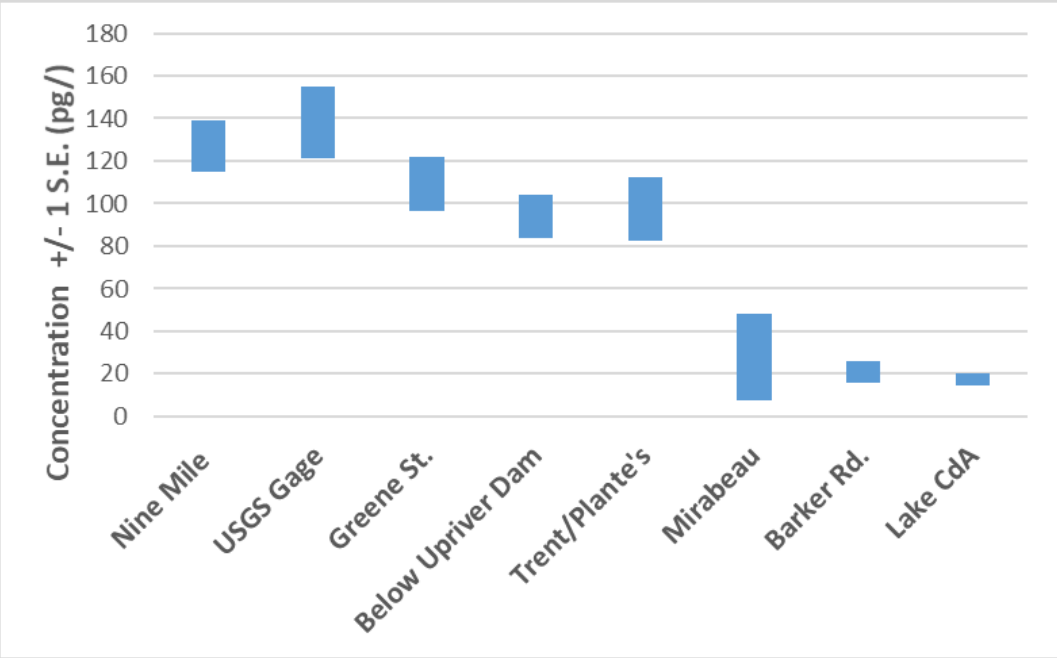




- Higher river flow provides more dilution of continuous (flow-independent) source
  - Potentially relevant to trend analyses

Water Column Status

- Uncertainty in averages decreases as the amount of data increases
  - Standard error of the mean = Standard deviation /√n



