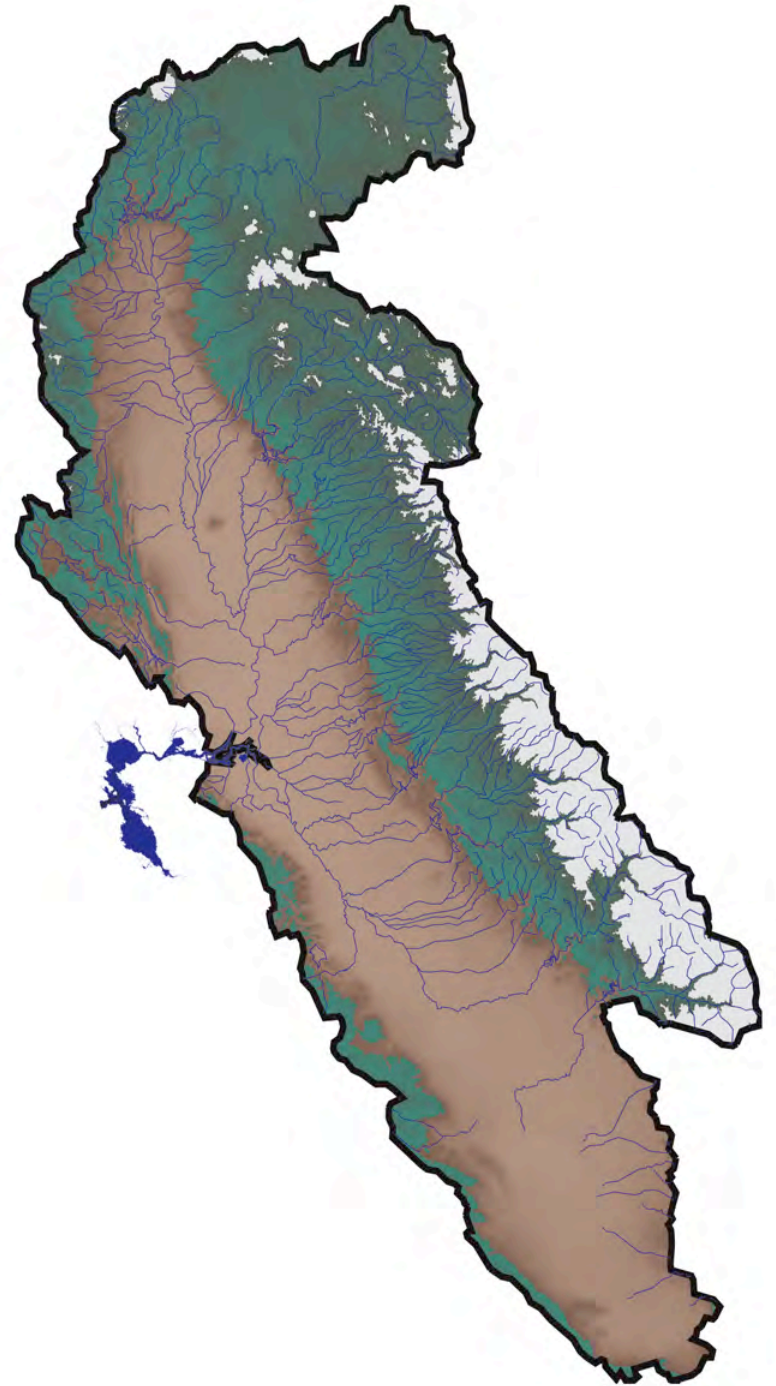


# Suspended Sediment: Past a Tipping Point – What's Next?

David Schoellhamer  
U.S. Geological Survey



# Acknowledgements

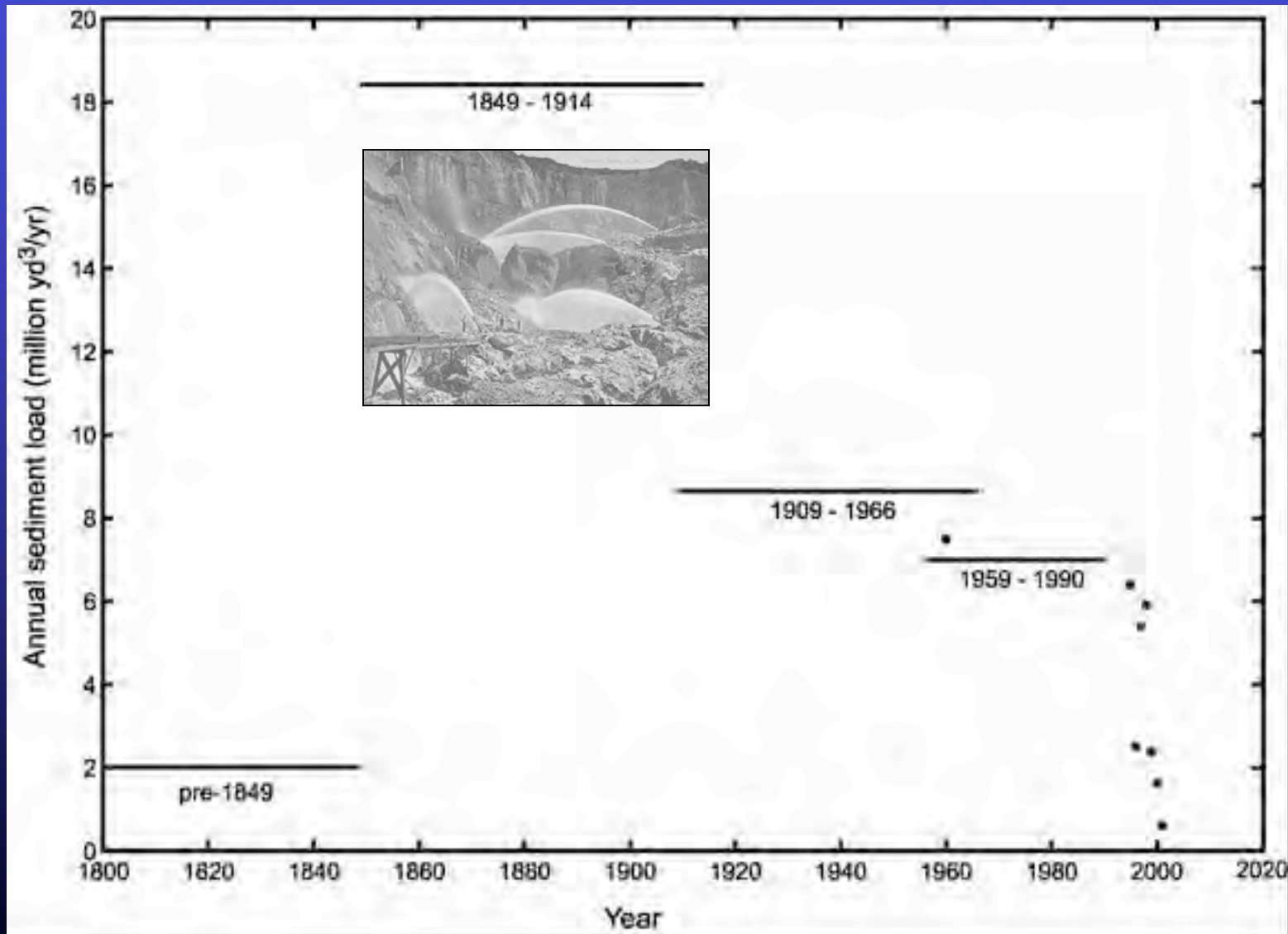
Greg Brewster, Paul Buchanan, Elizabeth Canuel, Jay Davis, Judy Drexler, David Fairman, Amber Forest, Neil Ganju, Bruce Jaffe, Megan Lionberger, Jim McGrath, Lester McKee, Allan Mlodnosky, Tara Morgan, Cathy Ruhl, Rob Sheipline, Greg Shellenbarger, Brad Sullivan, and Scott Wright

