Sites Project Water Quality Group Discussion

May 13, 2021

Sites

Agenda

1. Introductions
2. Group Norms
3. Action Item Follow-up
4. Key Concepts
    a) Reservoir Management Plan
    b) Temperature Model
    c) Evapoconcentration
5. In-Lake Analyses
6. Action Items and Next Steps

Group Norms

- Encourage everyone to be on video
- Mute yourself when others are speaking
- Respectful, professional dialogue
- Ask questions throughout, lets have a dialogue
  - Let the speaker finish their point
  - Use the raise your hand function in Teams if needed
- Topics for next meeting will be discussed and recorded

Action Item Follow-up

Action Item	Addressed	Pending	Notes
Specificity on years for data	X		
Distribute metals table	X		
Effects of release temperature on rice		X	Email out to Tim Johnson
Effects of Hg and As on rice		X	Email out to Tim Johnson
Effects of reservoir operations on water quality of Stone Corral and Funks creeks.		X	Next meeting
Anti-degradation policy and Sites		X	Next meeting
Synergistic effects of chemicals		X	Next meeting

Key Concepts

Reservoir Management Plan

- Part of the Project
- Purpose: describe the management of water resources in Sites Reservoir
  - Water Quality: describe metrics, standards, testing and monitoring protocols, and outcomes
- Constituents currently included:
  - HABs
  - Methylmercury
  - Metals
  - Water Temperature
  - Salt and Minerals (Salt Pond)

Temperature Model: CE QUAL W2

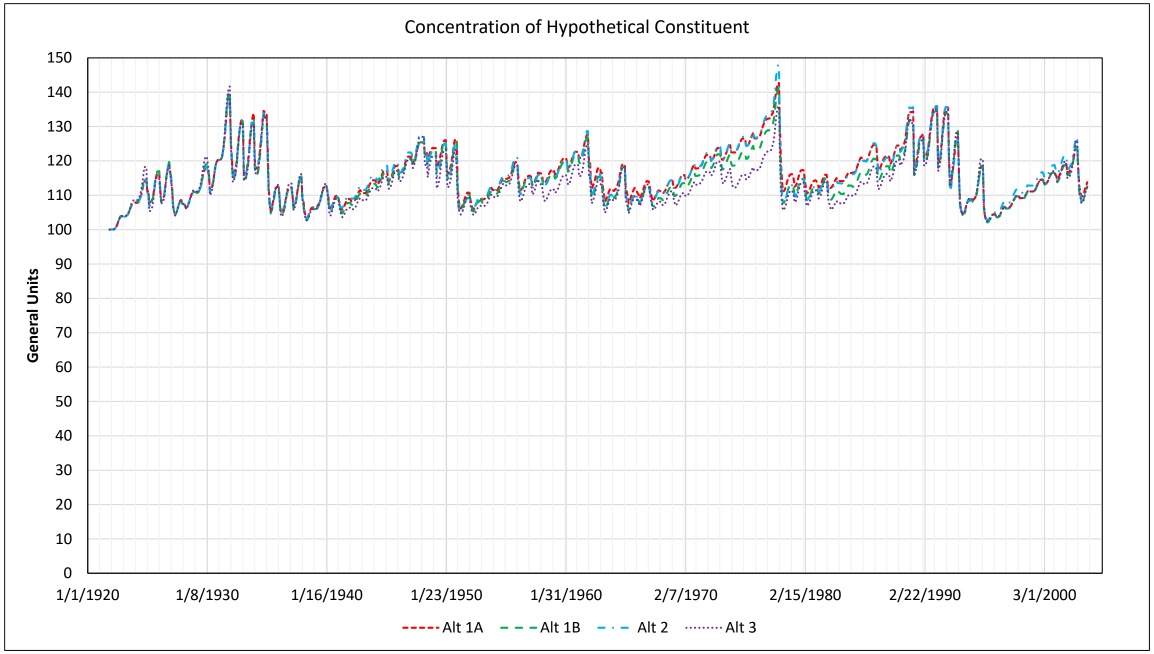
- CE QUAL W2
  - 2D Reservoir Temperature Model
  - Daily timestep
  - Version 4.1
- Assumptions:
  - Reservoir size
  - Estimates surface area with storage volume
  - Considers I/O Tower