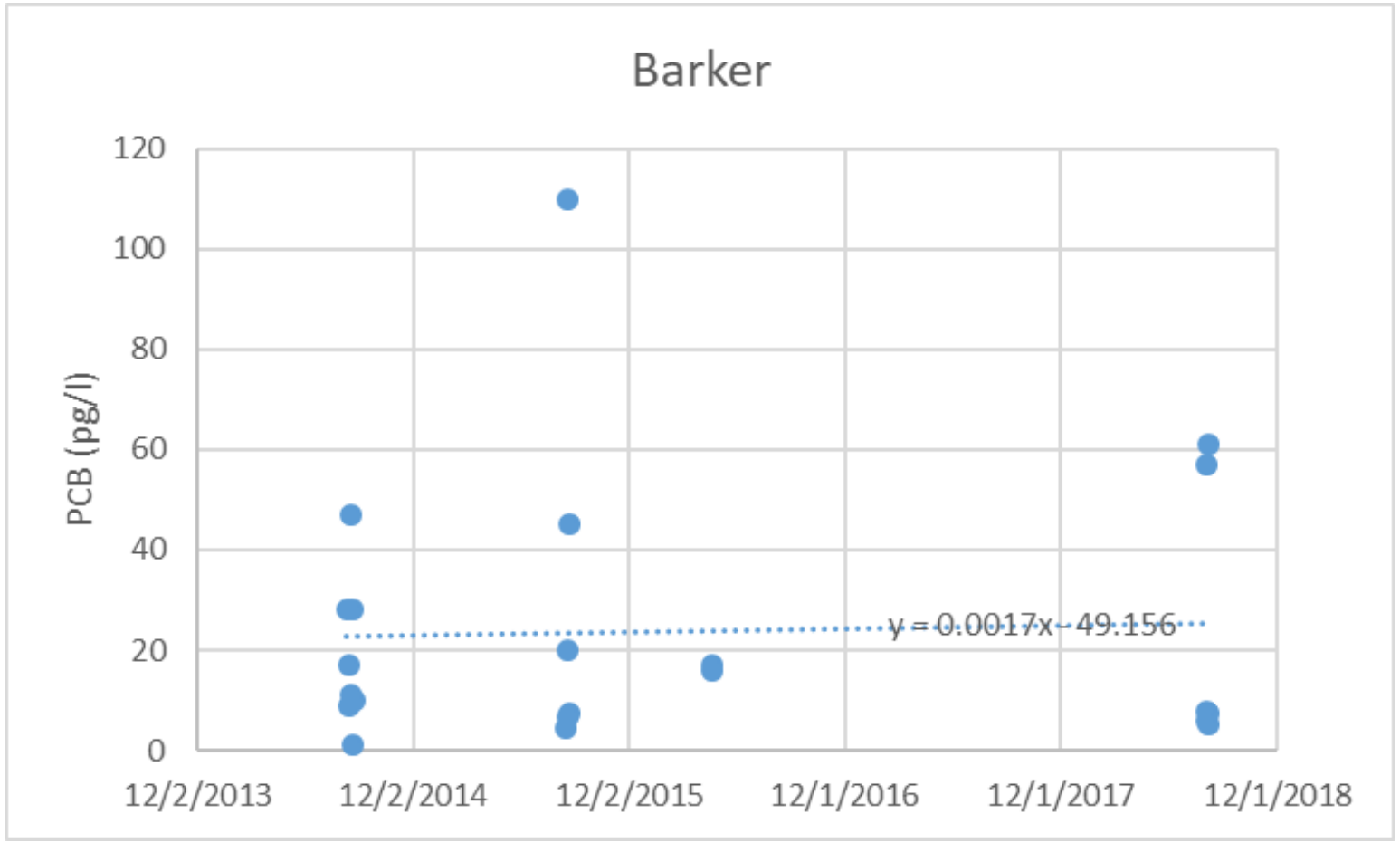
Station	Avg. Conc. (pg/l)	Std. Error (pg/l)	n
Nine Mile	126.9	12.3	22
USGS Gage	138.2	16.9	27
Greene St.	109.1	12.6	27
Below Upriver Dam	93.9	9.9	6
Trent/Plante's	97.4	15.1	26
Mirabeau	27.6	20.4	11
Barker Rd.	20.9	5.3	23
Lake CdA	17.2	3.1	23

Trend Analysis: Task Summary

- Are concentrations decreasing over time?
- Data analyzed at four sites
  - Barker Rd.
  - Trent Ave./Plante's Ferry
  - USGS Gage
  - Nine Mile
- Two standard statistical tests applied
  - Linear regression
  - Mann-Kendall non-parametric