This work was funded by the U.S. Army Corps of Engineers as part of the Regional Monitoring Program

# Ideas and RMP adaptations

- 1) Less sediment supply from Central Valley: local watersheds relatively more important
- 2) Future sediment supply: stabilize or decrease?
- 3) Other possible adaptations

# Sediment supply: past 200 years



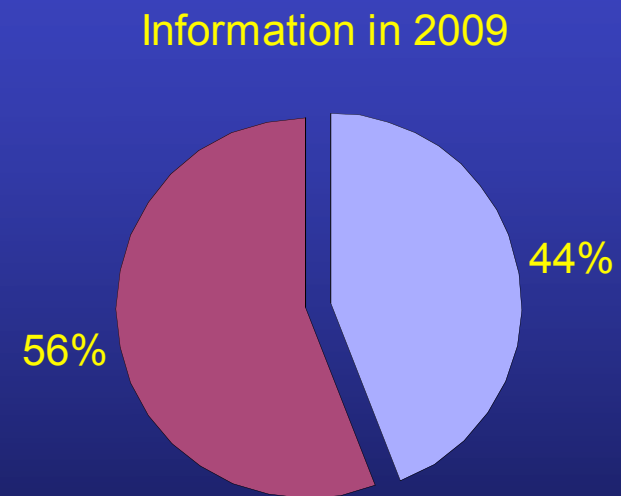
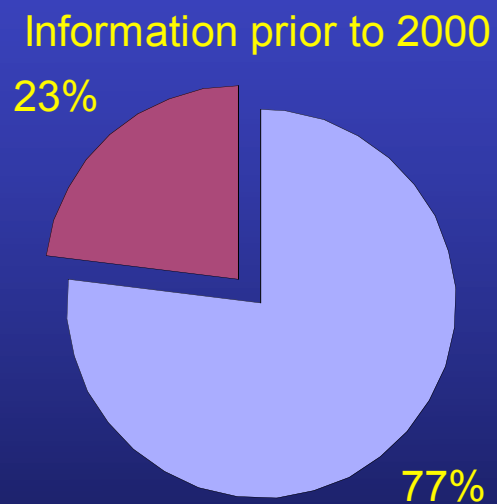
Gilbert 1917, Porterfield 1980, Ogden Beeman & Krone 1992, McKee et al 2006

# Why less sediment?

12~13 Mm<sup>3</sup>/yr less than peak (~90%)

- 1) **Diminishment of hydraulic mining pulse**
- 2) **Reservoir deposition:** Deposition in Oroville, Folsom, and Englebright ~2.4 Mm<sup>3</sup>/yr (Wright and Schoellhamer 2004)
- 3) **Smaller floods:** Dams reduce downstream flood flows
- 4) **Flood bypasses:** Deposition in Colusa, Sutter, Yolo near Fremont Weir 1.3 Mm<sup>3</sup>/yr (Singer and Aalto 2008)
- 5) **Bank protection:** Banks on over half the lower Sacramento River were protected from 1960-2000 (USFWS 2000)

# Less sediment from the Central Valley makes supply from local watersheds relatively more important



# Possible RMP adaptations

Goal: better quantify local watershed supply

- 1) **Expand stream gaging:** no sediment supply measurements  
1974-1999
- 2) **Creek mouth measurements:** traditional stream gages  
above tides, deposition in tidal creeks decreases Bay supply
- 3) **Watershed model:** too many watersheds to measure, use to  
extrapolate gage data to ungaged creeks

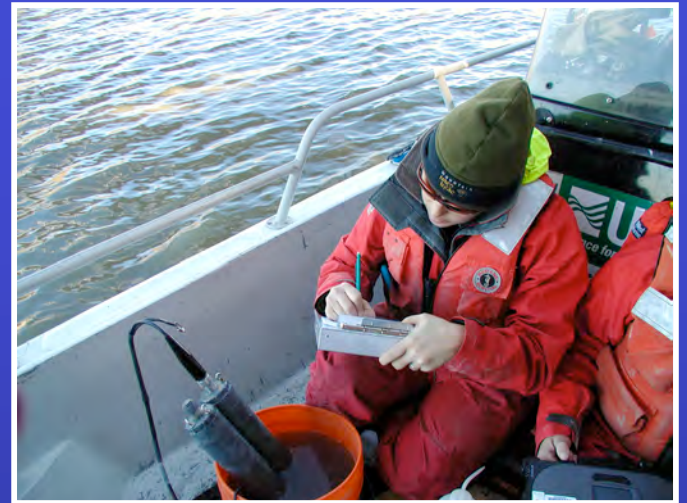
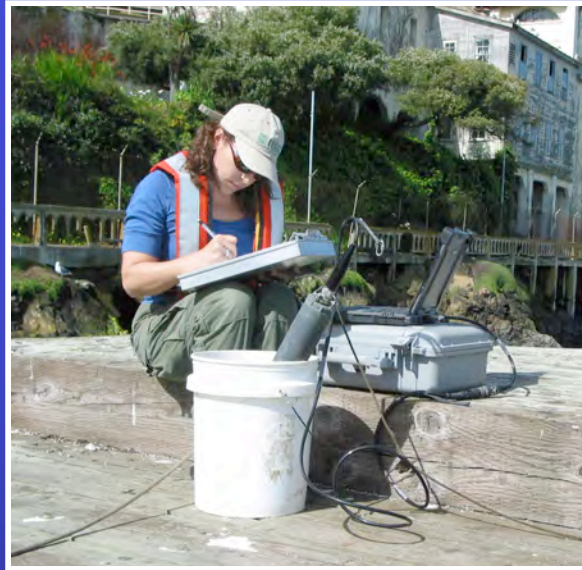
# Ideas and RMP adaptations