Temperature Model: CE QUAL W2

- Inputs
  - Daily flows from operations model (USRDOM)
  - Daily temperature from Sacramento River temperature model (HEC5Q)
  - Daily net evaporation rate (consistent with CalSim II)
- Outputs
  - Surface water temperature
  - Release temperature

Evapoconcentration

- Calculations using water balance information from CALSIM
- Increase in concentration limited by freshening due to release and refilling
- Most relevant to conservative constituents
- Average concentration approximately 13-16 percent higher than the inflow concentration
- Maximum of 41 – 48 percent depending on alternative



In-Lake Analyses

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Mercury

- Approach
  - Input sources
  - Transformation processes
  - Comparison with similar/nearby reservoirs
    - Concentrations in surface waters and in fish tissues
    - Annual reservoir water level fluctuation
- Key Data Sources
  - California Environmental Data Exchange Network (CEDEN)
  - DWR Water Data Library
  - SWRCB 2017 – Reservoir TMDL draft staff report

Mercury

- Long-term (~10 years after initial filling)
  - Comparable to existing reservoirs
  - 1.6 to 1.9 ng/L total mercury
  - 0.10 to 0.15 methylmercury
- Short-term (up to ~10 years after initial filling)
  - Conditions are conducive to mercury methylation
  - 3.2 to 3.8 ng/L total mercury
  - 0.2 to 0.3 ng/L methylmercury
- Total mercury concentrations would not exceed California Toxics Rule Objective (50 ng/L)
- Tissue concentrations among other reservoirs > CA sport fish objective (0.2 mg/kg ww in 350 mm largemouth bass)