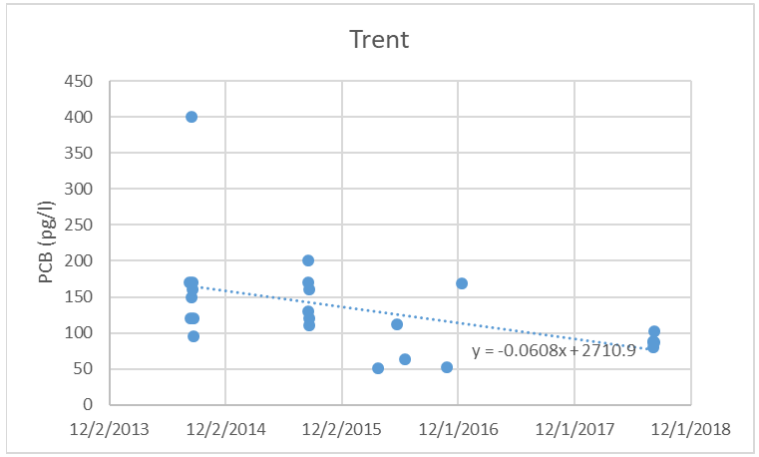
Trend Analysis: First Cut

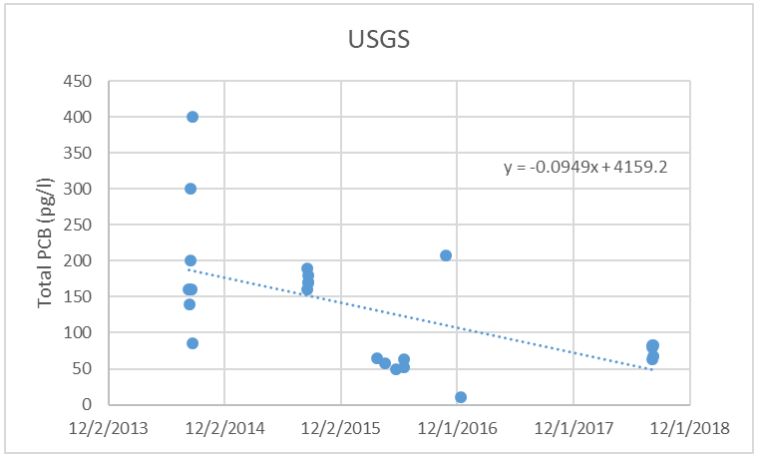
- No significant temporal trend at Barker Rd.

