

# **Guadalupe River Loads WY 2010 update**

**Lester McKee, Jennifer Hunt, Ben Greenfield**

**San Francisco Estuary Institute, Oakland, CA**

RMP Sources, Pathways, and Loadings Workgroup  
May 12, 2011

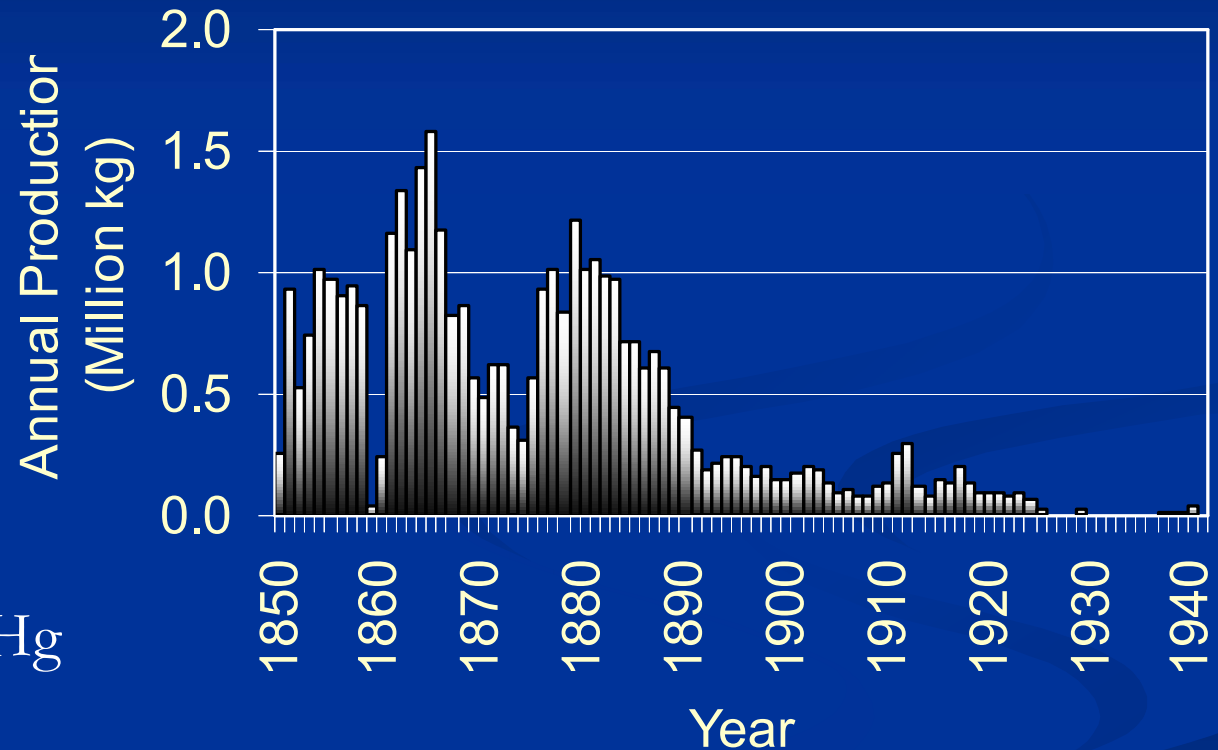
# Impetus for WY 2010

- The Santa Clara Valley Water District (SCVWD) permit and others in the Guadalupe
  - Monitor mercury loads to gauge progress towards attainment of Hg TMDL loads allocations
  - 91% reduction from the estimated 106.5kg base line
  
- In addition – RMP member agencies were interested in learning more about:
  - Distribution of PCBs in the watershed
  - Dioxins in urban and non-urban areas



# New Almaden Historic Mining District

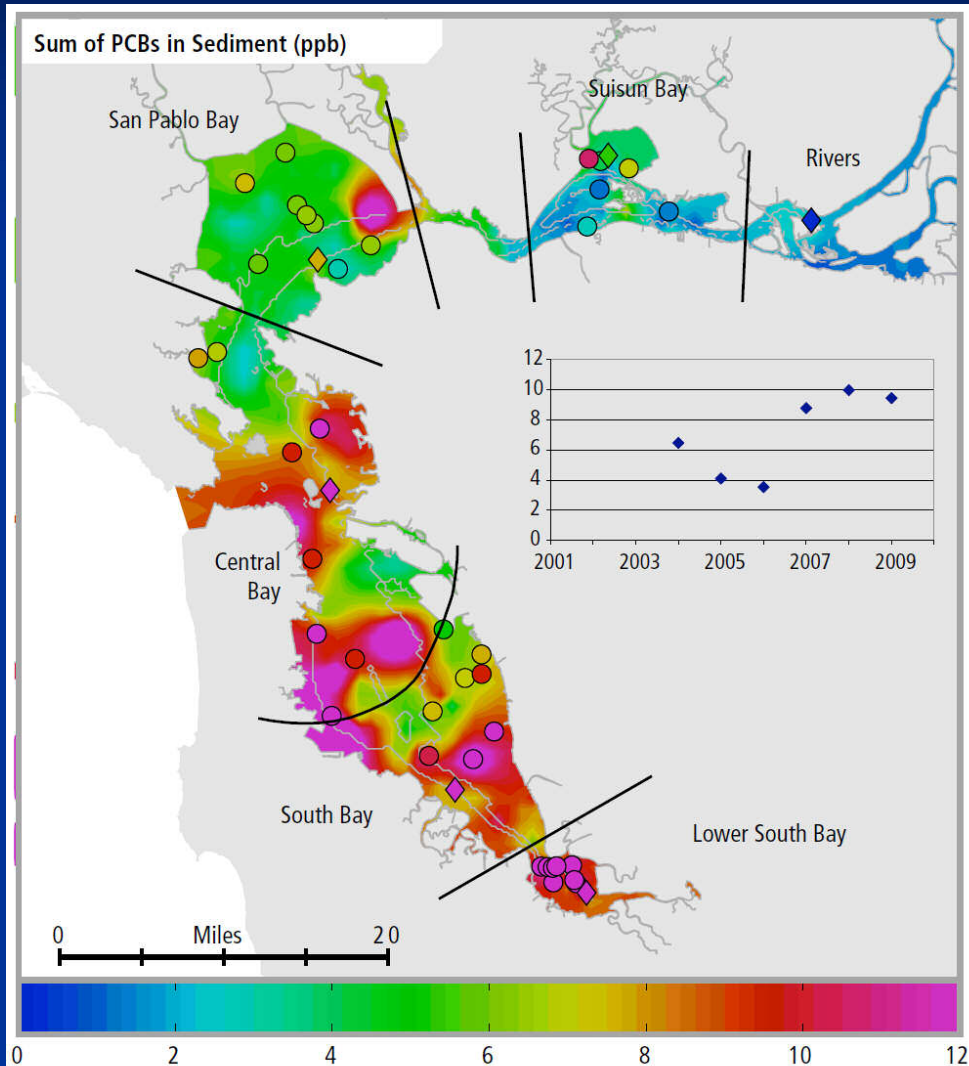
(Now the Almaden Quicksilver County Park)



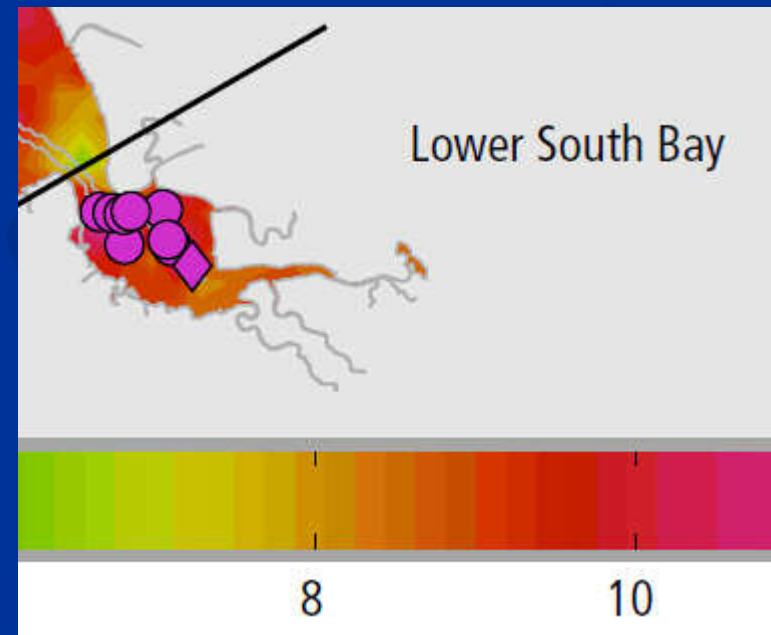
- Largest producer of Hg in North America
- Peak Production 1865: 1.6 million kg
- Total Production: 1845 – 1975: 38 million kg