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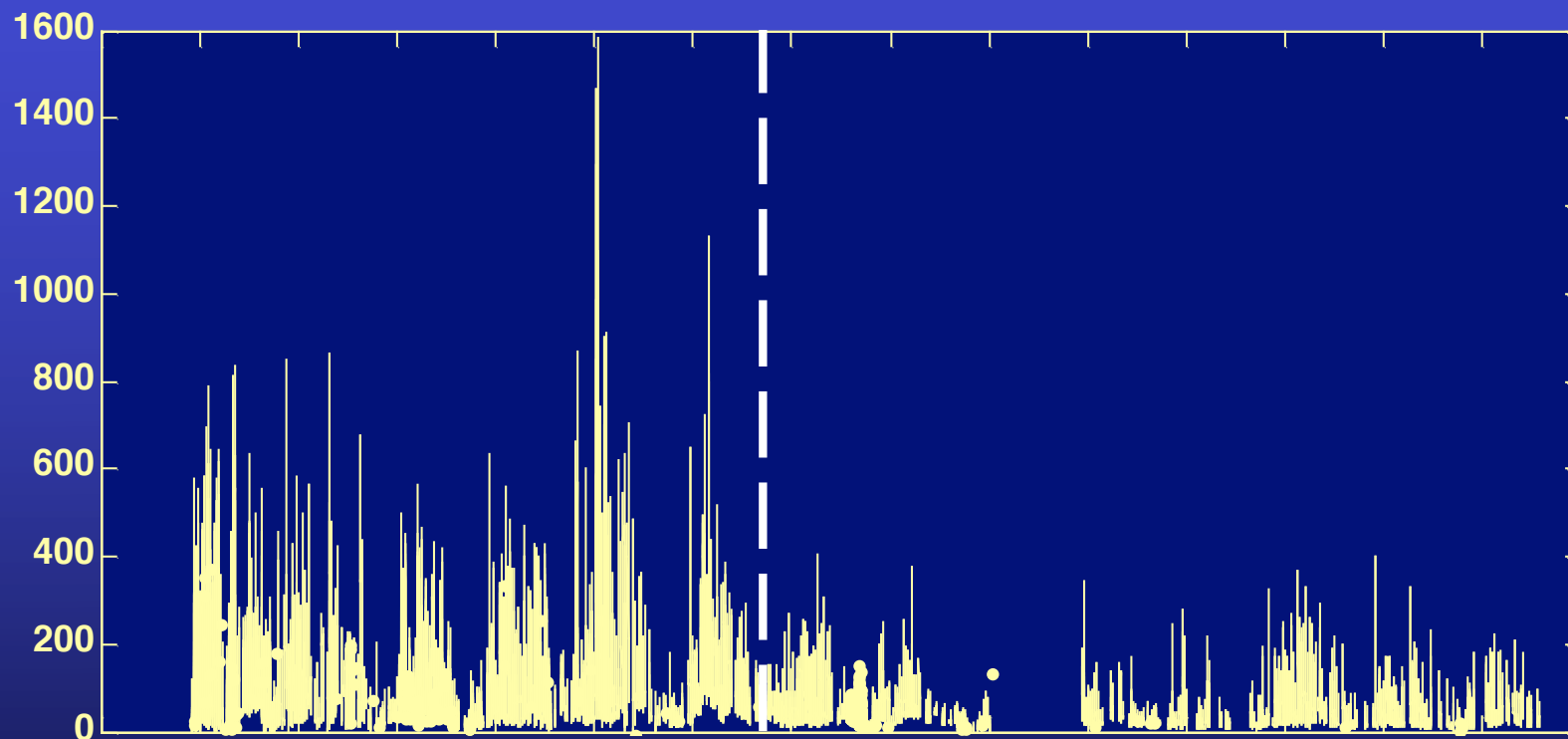