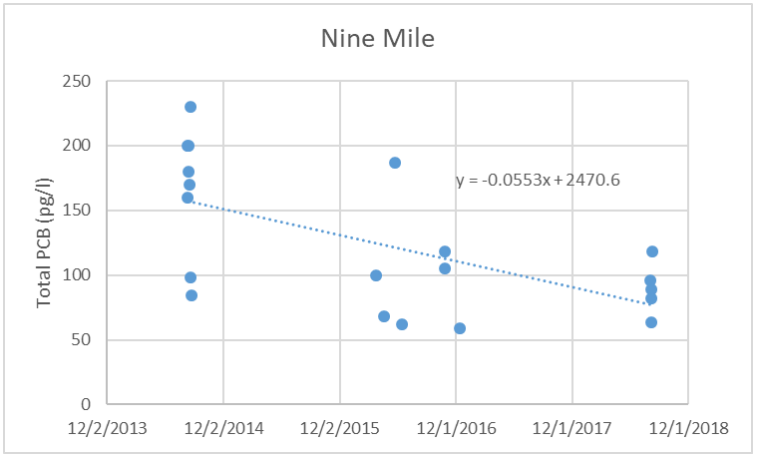


Trend Analysis: First Cut

- Significant decreasing trend at Trent, USGS, and Nine Mile

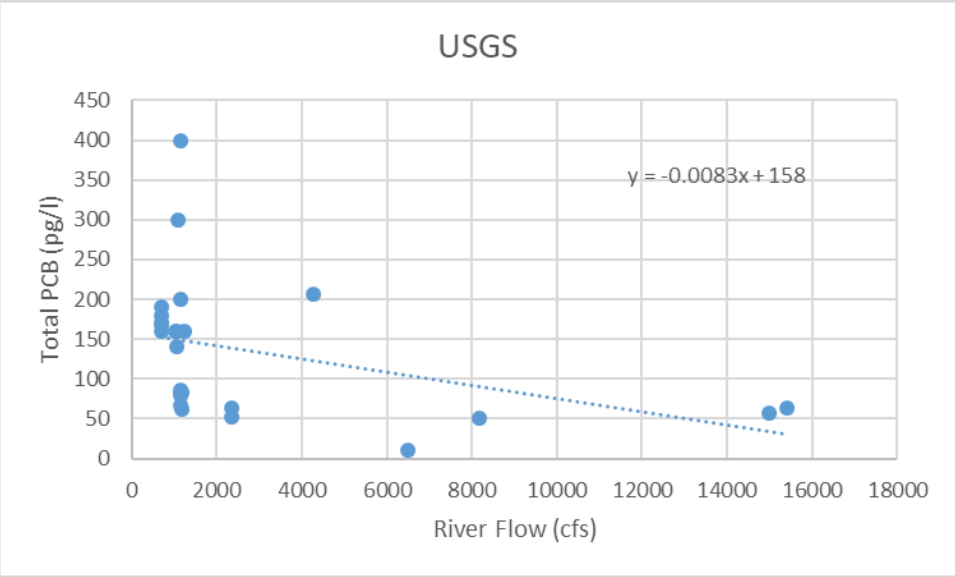


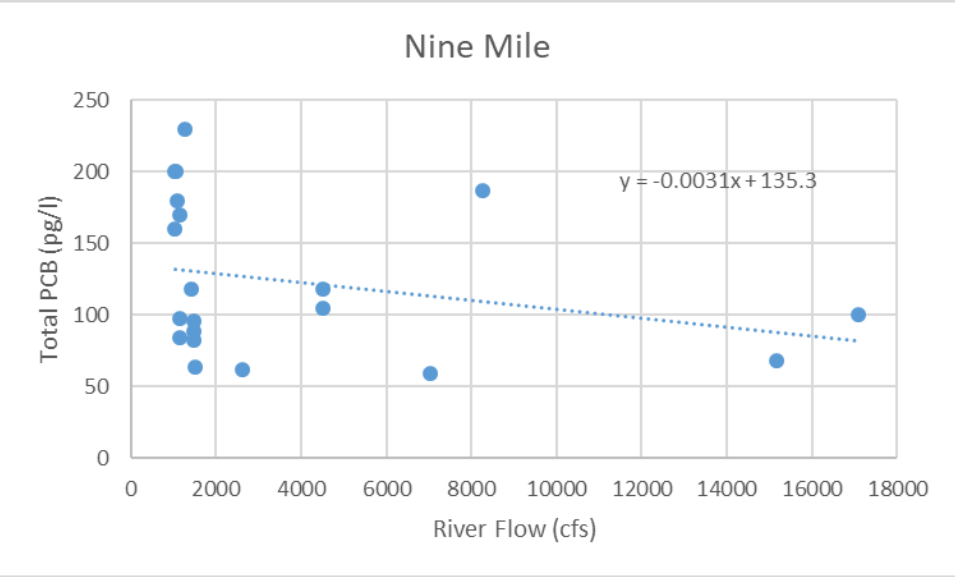




Dependency of Concentration on River Flow

- Downstream concentrations negatively correlated to river flow