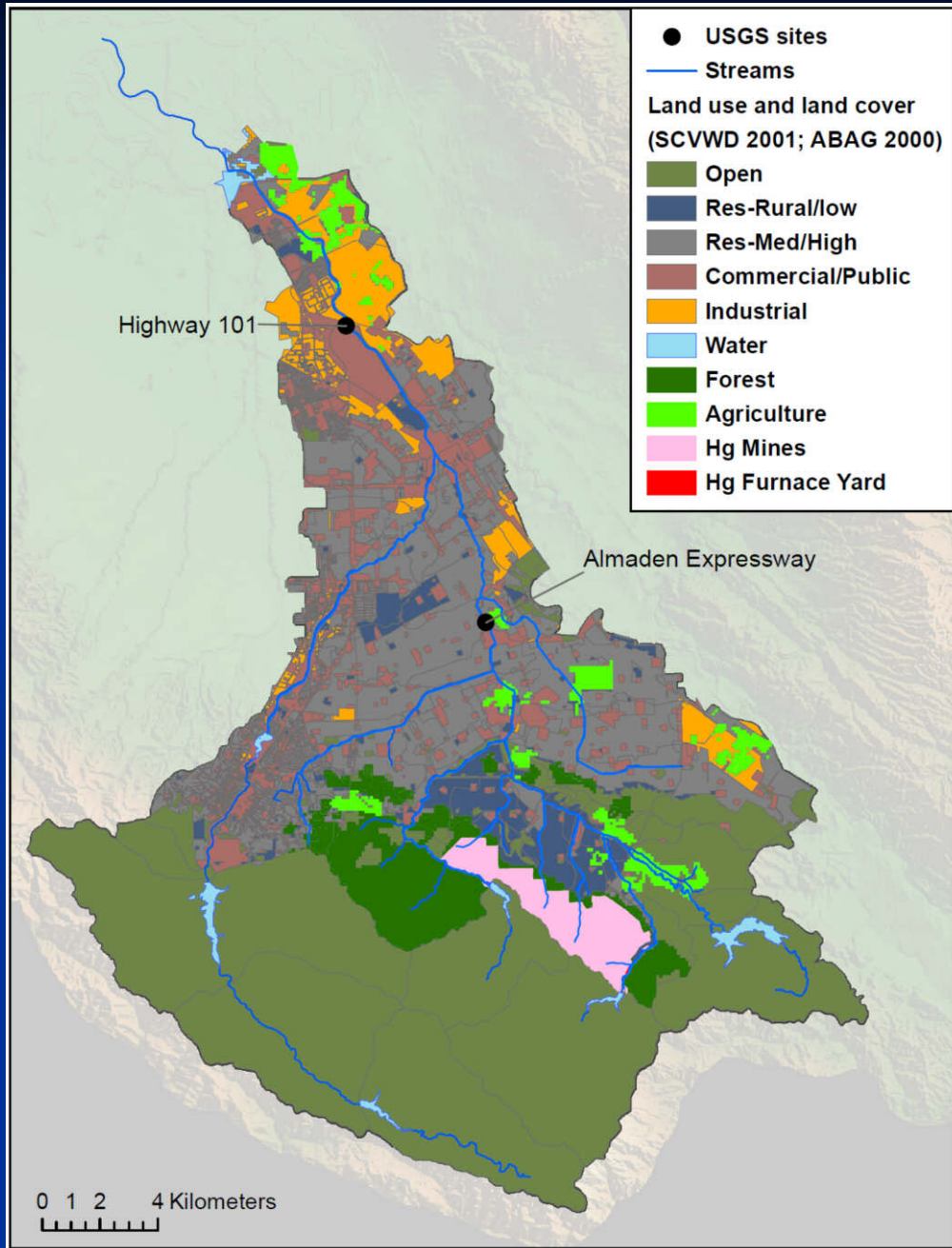
# South Bay PCBs are also high



Footnote: Map plot based on 282 RMP data points from 2004 – 2009. Data from 2002 and 2003 are not available. The maximum concentration was 30 ppb in South Bay in 2008. Trend plot shows annual Bay-wide averages. Colored symbols show results for samples collected in 2009. Circles represent random sites. Diamonds represent historic fixed stations.



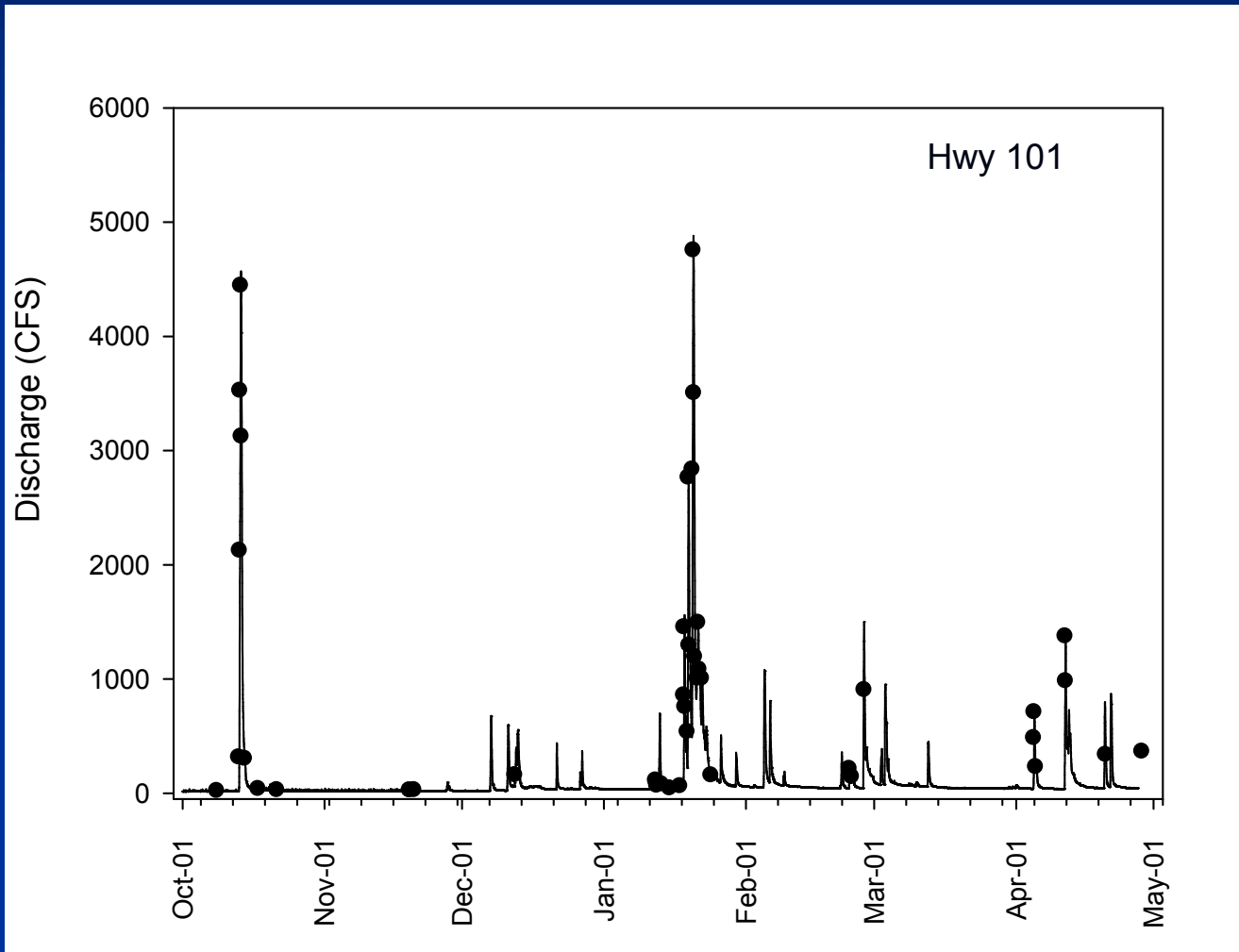
## Agenda Item #4



# Sampling locations and land use



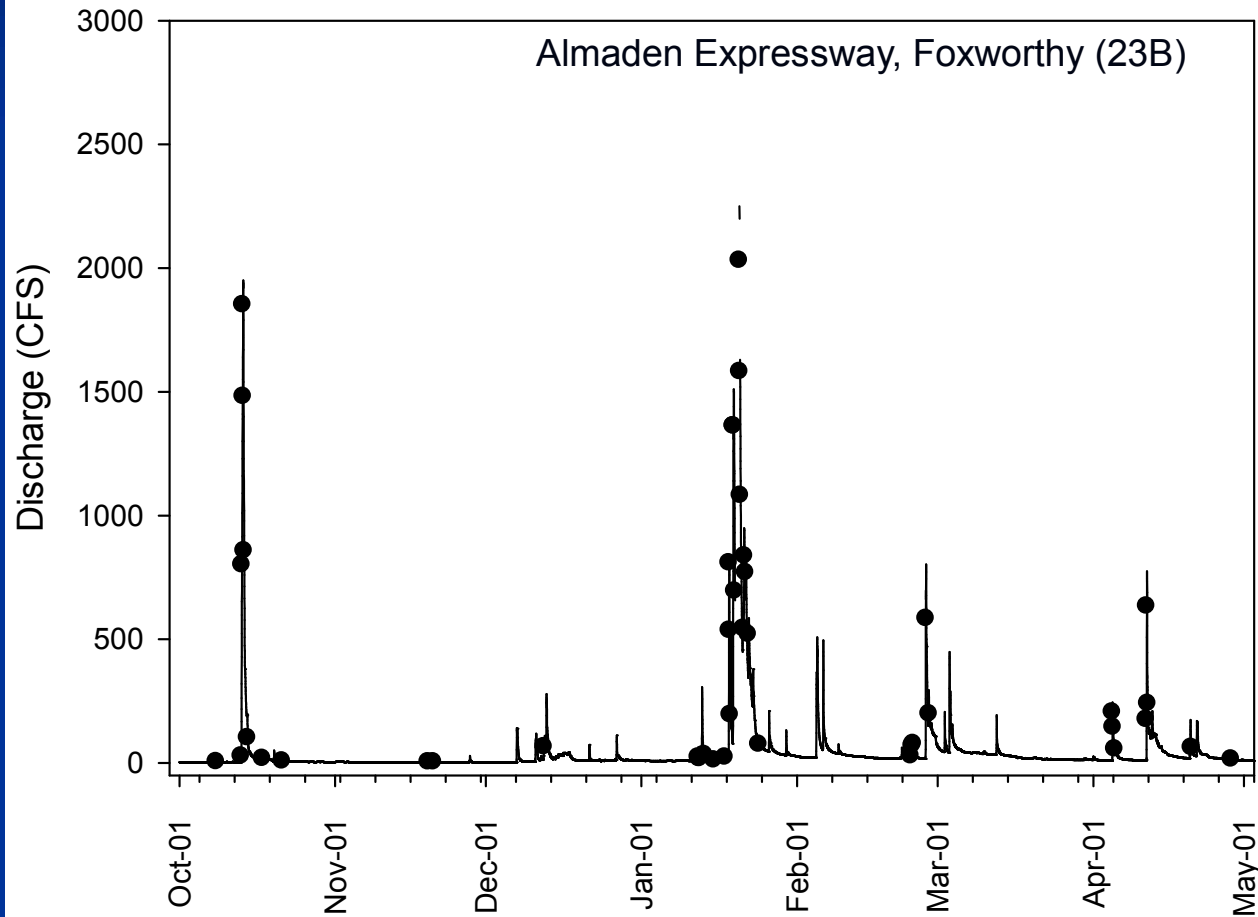
# WY 2010 Sample collection



- 16 storms sampled, base flow, rise, peak, and fall
  - Including the October storm – a rare long duration event
- Base flow during two dry weather periods