# Continuous monitoring of SSC 1991-present





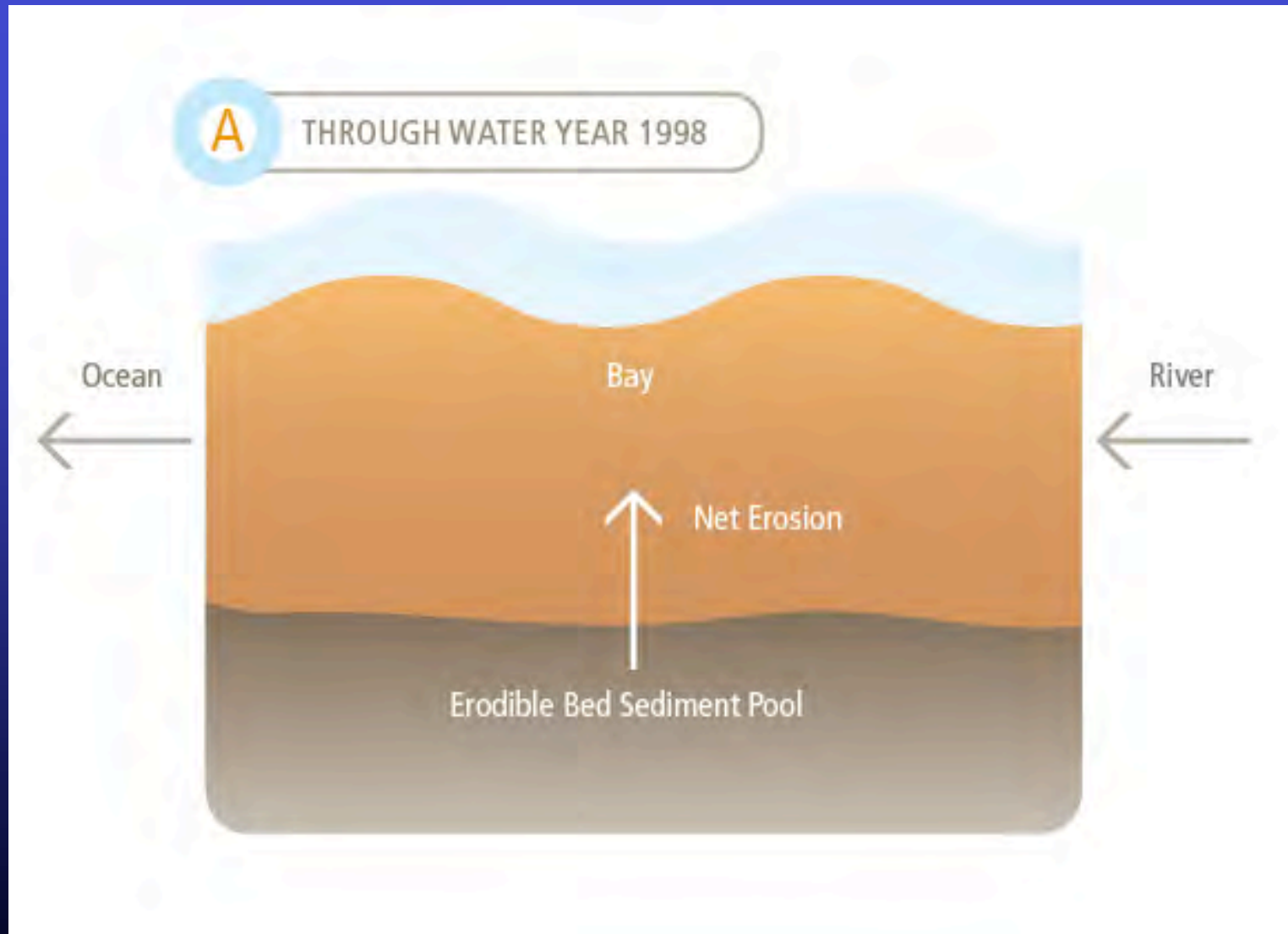
# WY1999: 36% step decrease in Bay SSC



Point San Pablo, mid-depth, USGS

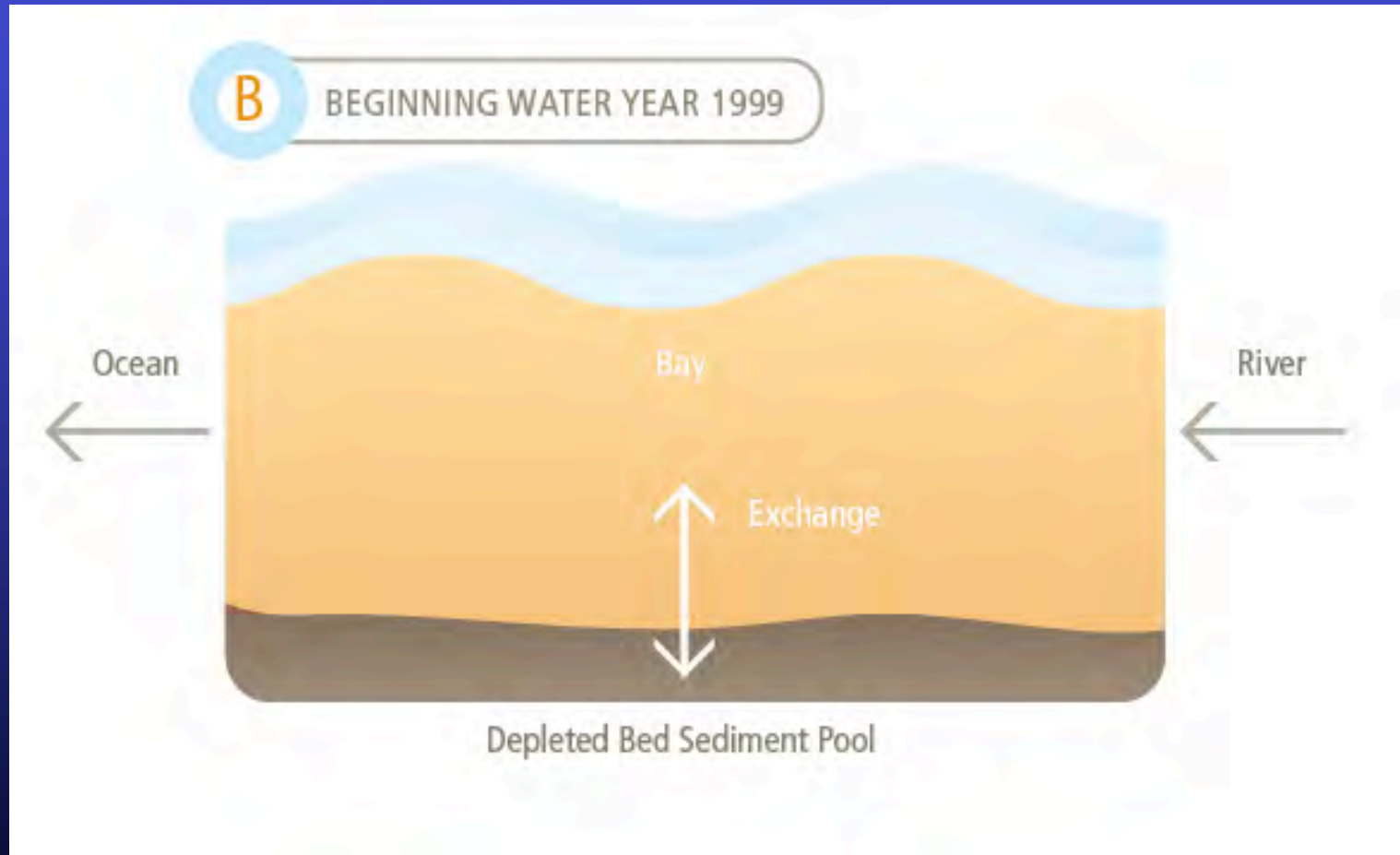


# Transport regulation





# Supply regulation



# SF Bay

Time

Prior to 1850, the rivers and Bay were relatively clear

1850

Hydraulic mining

# SF Bay

Time