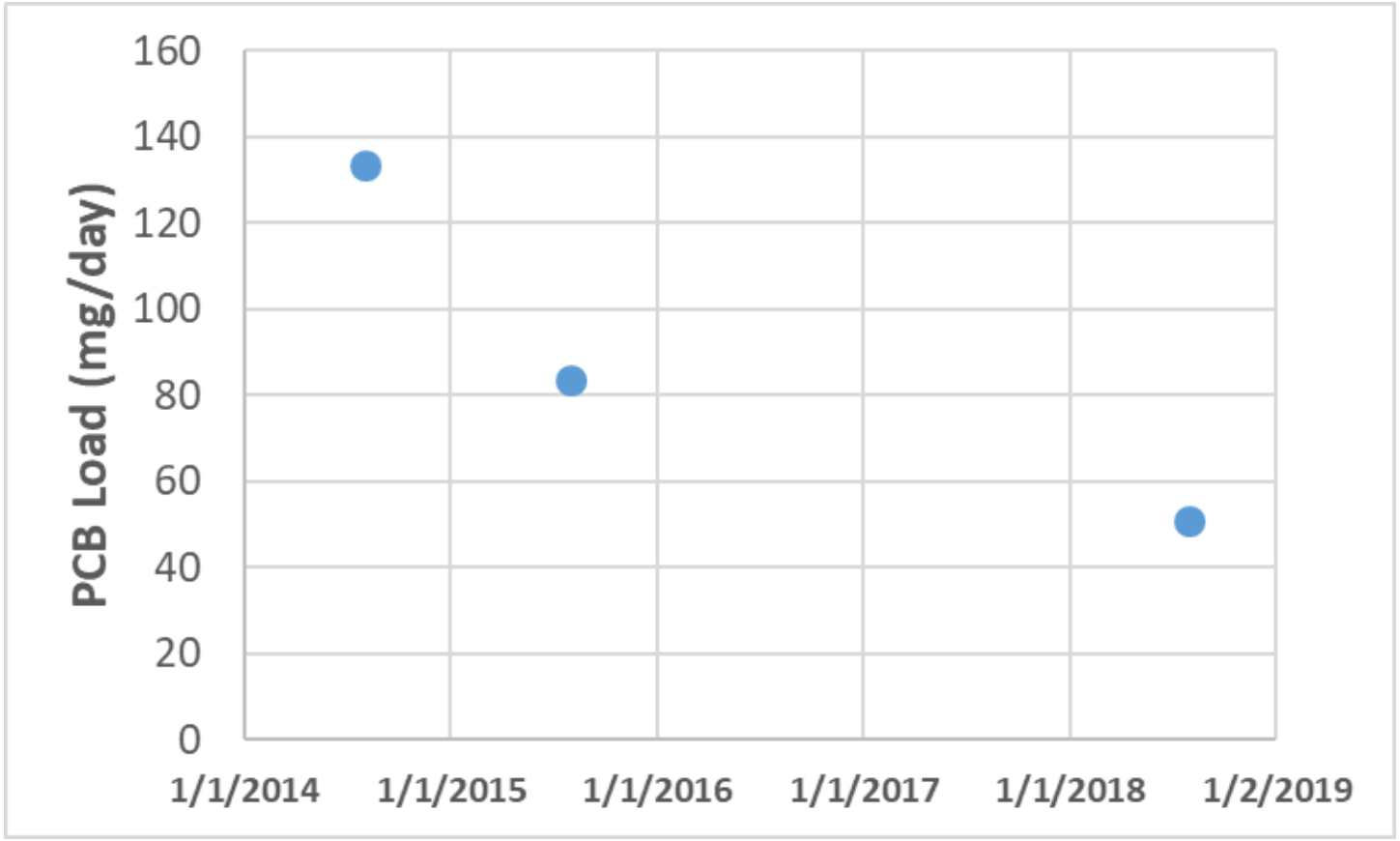




- Higher river flow during 2018 provides more dilution
  - Repeat trend analyses with concentrations normalized to observed river flow
  - Significant trend still exists

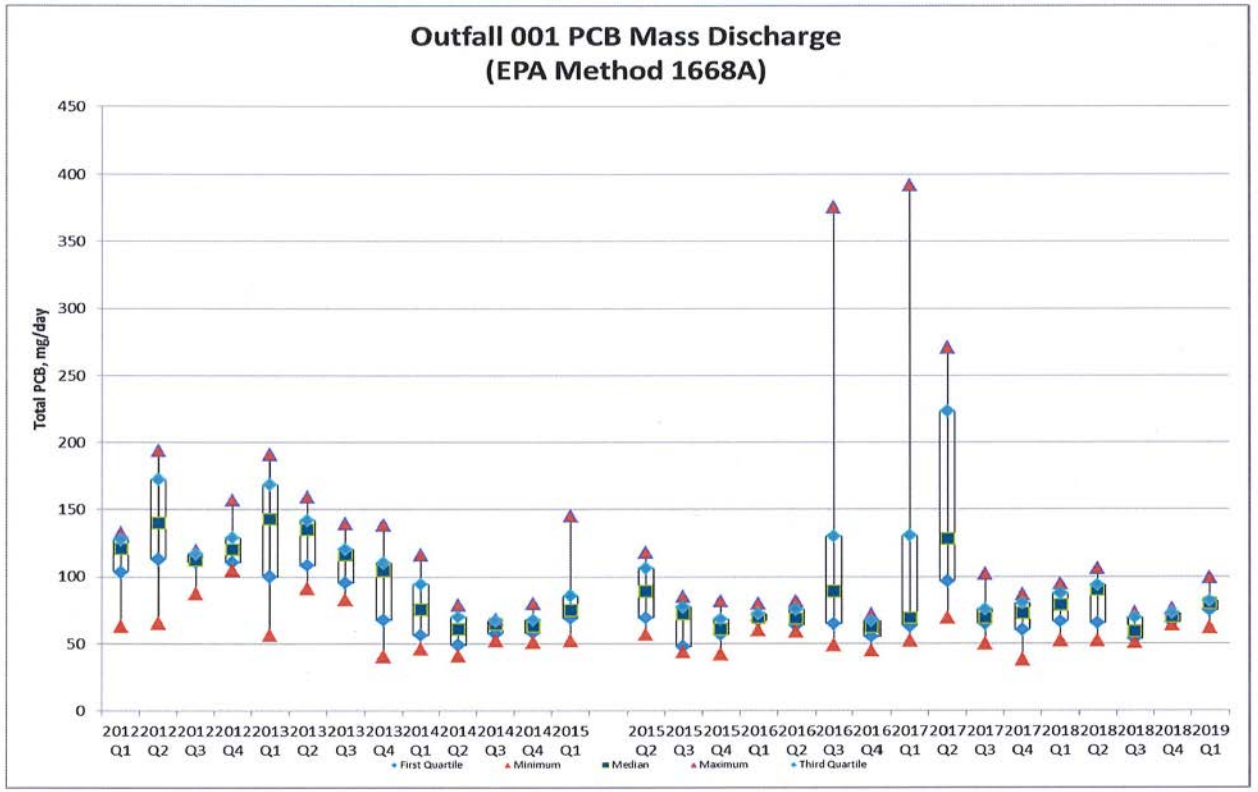
Are Concentrations Really Improving?