# WY 2010 Sample collection



- 16 storms sampled, base flow, rise, peak, and fall
- Including the October storm – a rare long duration event
- Base flow during two dry weather periods





# Sampling team

(n=19)

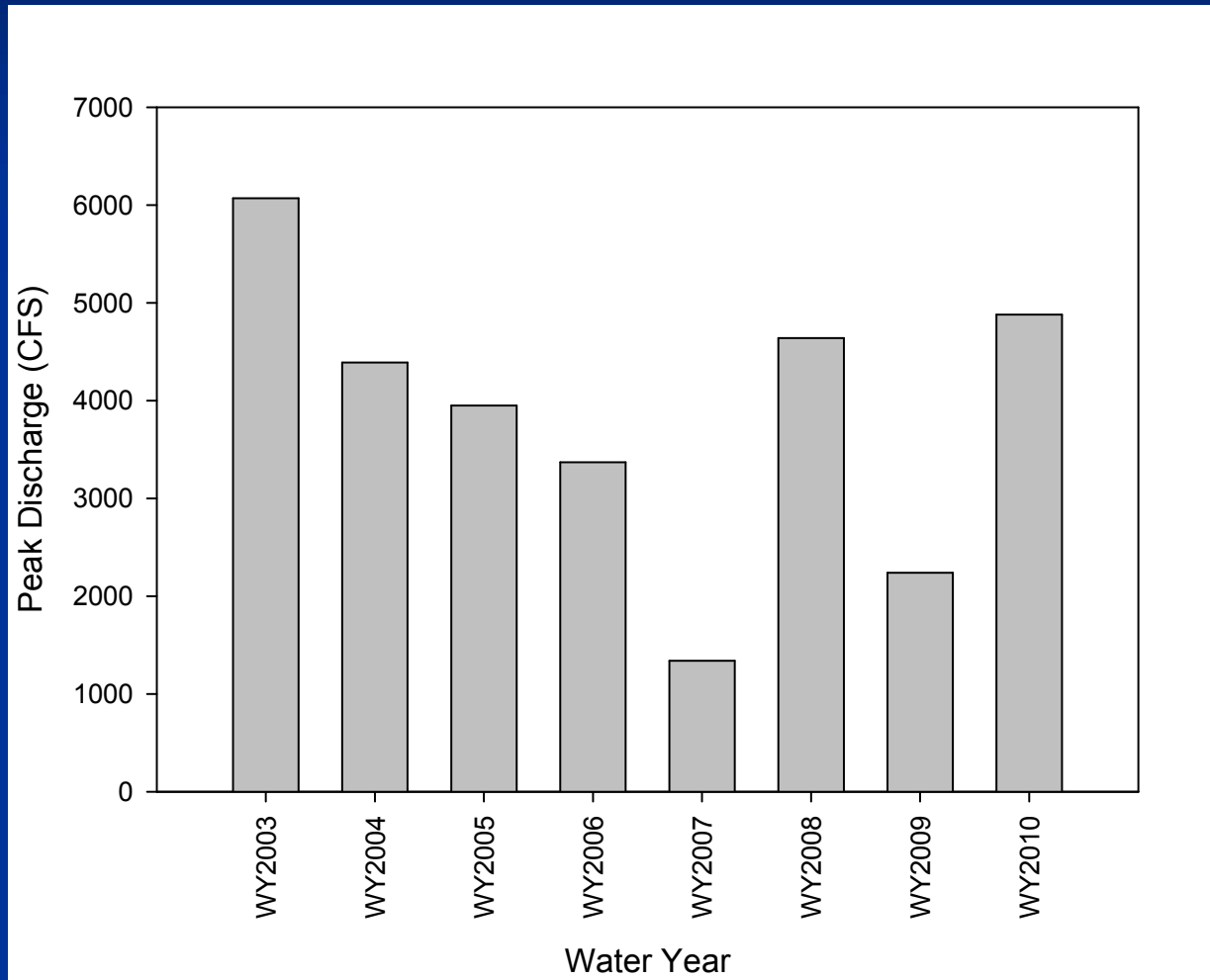
- Nicole David\*
- Donald Yee\*
- Sarah Pearce\*
- Sarah Lowe\*
- Michelle Lent
- Meredith Williams
- Rachel Allen\*
- Annie Bellows
- Paul Crozier
- Jennifer Hunt\*
- Lester McKee\*
- Ben Greenfield\*
- Lawrence Leung
- Kat Ridolfi
- Amy Franz
- Marcus Klatt
- Gregory Tseng
- Anastasia Ennis
- Brandy Garland

\* = field leader





# The Water Year in Context



4880 cfs Jan 20<sup>th</sup>  
2010 at 1:15 pm  
(2.5 hours later  
than Almaden  
Exwy)

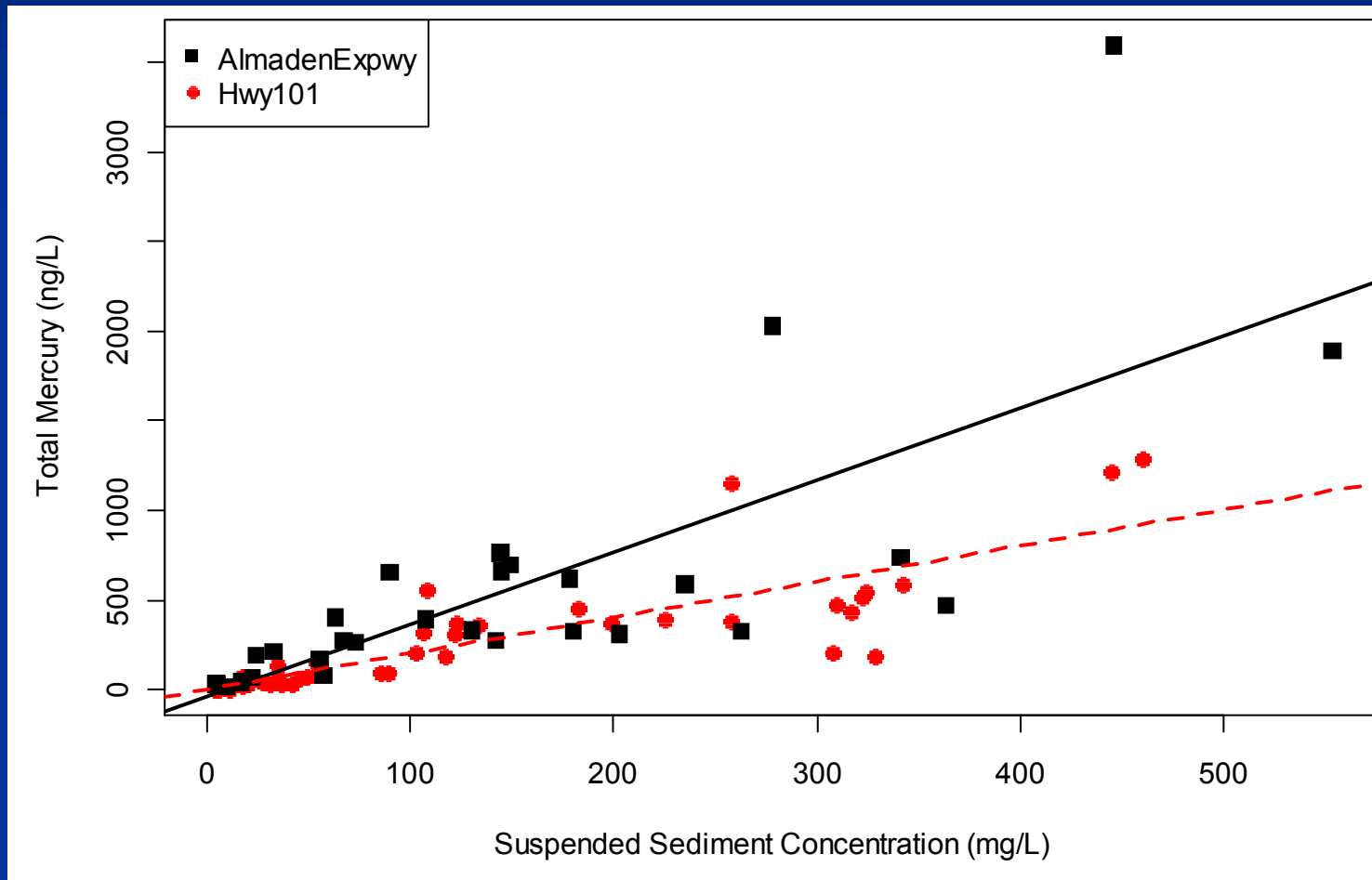


# Data Summary

|                                | Highway 101<br>(Lower site) | Almaden Expressway<br>(Upper site) |
|--------------------------------|-----------------------------|------------------------------------|
| Total mercury (ng/L)           |                             |                                    |
| Minimum                        | 5.2                         | 7.4                                |
| Maximum                        | 1290                        | 3590                               |
| FWMC                           | 274                         | 553                                |
| Total dissolved mercury (ng/L) |                             |                                    |
| Minimum                        | 0.64                        | 2.1                                |
| Maximum                        | 21.5                        | 27.5                               |
| FWMC                           | 6.3                         | 20                                 |
| Total methylmercury (ng/L)     |                             |                                    |
| Minimum                        | 0.06                        | 0.21                               |
| Maximum                        | 2.51                        | 2.38                               |
| FWMC                           | 0.47                        | 0.90                               |
| Dissolved methylmercury (ng/L) |                             |                                    |
| Minimum                        | 0.028                       | 0.05                               |
| Maximum                        | 0.179                       | 0.77                               |
| FWMC                           | 0.079                       | 0.18                               |