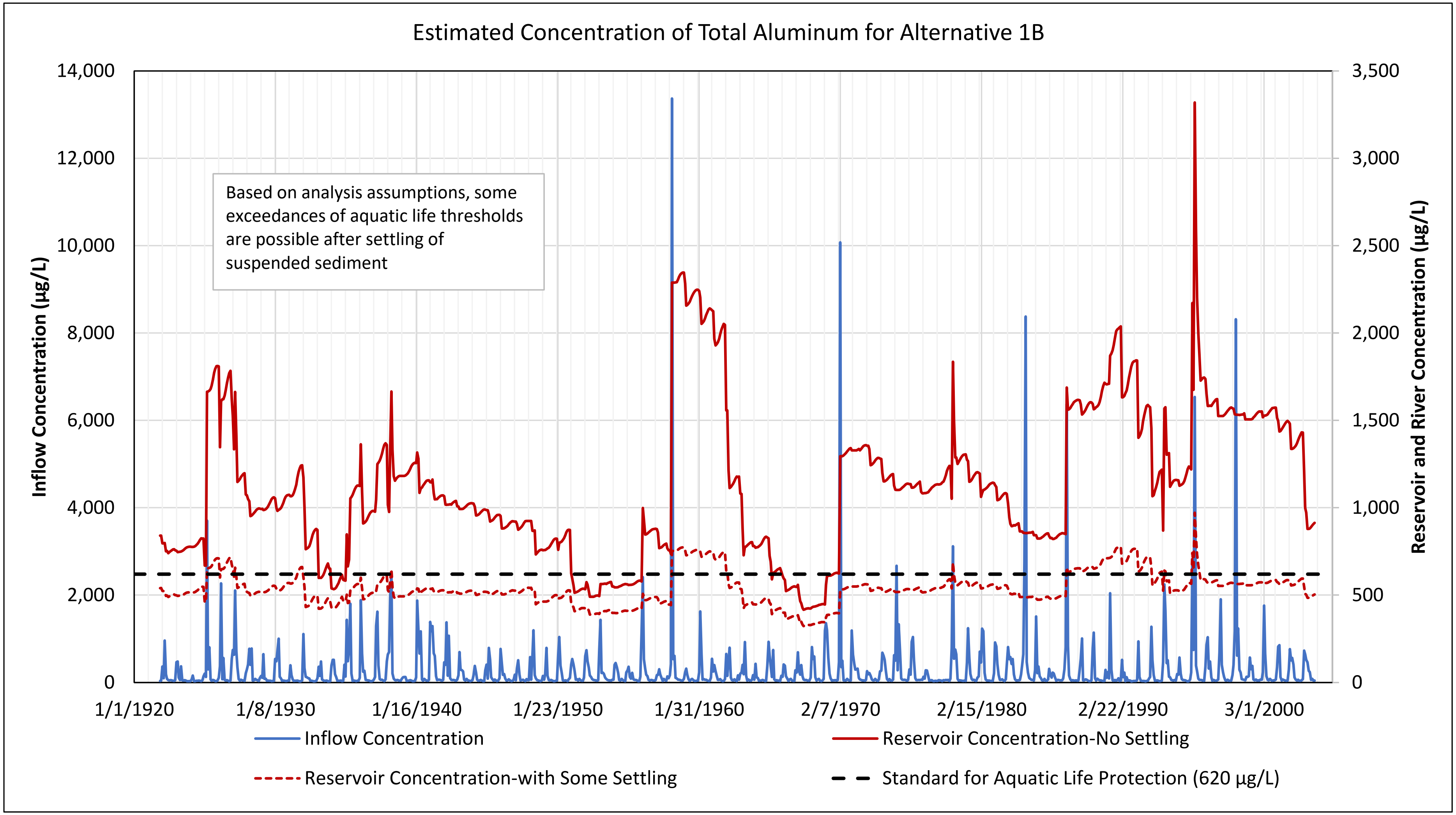
Mercury

- Reservoir Management Plan
  - Remove vegetation in inundation footprint prior to initial filling
  - Monitor reservoir fish tissue methylmercury
  - Post fish consumption warning signs if fish tissue methylmercury concentrations exceed CA sport fish objective
  - Adhere to the State Water Board TMDL for mercury in reservoirs, once adopted