Prior to 1850, the rivers and Bay were relatively clear

1850

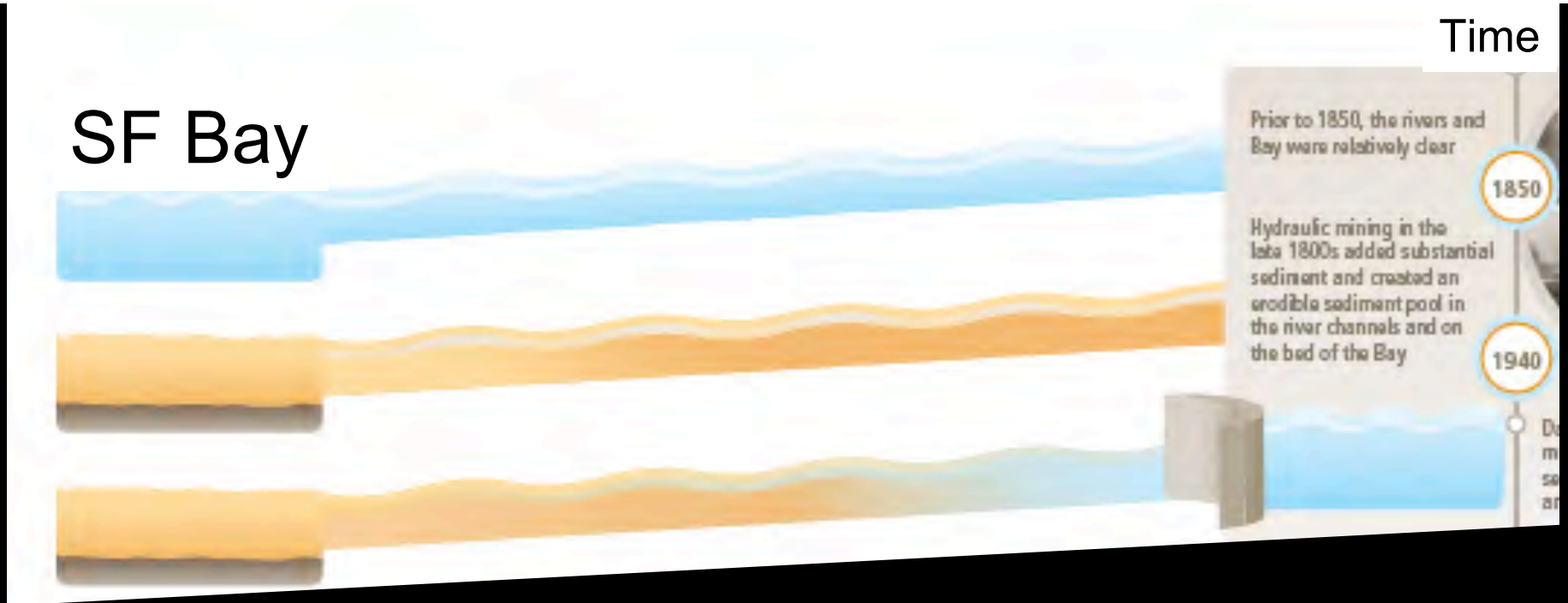
Hydraulic mining in the late 1800s added substantial sediment and created an erodible sediment pool in the river channels and on the bed of the Bay

1940

Gilbert 1917, James 1999, McKee et al 2006, Cappiella et al. 1999, Jaffe et al 1998, Fergoso et al 2008