# HgT concentrations between the upper and lower sites



# Relationships between parameters

|           | Discharge | SS   | Turbidity | POC  | DOC  | HgT  | HgD  | MeHgT |
|-----------|-----------|------|-----------|------|------|------|------|-------|
| SS        | 0.88      |      |           |      |      |      |      |       |
| Turbidity | 0.88      | 0.86 |           |      |      |      |      |       |
| POC       | 0.78      | 0.90 | 0.82      |      |      |      |      |       |
| DOC       | 0.41      | 0.46 | 0.52      | 0.56 |      |      |      |       |
| HgT       | 0.85      | 0.89 | 0.91      | 0.85 | 0.56 |      |      |       |
| HgD       | 0.39      | 0.48 | 0.56      | 0.48 | 0.66 | 0.68 |      |       |
| MeHgT     | 0.65      | 0.74 | 0.80      | 0.73 | 0.66 | 0.85 | 0.68 |       |
| MeHgD     | -0.04     | 0.17 | 0.13      | 0.11 | 0.35 | 0.30 | 0.69 | 0.50  |



# Loads Calculation Methods

- Turbidity surrogate regression (15 min discharge and turbidity)
- Linear interpolation (Preferred method for contaminants)
- Equipment failures
  - Hwy 101 Non storm loads: October 1st 2009 to January 13th 10:45 am, 2010 turbidity probe malfunction. Estimation using a discharge versus SSC regression estimator
  - Almaden Expressway Storm loads January 19th at 3:30 pm to January 20th at 3:30 pm loss of continuous discharge and turbidity data. Spot data obtained at 1:15 am, 5 am, 10:15 am, and 1:30 pm. Linear interpolation was used to fill the data gaps.



# Mercury Loads at Hwy 101

|     | Discharge<br>(Avg cfs) | SS load<br>(metric t) | HgT<br>(kg) | MeHgT<br>(g) | MeHg<br>(%HgT) | HgD<br>(g) | HgD<br>(%HgT) | MeHgD<br>(g) | MeHgD<br>(%HgT) |
|-----|------------------------|-----------------------|-------------|--------------|----------------|------------|---------------|--------------|-----------------|
| Oct | 96                     | 1608                  | 2.51        | 4.51         | 0.18           | 51.9       | 2.1           | 0.602        | 0.02            |
| Nov | 21                     | 19.4                  | 0.027       | 0.276        | 1.01           | 4.36       | 16.0          | 0.090        | 0.3             |
| Dec | 65                     | 250                   | 0.479       | 1.83         | 0.38           | 35.0       | 7.3           | 0.422        | 0.09            |
| Jan | 258                    | 3979                  | 9.48        | 11.4         | 0.12           | 157.5      | 1.7           | 1.60         | 0.017           |
| Feb | 109                    | 441                   | 1.07        | 2.85         | 0.27           | 41.8       | 3.9           | 0.558        | 0.052           |
| Mar | 77                     | 169                   | 0.414       | 1.98         | 0.48           | 20.7       | 5.0           | 0.451        | 0.11            |
| Apr | 102                    | 363                   | 0.836       | 2.75         | 0.33           | 31.8       | 3.8           | 0.548        | 0.07            |
|     |                        | 6829                  | 14.8        | 25.6         | 0.17           | 343        | 2.3           | 4.3          | 0.029           |



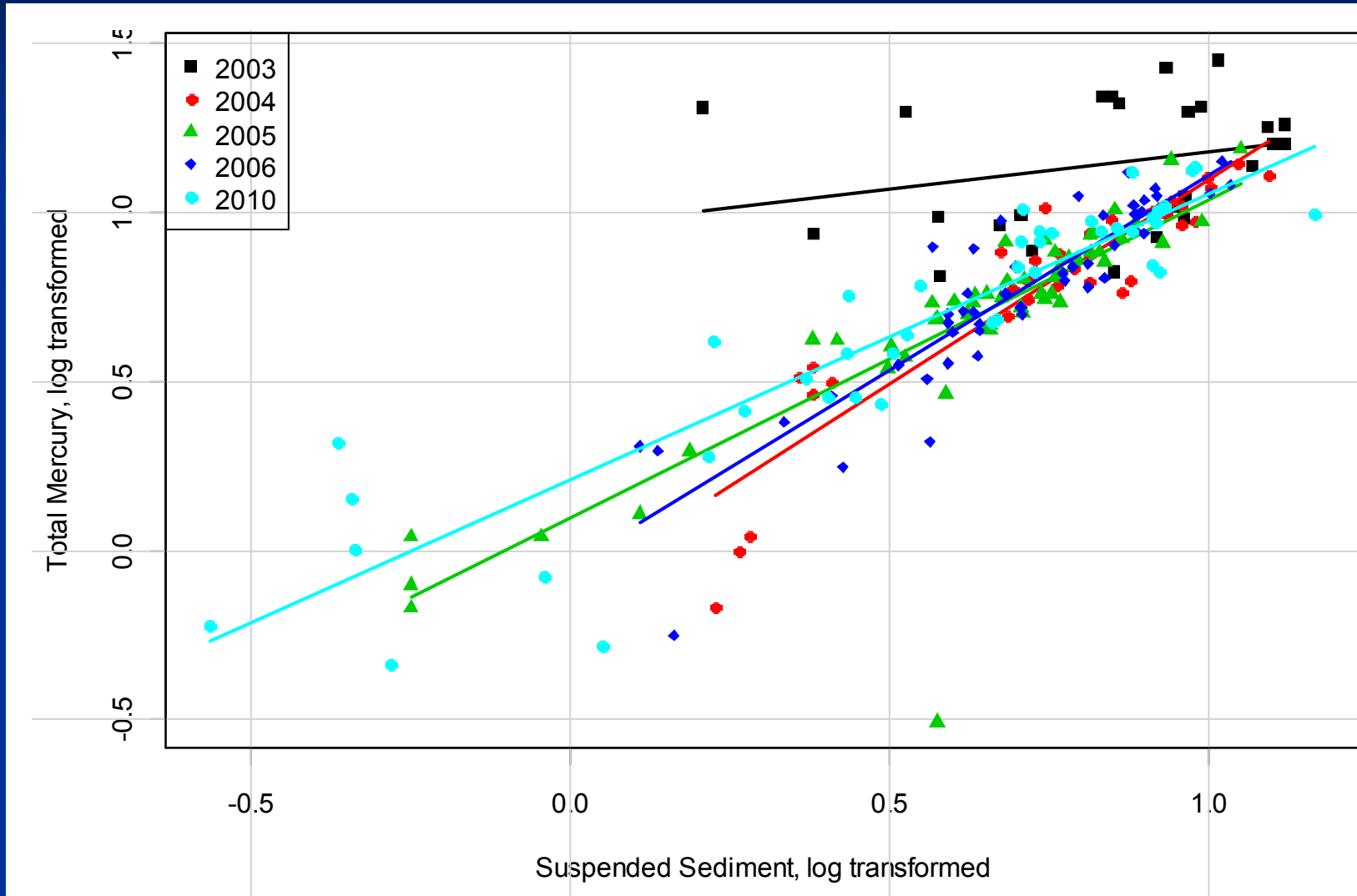
# Mercury Loads at Almaden Expressway

|     | Discharge<br>(Avg cfs) | SS load<br>(metric t) | HgT<br>(kg) | MeHgT<br>(g) | MeHg<br>(%HgT) | HgD<br>(g) | HgD<br>(%HgT) | MeHgD<br>(g) | MeHgD<br>(%HgT) |
|-----|------------------------|-----------------------|-------------|--------------|----------------|------------|---------------|--------------|-----------------|
| Oct | 35                     | 334                   | 0.83        | 2.83         | 0.34           | 35.3       | 4.3           | 0.478        | 0.06            |
| Nov | 3                      | 2                     | 0.0028      | 0.110        | 3.87           | 1.15       | 40.6          | 0.068        | 2.4             |
| Dec | 17                     | 28                    | 0.094       | 0.771        | 0.82           | 13.0       | 13.9          | 0.275        | 0.29            |
| Jan | 129                    | 1867                  | 10.01       | 11.1         | 0.11           | 255        | 2.5           | 1.67         | 0.017           |
| Feb | 49                     | 182                   | 0.79        | 2.30         | 0.29           | 68.5       | 8.7           | 0.624        | 0.079           |
| Mar | 33                     | 55                    | 0.25        | 1.45         | 0.58           | 31.5       | 12.5          | 0.474        | 0.19            |
| Apr | 35                     | 96                    | 0.37        | 1.60         | 0.44           | 36.3       | 9.9           | 0.478        | 0.13            |
|     |                        | <u>2563</u>           | <u>12.3</u> | <u>20.1</u>  | <u>0.16</u>    | <u>440</u> | <u>3.6</u>    | <u>4.1</u>   | <u>0.033</u>    |