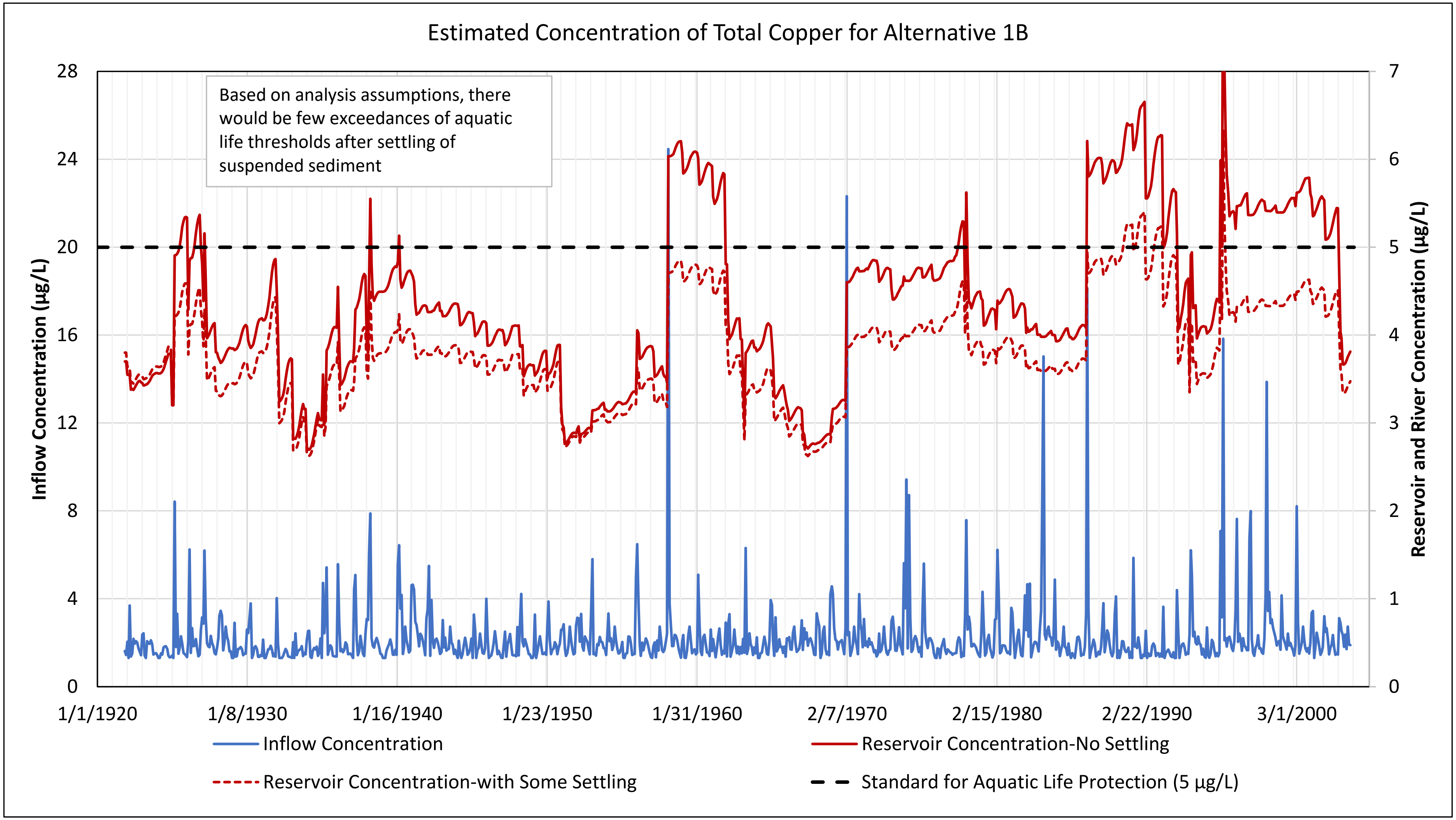
Metals

- Calculations include:
  - Improved estimation of inflow concentration (based on both flow at Keswick and Keswick/Bend Bridge)
  - Evapoconcentration
  - With and without settling of suspended sediment
- Reservoir Management Plan
  - Monitor concentrations of aluminum, copper, iron, and lead upstream of, in, and downstream of Sites Reservoir