- Examine change in PCB loads between 2014, 2015 and 2018 surveys
- Kaiser load varies significantly across synoptic surveys



Are Concentrations Really Improving?

- Examine change in Kaiser PCB loads between 2012-2019
  - Large decrease in load observed between synoptic surveys may have been an artifact
  - If so, observed decreasing trend in concentrations may also be an artifact

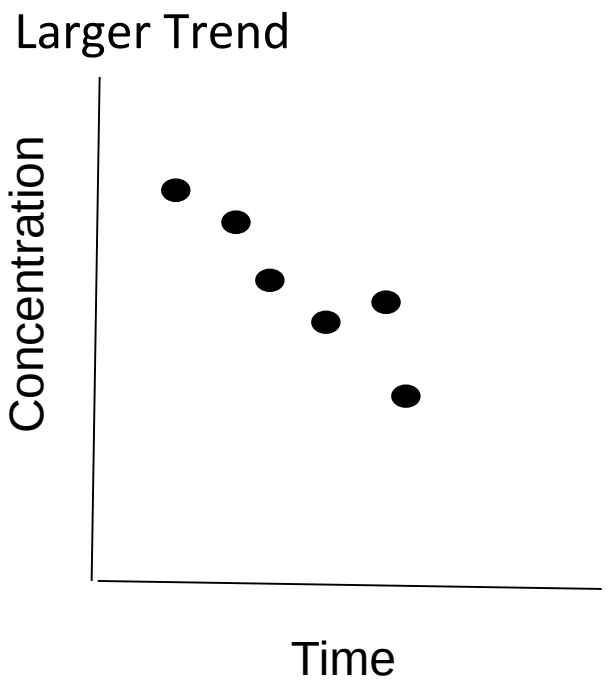


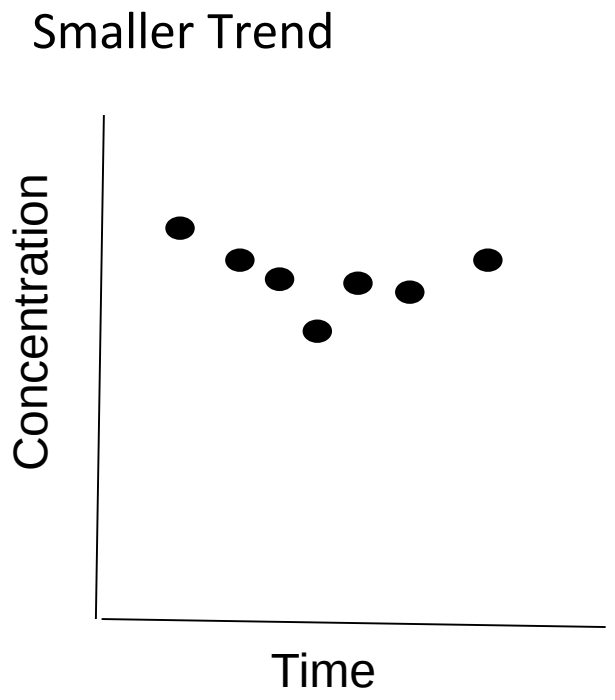
How Much Data Do We Need to Discern a Trend?