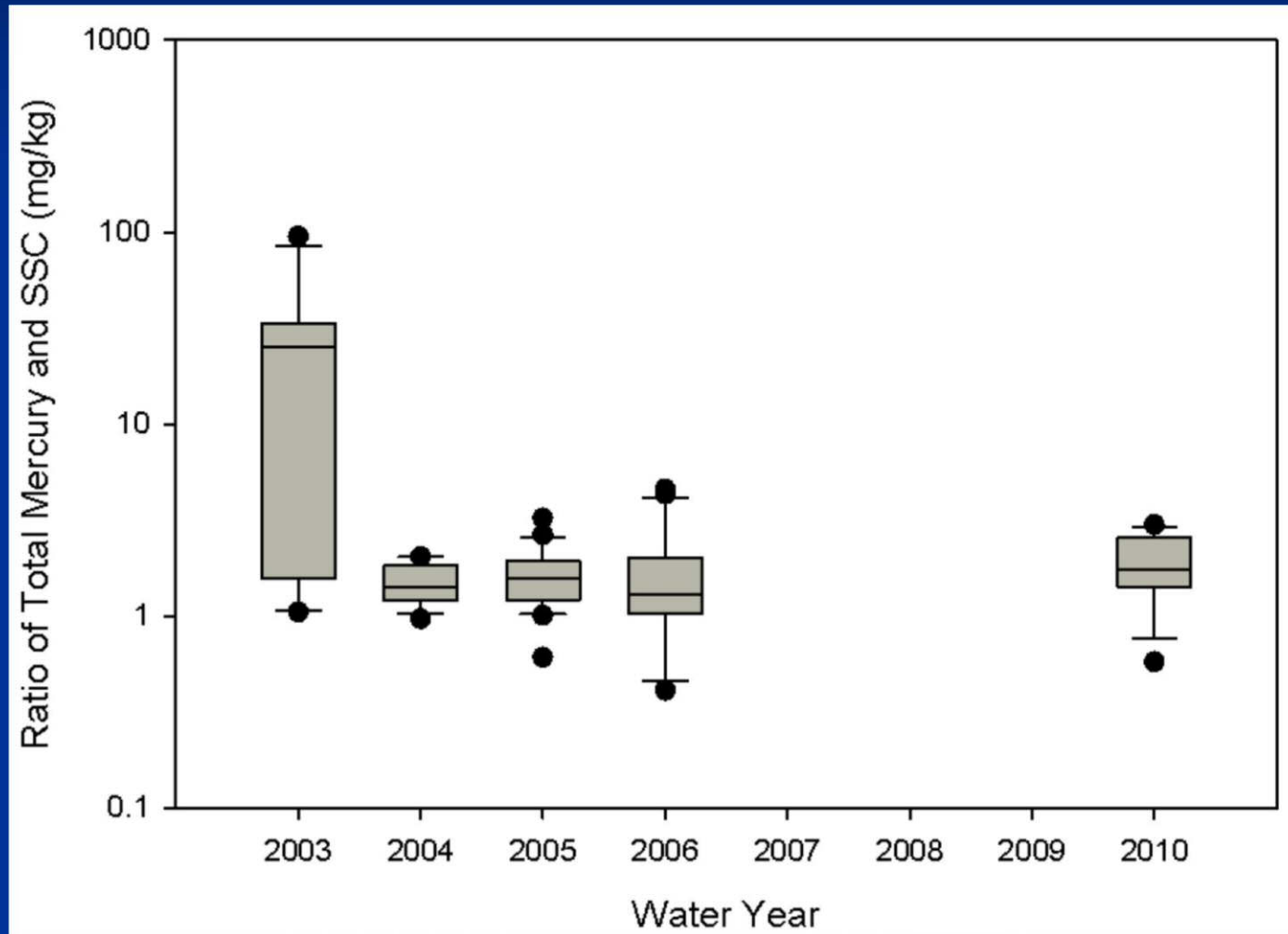




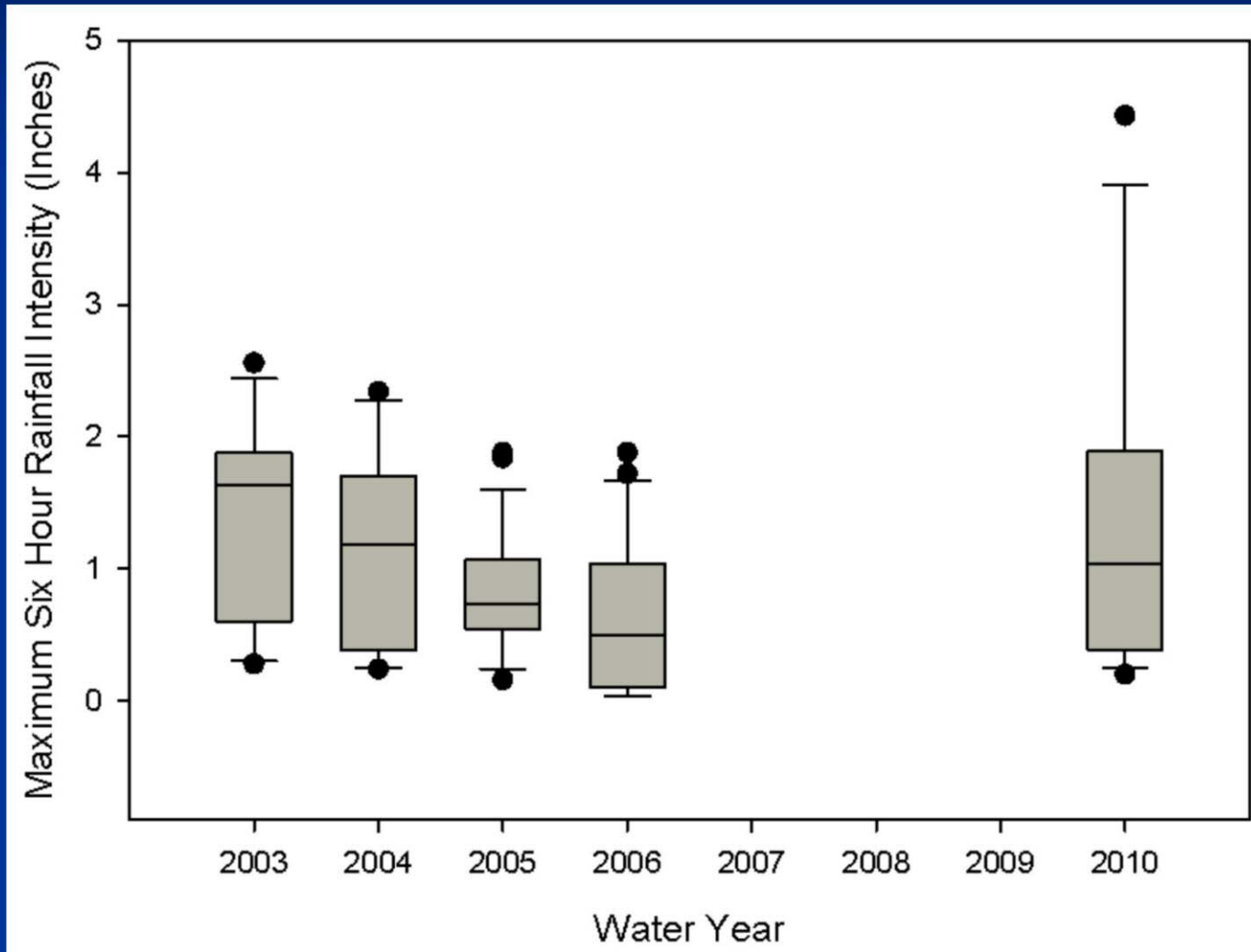
# Comparison to Previous Data



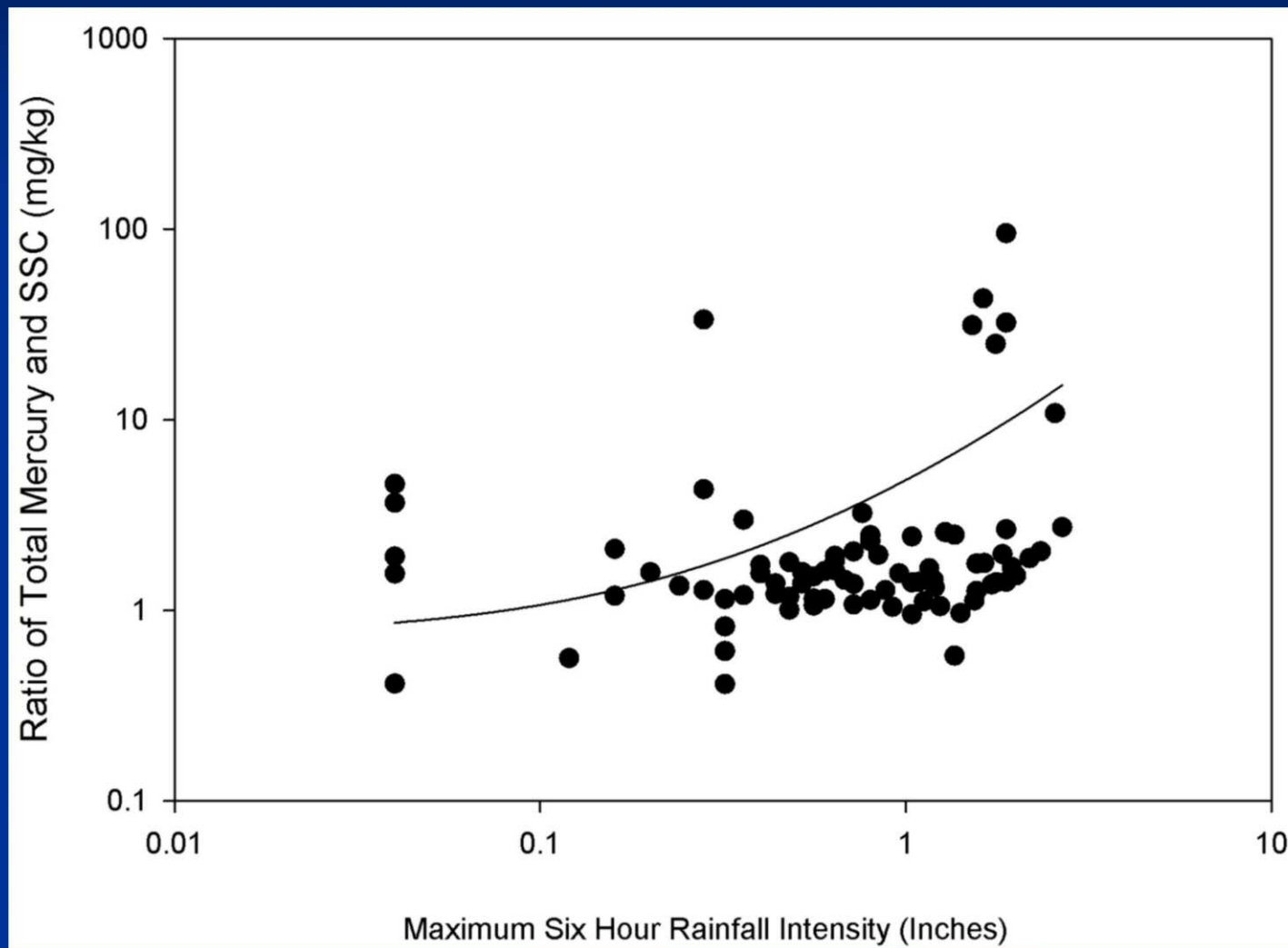
# Comparison to Previous Data



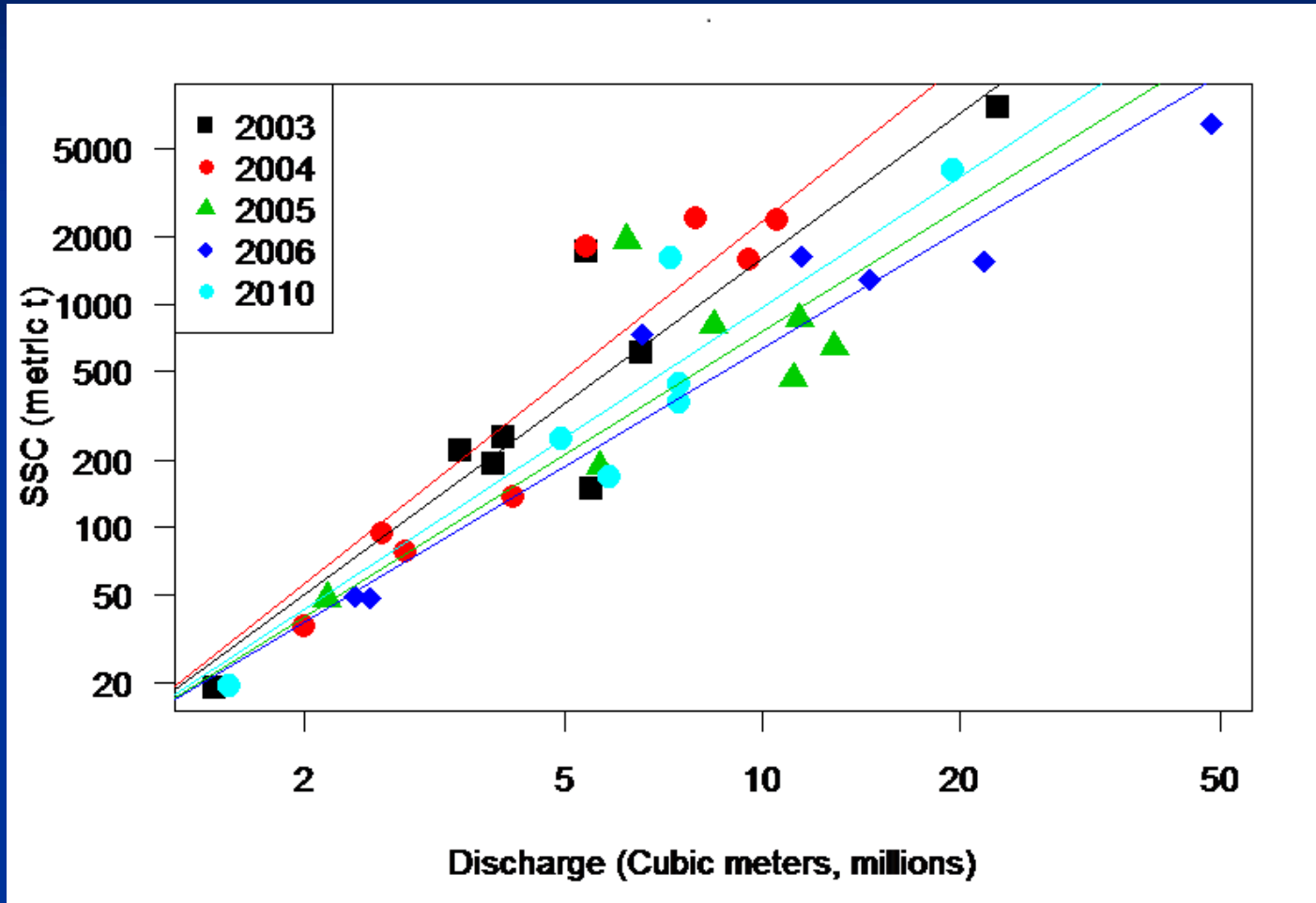
# Comparison to Previous Data



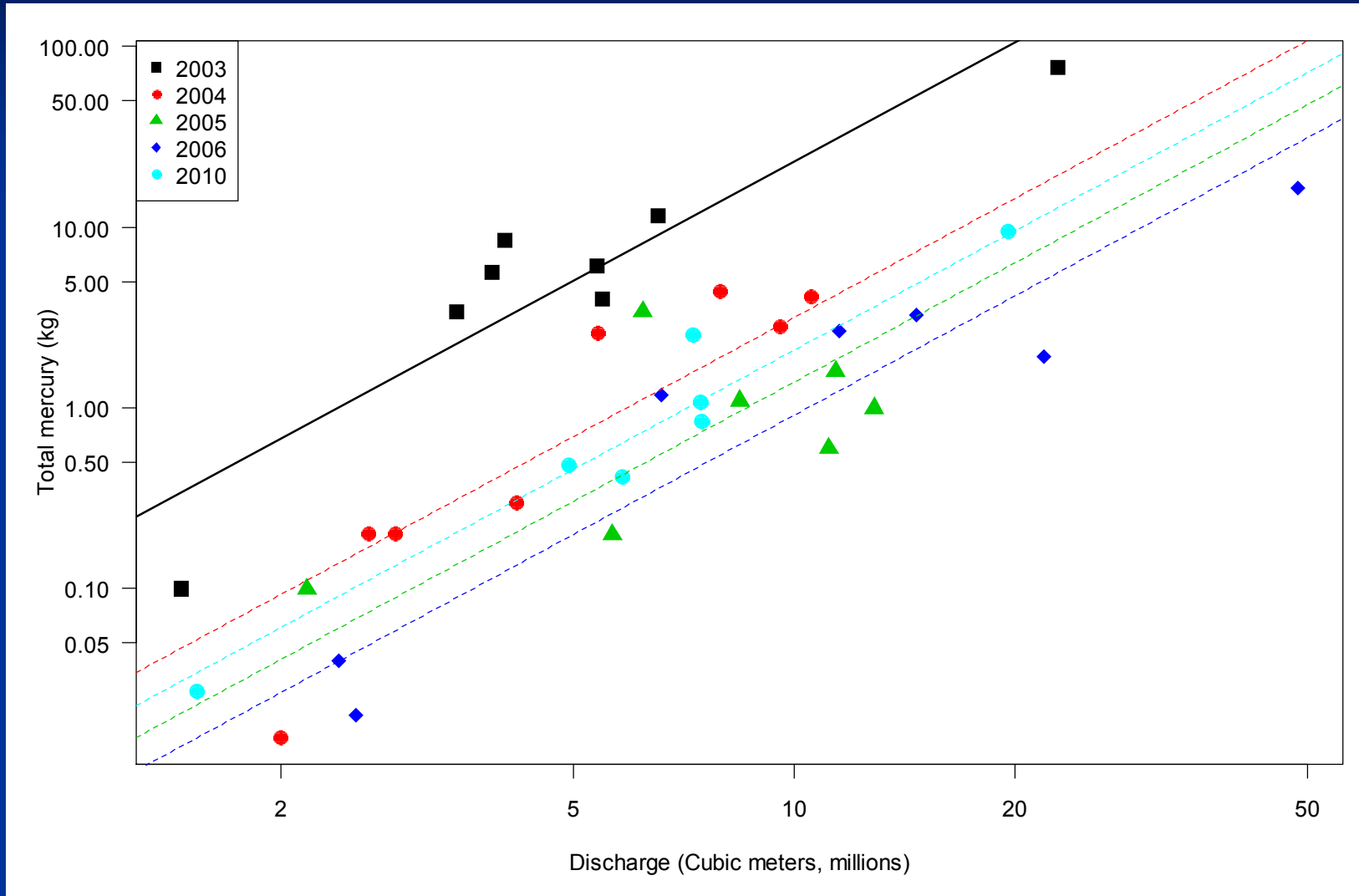
# Comparison to Previous Data



# Comparison to Previous Data



# Comparison to Previous Data



# Hg removal from SCVWD facilities

| Year      | Mercury Removed   |
|-----------|-------------------|
| 2004-2005 | 390 kg            |
| 2005-2006 | 31 kg             |
| 2006-2007 | 43 kg             |
| 2007-2008 | 100 kg            |
| 2008-2009 | 46 kg             |
| 2009-2010 | 327 kg – 1632 kg* |

\*Assuming that 12,000 cubic yards of soil has been removed at 20mg/kg – 100mg/kg, the amount of mercury removed would be in the range of 327 kg Hg – 1632 kg Hg.





# TMDL targets

- Loads target (9.8 kg) was nearly met for WY 2010 at Hwy 101
- Particle target (0.2 mg/kg) was exceeded by about 10 x

| Water Year | Suspended sediment (metric t) | Total Mercury (kg) | Mean particulate mercury concentration (mg/kg) |
|------------|-------------------------------|--------------------|------------------------------------------------|
| 2003       | 10,587                        | 116                | 11                                             |
| 2004       | 8,485                         | 15                 | 1.7                                            |
| 2005       | 4,918                         | 8.0                | 1.6                                            |
| 2006       | 11,768                        | 22                 | 1.9                                            |
| 2007       | 1,232                         | -                  | -                                              |