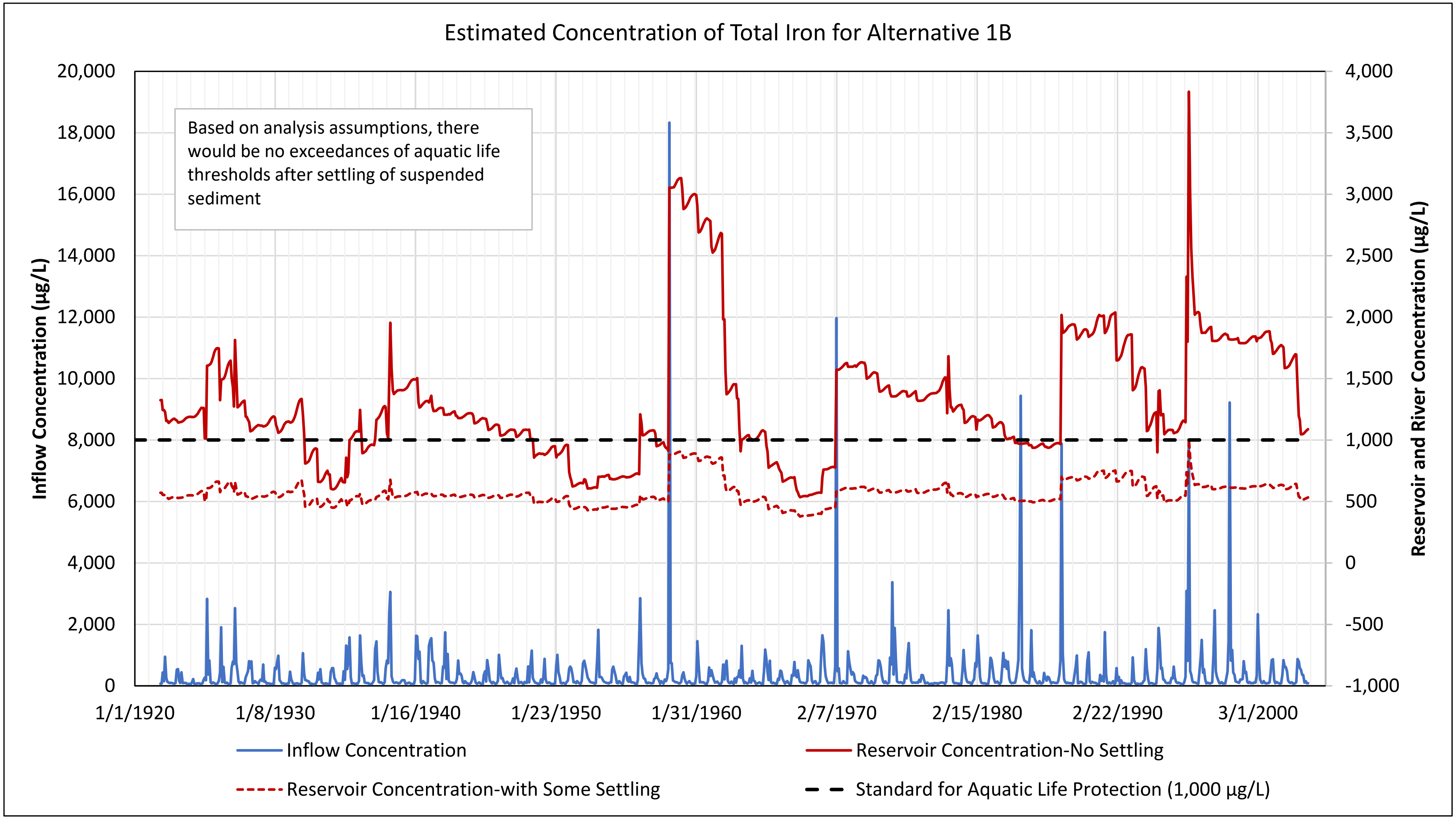
Metals


Estimated Concentration of Total Aluminum for Alternative 1B
Based on analysis assumptions, some exceedances of aquatic life thresholds are possible after settling of suspended sediment
Inflow Concentration (µg/L)
Reservoir and River Concentration (µg/L)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1/1/1920
1/8/1930
1/16/1940
1/23/1950
1/31/1960
2/7/1970
2/15/1980
2/22/1990
3/1/2000
Inflow Concentration
Reservoir Concentration-No Settling
Reservoir Concentration-with Some Settling
Standard for Aquatic Life Protection (620 µg/L)