Time

# SF Bay



James 1997, Wright and Schoellhamer 2004, Fairman 2007



Time

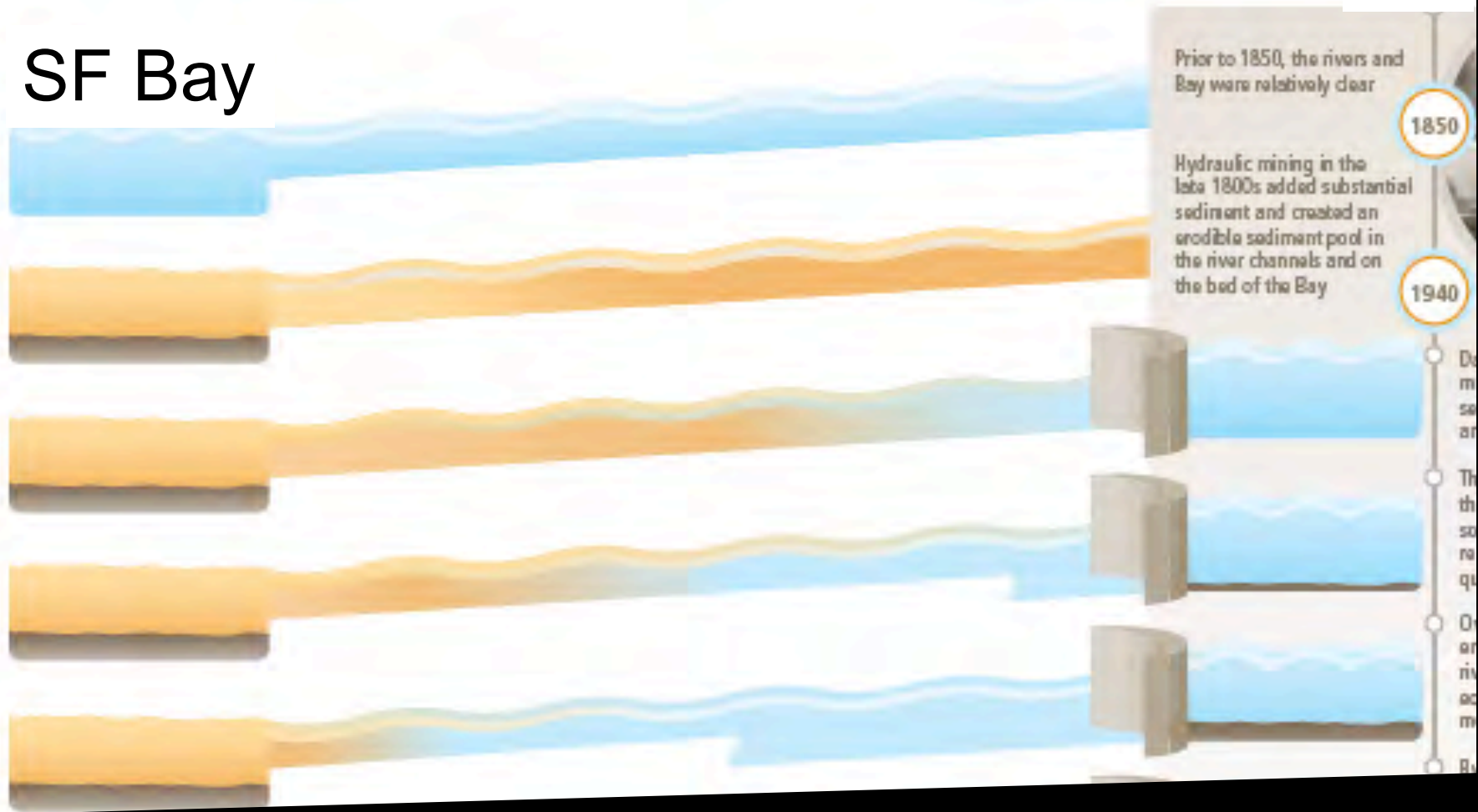
# SF Bay



James 1997, Wright and Schoellhamer 2004, Fairman 2007

Time

# SF Bay



James 1997, Wright and Schoellhamer 2004, Fairman 2007

Time

# SF Bay



Wright and Schoellhamer 2004, Fairman 2007, McKee et al 2006, Canuel et al 2009, Jassby et al. 2002, Hestir et al. in prep, Cappiella et al. 1999, Jaffe et al 1998, Fergoso et al 2008

Time

# SF Bay

Prior to 1850, the rivers and Bay were relatively clear

1850

Hydraulic mining in the late 1800s added substantial sediment and created an erodible sediment pool in the river channels and on the bed of the Bay

1940

Debris

sediment

and

the

soil

re-

quired

Over

the

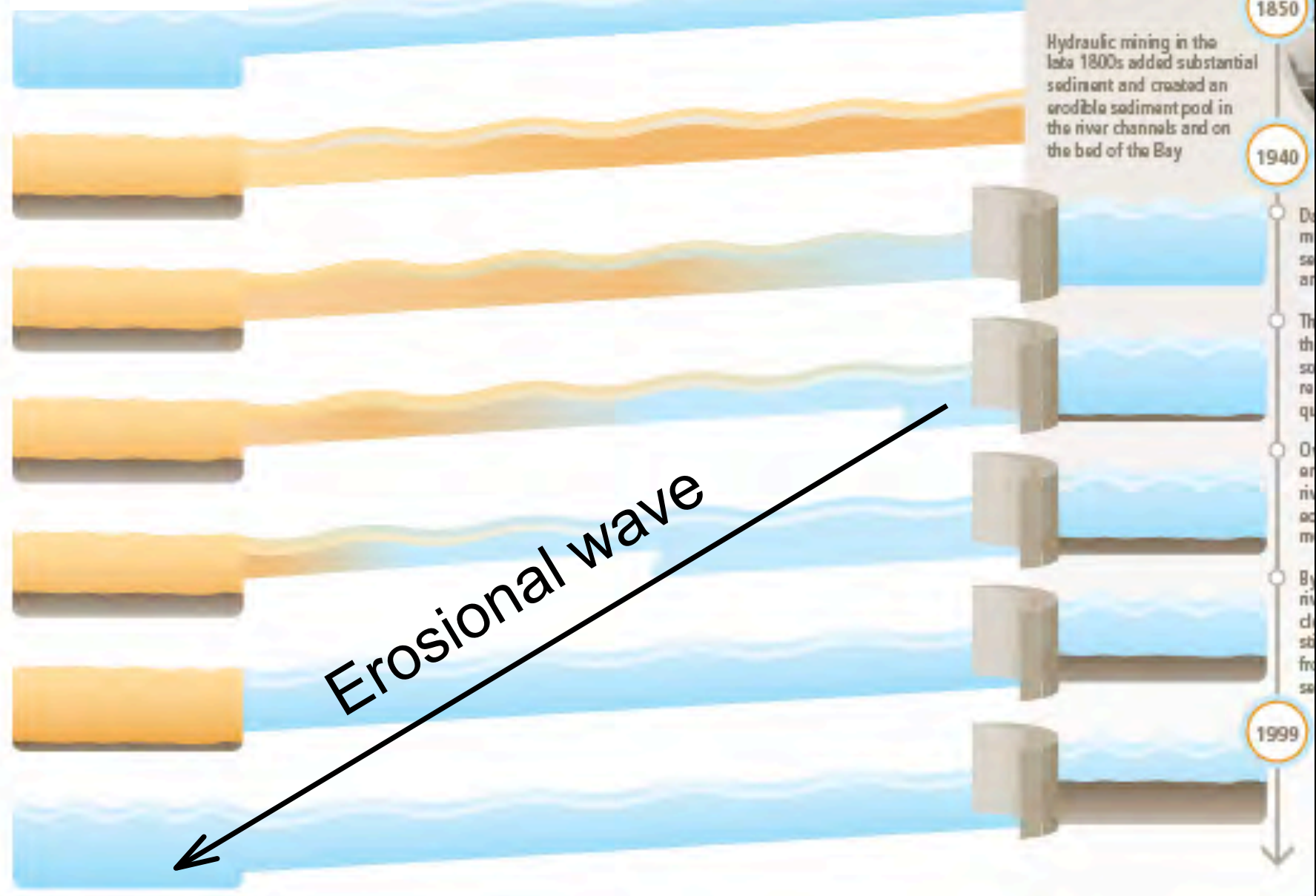
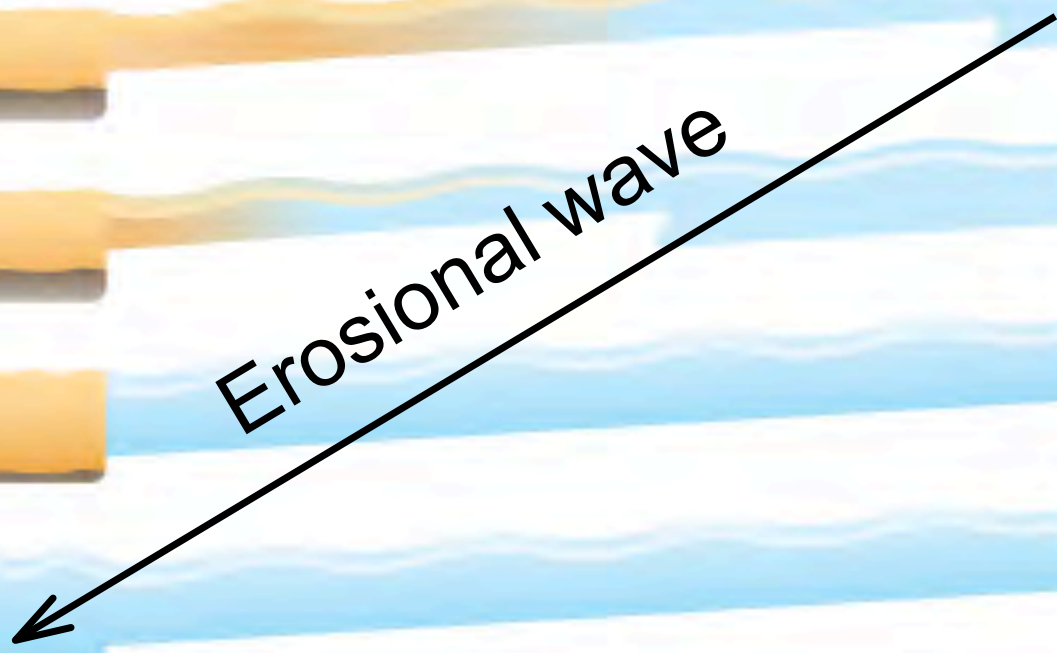
years