| 2008       | 4,699                         | -                  | -                                              |
| 2009       | 2,280                         | -                  | -                                              |
| 2010       | 6,829                         | 14.8               | 2.2                                            |



# Loads between the two gauges

| Land use      | Upstream of Highway 101 |       | Upstream of Almaden Expressway |       | Land between two gages |         |
|---------------|-------------------------|-------|--------------------------------|-------|------------------------|---------|
|               | km <sup>2</sup>         | %     | km <sup>2</sup>                | %     | km <sup>2</sup>        | %       |
| OPEN          | 30                      | 13%   | 20                             | 26%   | 9.8                    | 6.10%   |
| RES-RURAL-LOW | 22.1                    | 9.20% | 14                             | 17%   | 8.5                    | 5.30%   |
| RES-MED-HI    | 93.4                    | 39%   | 5.6                            | 7.10% | 87.8                   | 55%     |
| COMM-PUBLIC   | 37.9                    | 16%   | 2.9                            | 3.60% | 35                     | 22%     |
| FOREST        | 36.2                    | 15%   | 32                             | 41%   | 4.2                    | 2.60%   |
| AGRICULTURE   | 8.3                     | 3.50% | 4.4                            | 5.50% | 3.9                    | 2.50%   |
| INDUSTRIAL    | 10.6                    | 4.40% | 0.06                           | 0.08% | 10.5                   | 6.60%   |
| Total         | 238                     | 100%  | 79                             | 100%  | 160                    | 100.00% |