Metals

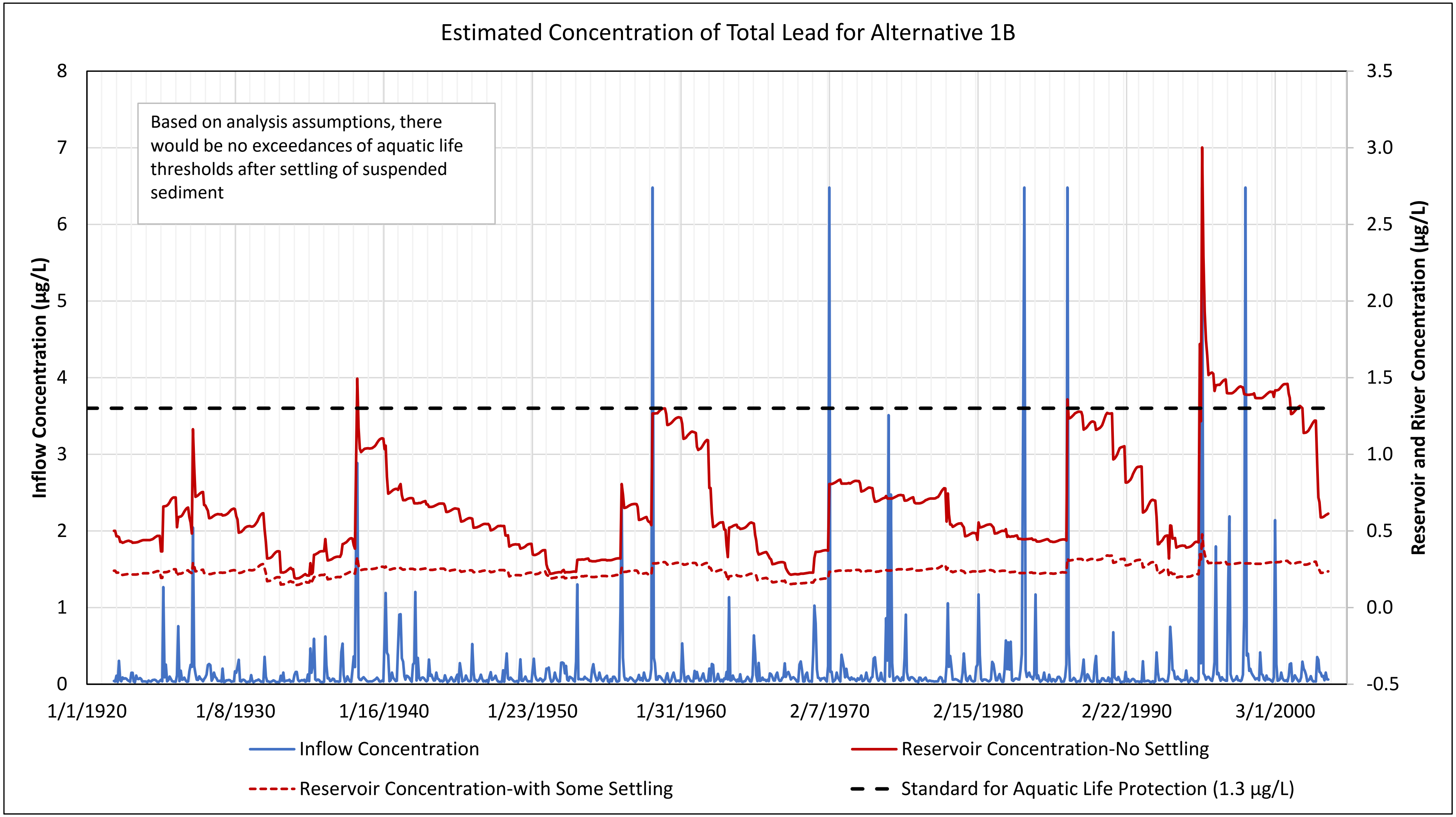

Estimated Concentration of Total Copper for Alternative 1B
Based on analysis assumptions, there would be few exceedances of aquatic life thresholds after settling of suspended sediment
Inflow Concentration (µg/L)
Reservoir and River Concentration (µg/L)
0
4
8
12
16
20
24
28
0
1
2
3
4
5
6
7
1/1/1920
1/8/1930
1/16/1940
1/23/1950
1/31/1960
2/7/1970
2/15/1980
2/22/1990
3/1/2000
Inflow Concentration
Reservoir Concentration-No Settling
Reservoir Concentration-with Some Settling
Standard for Aquatic Life Protection (5 µg/L)

Metals



Estimated Concentration of Total Iron for Alternative 1B
Based on analysis assumptions, there would be no exceedances of aquatic life thresholds after settling of suspended sediment
Inflow Concentration (µg/L)
Reservoir and River Concentration (µg/L)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
-500
-1,000
1/1/1920
1/8/1930
1/16/1940
1/23/1950
1/31/1960
2/7/1970
2/15/1980
2/22/1990
3/1/2000
Inflow Concentration
Reservoir Concentration-No Settling
Reservoir Concentration-with Some Settling
Standard for Aquatic Life Protection (1,000 µg/L)