- Depends on two aspects of the data
  - Magnitude of the trend
  - Variability in the data

How Much Data Do We Need to Discern a Trend?

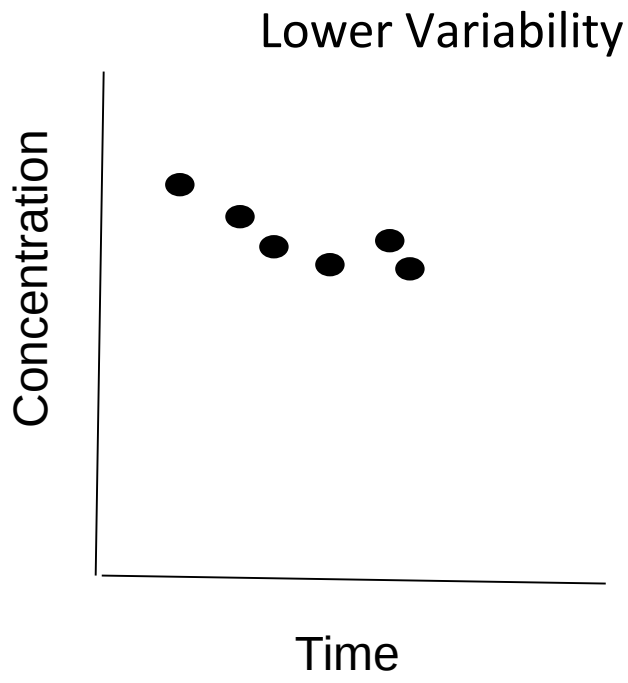
- Depends on two aspects of the data
  - Magnitude of the trend
    - Larger trends can be discerned more quickly than gradual changes

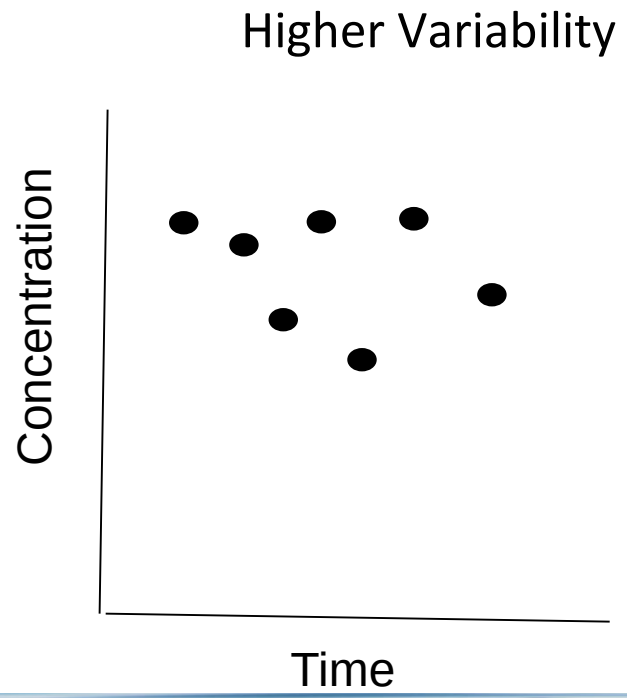




How Much Data Do We Need to Discern a Trend?

- Depends on two aspects of the data
  - Magnitude of the trend
  - Variability of the data
    - It takes longer to determine a trend if data are noisy





How Much Data Do We Need to Discern a Trend?

	Number of Years Required to Detect 10% Per Year Change	
Sampling Frequency	Low Variability (cv =0.2)	High Variability (cv =1.0)
Weekly	1.4	2.0
Monthly	2.6	7.8
Three per year	4.8	13.3
Annually	7.9	17.8

Trend Analysis Conclusions

- Simple statistical analysis concludes that concentrations are decreasing over time at Plante's Ferry and downstream stations
  - No significant trend at Barker Rd.
- More detailed look at data is less conclusive
- It will take a large amount of data to conclusively show a trend exists
  - Existing data have fairly high variability
  - Larger decreases will be easier to discern
  - Confounding factors may need to be accounted for