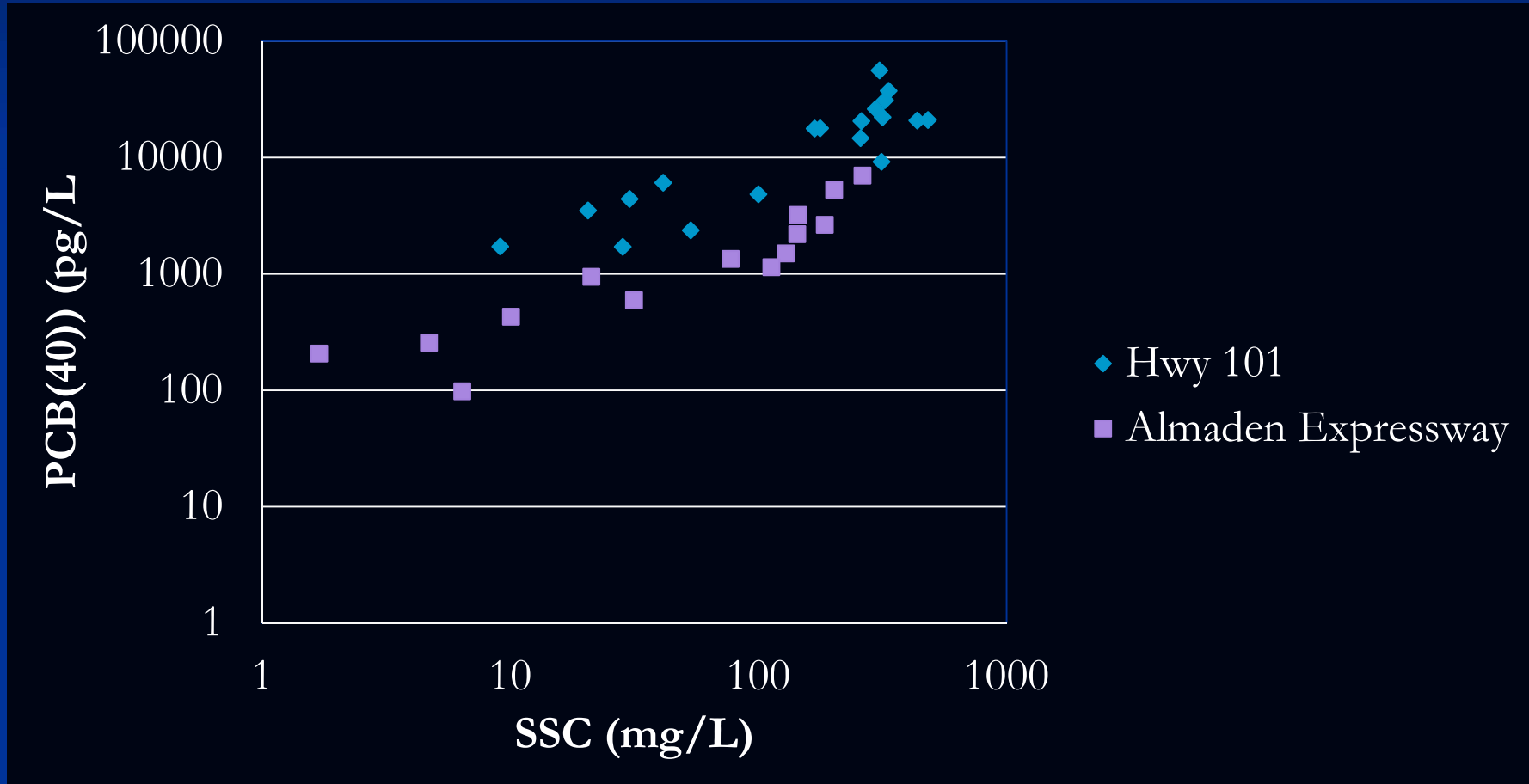


# Loads between the two gauges

|                                                                                                   | Area<br>(km <sup>2</sup> ) | SS<br>(metric t) | SS<br>(kg/ha) | HgT<br>(kg) | HgT<br>(µg/m <sup>2</sup> ) | MeHgT<br>(g) | MeHgT<br>(µg/m <sup>2</sup> ) |
|---------------------------------------------------------------------------------------------------|----------------------------|------------------|---------------|-------------|-----------------------------|--------------|-------------------------------|
| Highway 101 gage                                                                                  | 238                        | 6829             | 287           | 14.8        | 62.3                        | 25.6         | 0.11                          |
| Almaden Expressway gage                                                                           | 79                         | 2563             | 324           | 12.34       | 156.3                       | 20.1         | 0.25                          |
| Area in between the two<br>gages                                                                  | 159                        | 4266             | 268           | 2.5         | 15.6                        | 5.4          | 0.034                         |
| Cache Creek mercury<br>mining watershed in Yolo<br>county (Domagalski et al.,<br>2004)            | -                          | -                | -             | -           | 4.3                         | -            | -                             |
| Other watersheds with<br>urban dominated land use<br>(Literature review by<br>McKee et al., 2006) | -                          | -                | -             | -           | 0.26 - 24                   | -            | 0.03 - 0.16                   |