By

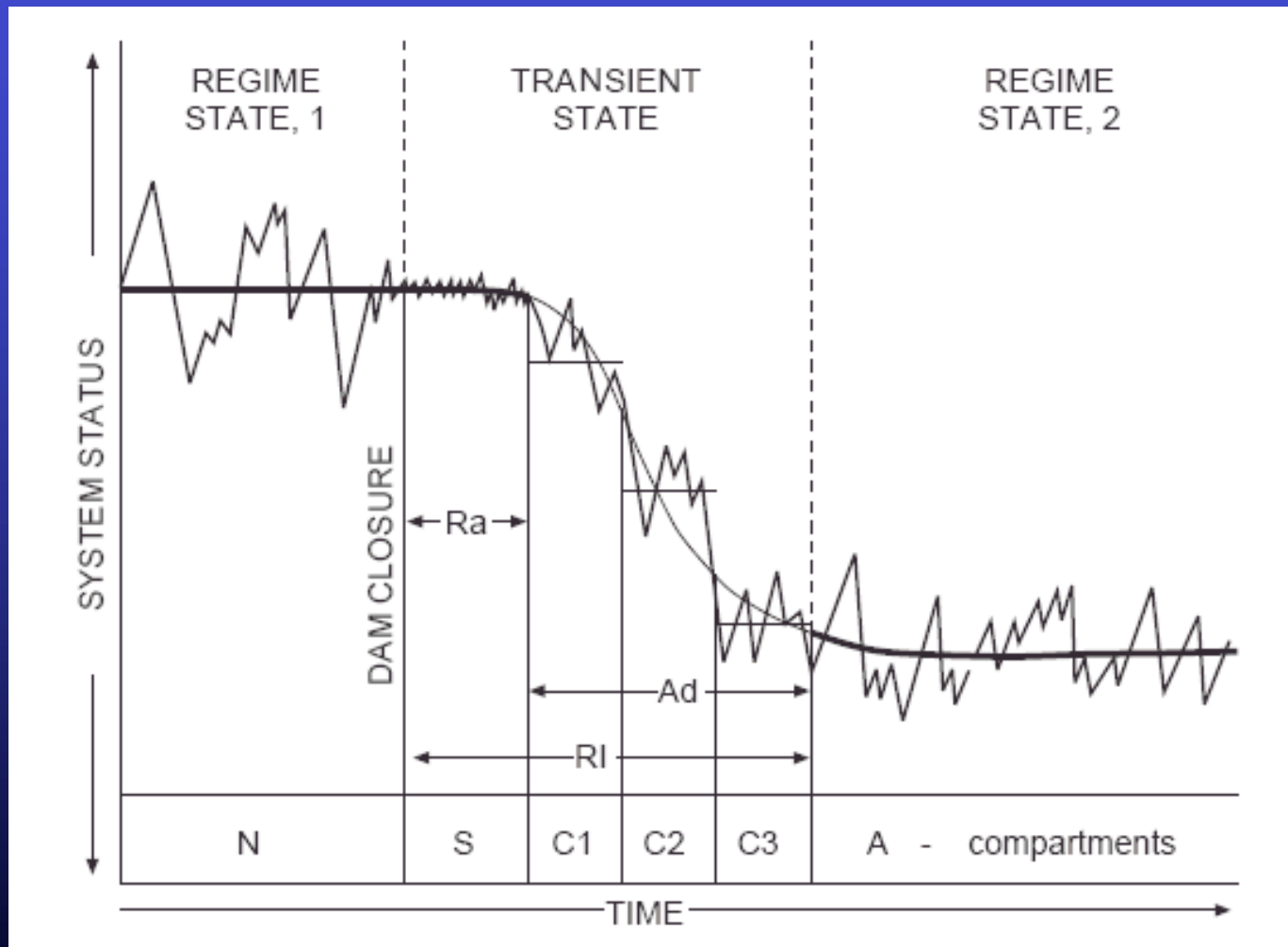
the

1999

Erosional wave



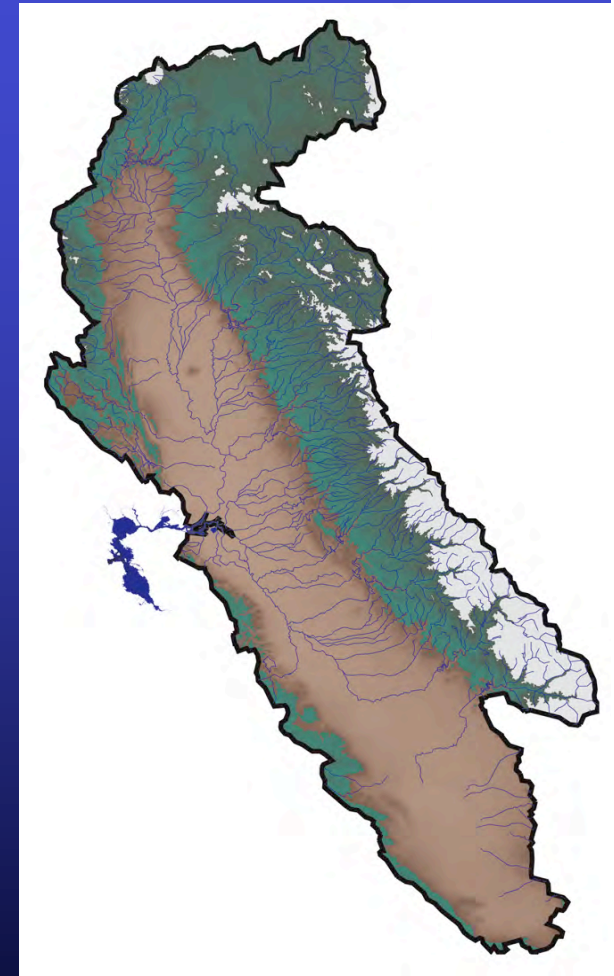
# Downstream effect of reduced sediment supply





# Hypotheses: Conclusions

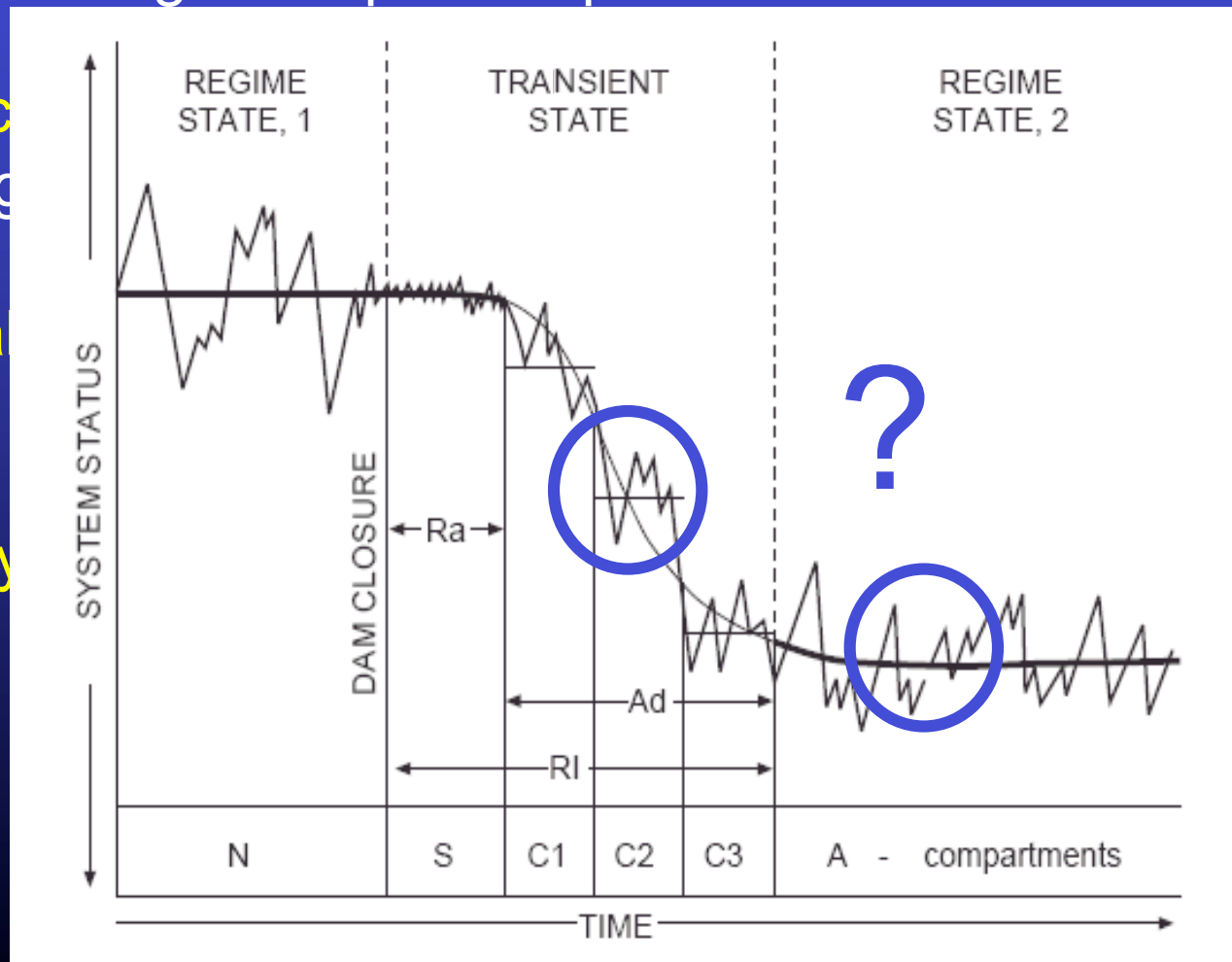
- 1) An erosional wave propagated from the watershed to the Bay during the 20th century: supported by synthesis of many studies
- 2) This wave is waning in the Bay, resulting in a new regime of lower sediment and carbon supply to the Bay: supply has decreased, establishment of a new regime is uncertain



# Possible RMP adaptations

Will Central Valley supply stabilize or decrease?:  
Key assumption for simulating Bay legacy contaminants  
and geomorphic response to sea level rise

- 1) River channel erosion
- 2) Central Valley supply
- 3) Directly



# Other Possible RMP adaptations

- 1) **Sediment supply between subembayments:** Measuring sediment flux at Dumbarton Bridge
- 2) **Golden Gate sediment flux:** biggest unknown in Bay sediment budget
- 3) **Salinity and temperature:** key ecosystem variables, monitored with SSC, water contractors want to stop funding



# Summary: Possible RMP adaptations

Expand stream gaging

Creek mouth measurements

Bay Area watershed sediment model

River cross section analysis

Central Valley watershed sediment model

Directly measure sediment supply at Mallard Island

Sediment supply between subembayments

Golden Gate sediment flux

Salinity and temperature

# Acknowledgements

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