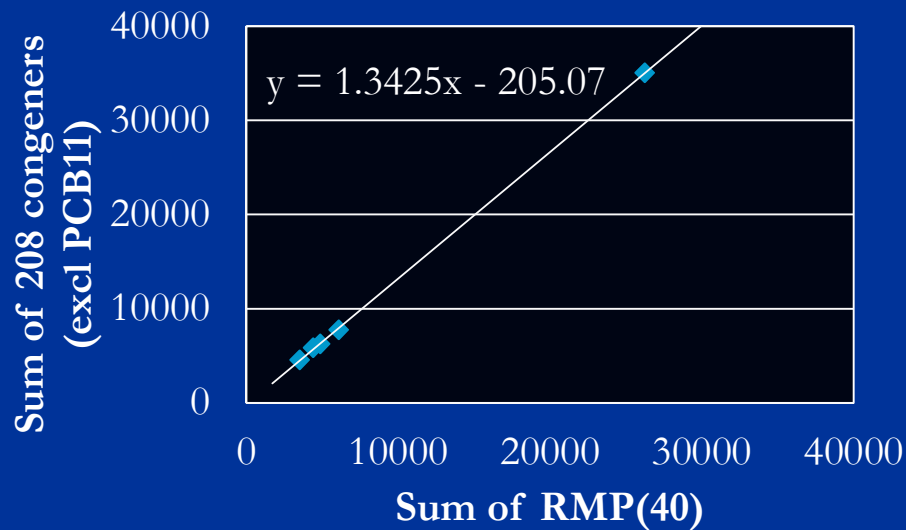


# PCB concentrations (WY 2010)

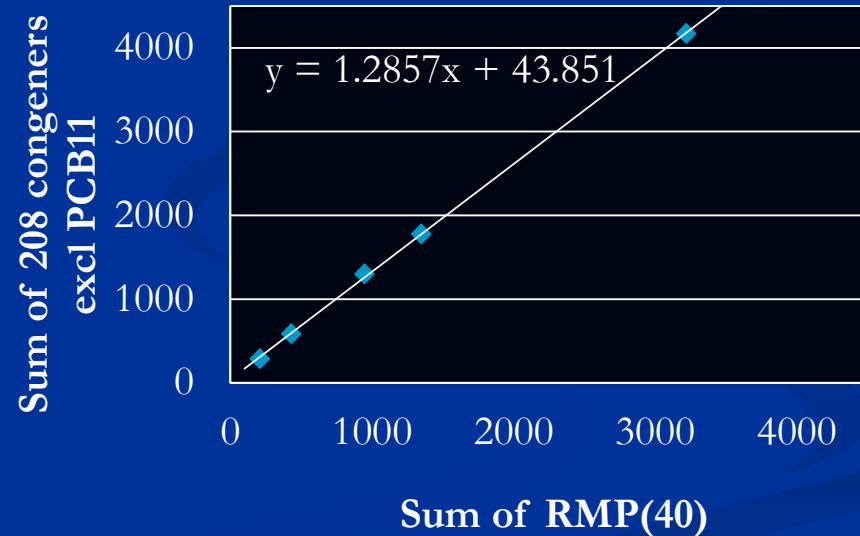


# PCB concentrations (pg/L) Comparison between RMP 40 and sum of 208 (excluding PCB 11)

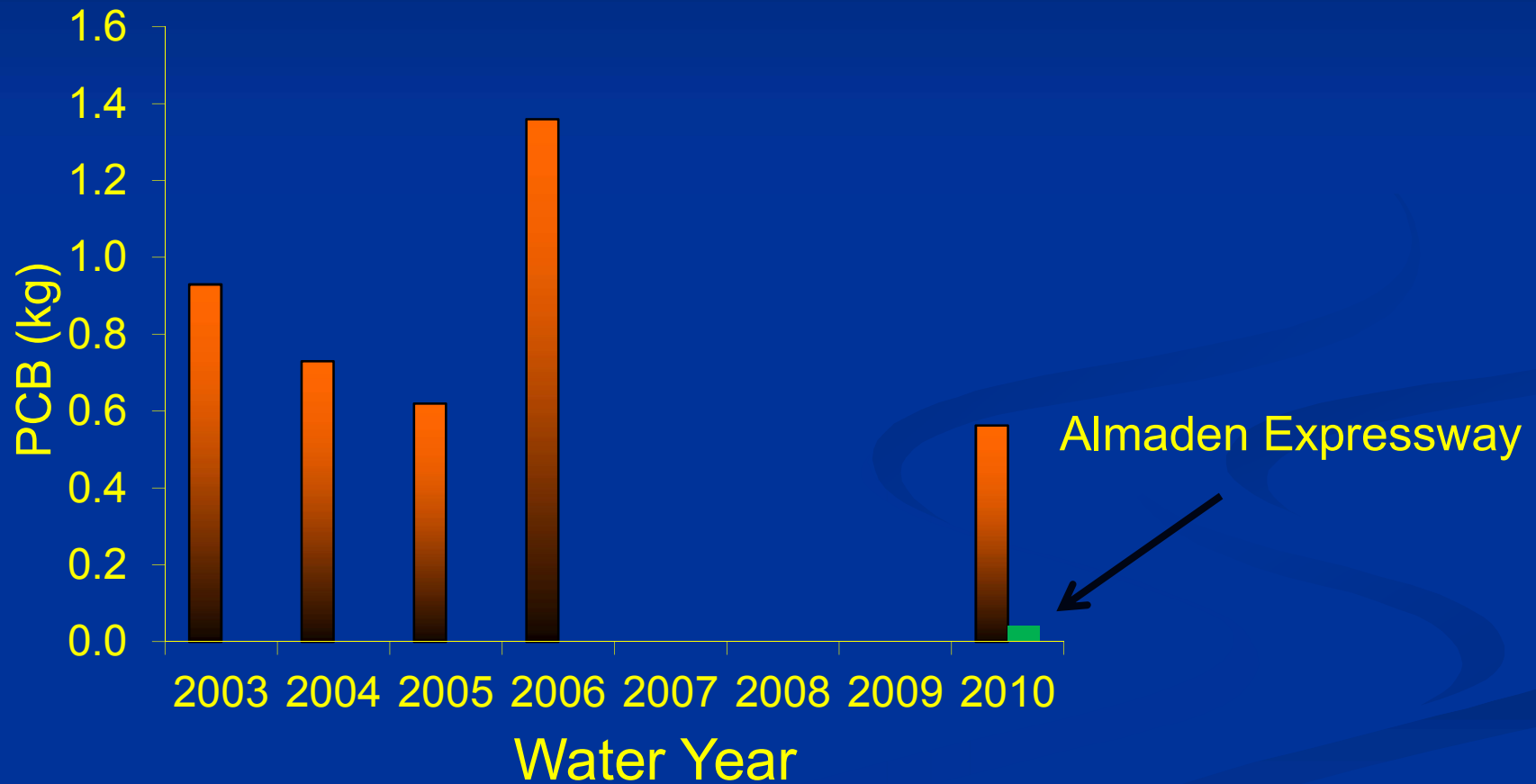
### Hwy 101



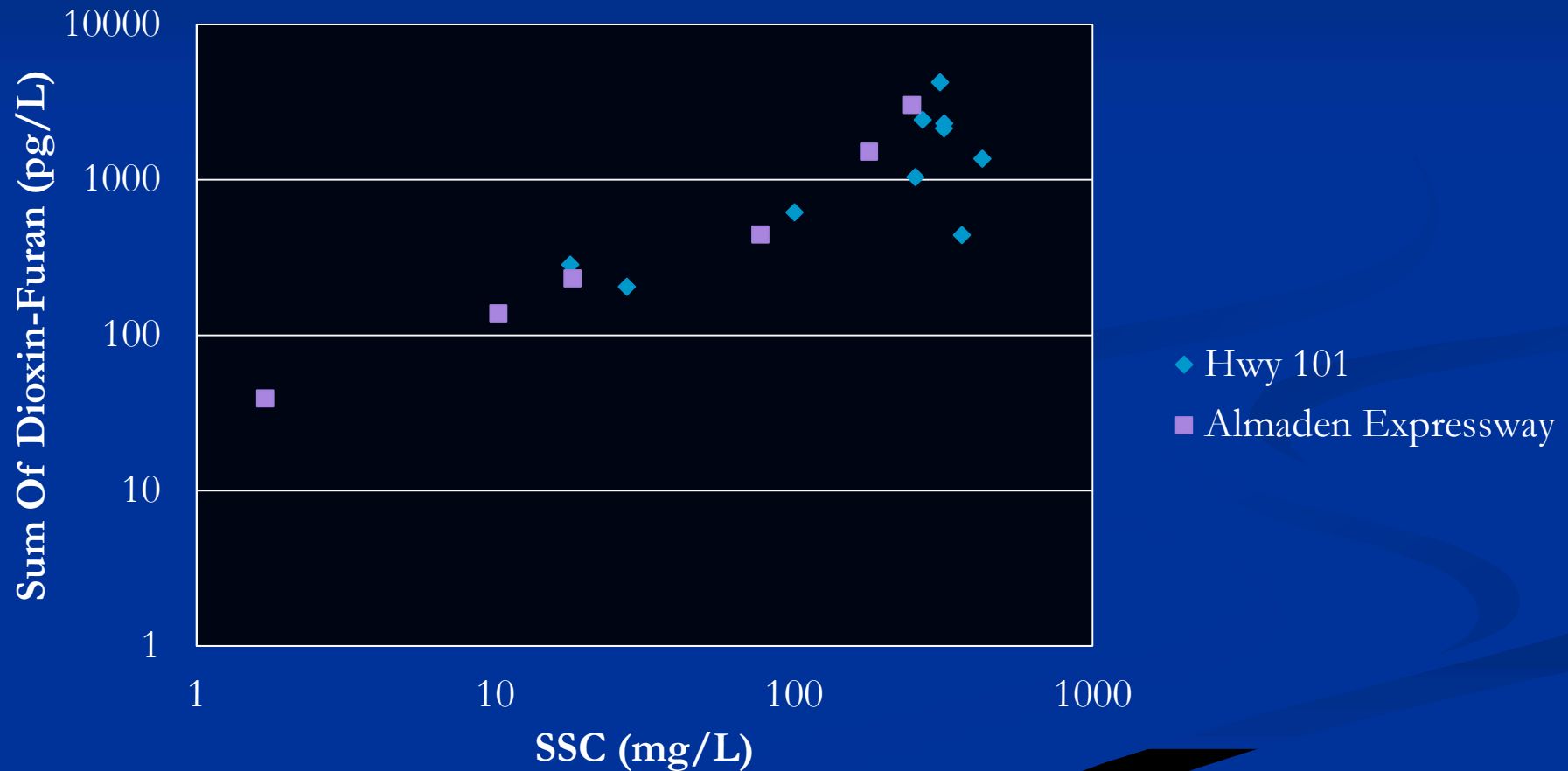
### Almaden Expressway



# PCB loads at Hwy 101



# Sum of Dioxin-Furan concentrations (WY 2010)





# Normalized Loads

|                            | Area               | SS         | SS      | PCB | PCB                  | Dioxin-Furan | Dioxin-Furan         |
|----------------------------|--------------------|------------|---------|-----|----------------------|--------------|----------------------|
|                            | (km <sup>2</sup> ) | (metric t) | (kg/ha) | (g) | (µg/m <sup>2</sup> ) | (g)          | (µg/m <sup>2</sup> ) |
| Highway 101 gage           | 238                | 6829       | 287     | 563 | 2.37                 | 46           | 0.19                 |
| Almaden Expressway gauge   | 79                 | 2563       | 324     | 42  | 0.53                 | 20           | 0.25                 |
| Area in between two gauges | 159                | 4266       | 268     | 521 | 3.28                 | 26           | 0.16                 |



|                     | Minimum | Maximum | Mean  | Number | WYs<br>(n) | FWMC  |
|---------------------|---------|---------|-------|--------|------------|-------|
| SSC (mg/L)          | 0.2     | 1366    | 29.4  | 104927 | 5          | 130.4 |
| Ag (ug/L)           | 0.0225  | 0.35    | 0.09  | 40     | 3          | 0.1   |
| As (ug/L)           | 1.07    | 5.23    | 1.98  | 87     | 3          | 1.8   |
| Cd (ug/L)           | 0.026   | 1.26    | 0.25  | 85     | 3          | 0.2   |
| Cr (ug/L)           | 0.802   | 98.2    | 17.63 | 87     | 3          | 11.3  |
| Cu (ug/L)           | 2.73    | 91.4    | 19.50 | 87     | 3          | 12.7  |
| Ni (ug/L)           | 1.77    | 189     | 35.73 | 87     | 3          | 22.1  |
| Pb (ug/L)           | 0.204   | 80.5    | 14.56 | 87     | 3          | 9.7   |
| Zn (ug/L)           | 4.62    | 350     | 76.39 | 87     | 3          | 52.3  |
| POC (mg/L)          | MDL     | 4.3     | 0.70  | 67     | 5          | 0.897 |
| TOC (mg/L)          | 2.5     | 19      | 4.98  | 67     | 5          | 5.16  |
| DOC (mg/L)          | 1.8     | 18      | 4.28  | 67     | 5          | 4.26  |
| PCB (ng/L)          | 0.73    | 167     | 30    | 72     | 5          | 12.6  |
| DDT (ng/L)          | 0.52    | 71      | 25    | 44     | 2          | 27    |
| Chlordane (ng/L)    | 0.63    | 64      | 20    | 44     | 2          | 24    |
| HCH (ng/L)          | 0.1     | 1.3     | 0.71  | 44     | 2          | 0.33  |
| Dieldrin (ng/L)     | 0.19    | 6       | 1.9   | 44     | 2          | 2.2   |
| HgT (ng/L)          | MDL     | 18673   | -     | 214    | 5          | 1811  |
| MeHgT (ng/L)        | 0.05    | 2.22    | -     | 85     | 5          | 0.52  |
| Dioxin_Furan (ng/L) | 0.205   | 4.246   | 1.357 | 12     | 1          | 0.845 |

## Summary of all Hwy 101 data



# Funding

- WY 2003 Clean Estuary Partnership (CEP)
- WY 2004 CEP, RMP, Santa Clara Valley Urban Runoff Pollution Prevention Program
- WY 2005 RMP and Santa Clara Valley Water District
- WY 2006 RMP and Santa Clara Valley Water District
- WY 2010 RMP and Santa Clara Valley Water District