Metals



Estimated Concentration of Total Lead for Alternative 1B
Based on analysis assumptions, there would be no exceedances of aquatic life thresholds after settling of suspended sediment
Inflow Concentration (µg/L)
Reservoir and River Concentration (µg/L)
8
7
6
5
4
3
2
1
0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
1/1/1920
1/8/1930
1/16/1940
1/23/1950
1/31/1960
2/7/1970
2/15/1980
2/22/1990
3/1/2000
Inflow Concentration
Reservoir Concentration-No Settling
Reservoir Concentration-with Some Settling
Standard for Aquatic Life Protection (1.3 µg/L)

HABs

- HABs occur in many reservoirs including Black Butte
- Sufficient nutrients and higher water temperatures (≥66 °F) in Sites Reservoir in May through September could create conditions conducive to formation and maintenance of HABs
- Reservoir Management Plan
  - Monitor for presence of HABs and, if found, cyanotoxins. Add warning signage if warranted
  - Coordinate with Water Board
  - Operate inlet/outlet tower to reduce likelihood of cyanotoxins in release

Other Topics: Salt Pond

- Salt Pond Information
  - August 1997 – dry
  - September 1997 EC = 194,100 µS/cm
  - January 1998 EC = 7,200 µS/cm
  - Estimated flow = 0.1 cfs based on pond size and evaporation rate for region

Other Topics: Salt Pond

- Salt Pond Evaluation:
  - Not expected to have substantial water quality effects
  - Conservatively assumed no decrease in spring discharge
  - Fate of spring discharge:
    - Full mixing of 0.1 cfs for a year into a volume of 200 TAF would represent 0.04 percent of the total volume (EC increase from 130 µS/cm to between 133 – 208 µS/cm)
    - Accumulation at bottom of reservoir due to higher density (74 years to reach low-level intake)
- Reservoir Management Plan
  - Measure EC in springs before construction
  - Measure EC in reservoir after inundation

Other Topics Metals and Erosion

- Metal Leaching from Groundwater
  - Reservoir water expected to seep into ground
  - Groundwater does not have elevated metal concentrations
- Reservoir Bank Erosion
  - Temporary increase in turbidity common to many waterbodies
  - Activities in the reservoir footprint (ranching) unlikely to contaminate soil

Action Items and Future Topics

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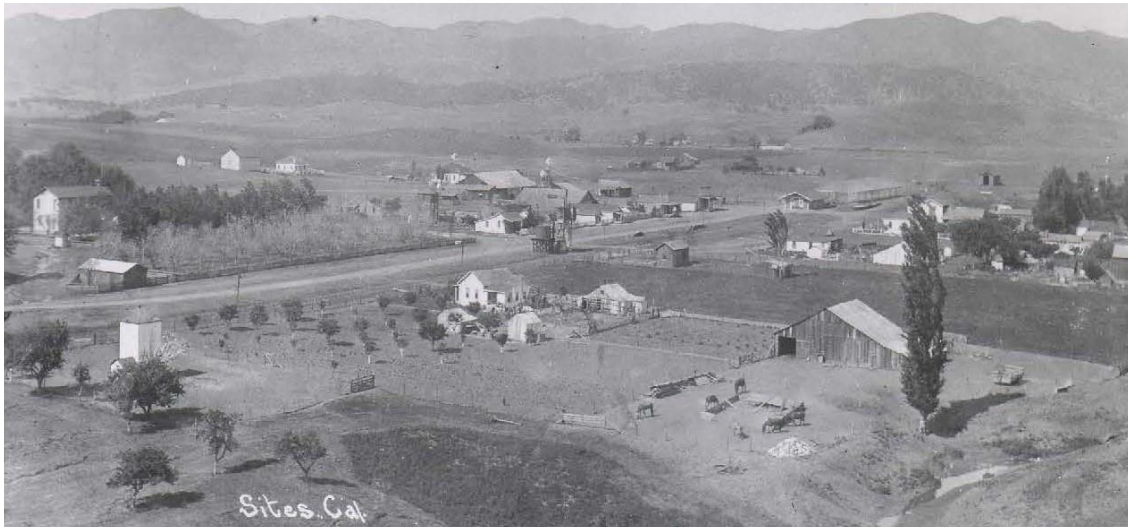
Additional Topics and Action Items

- Any additional questions, thoughts or topics for the next meeting?
- Action item review



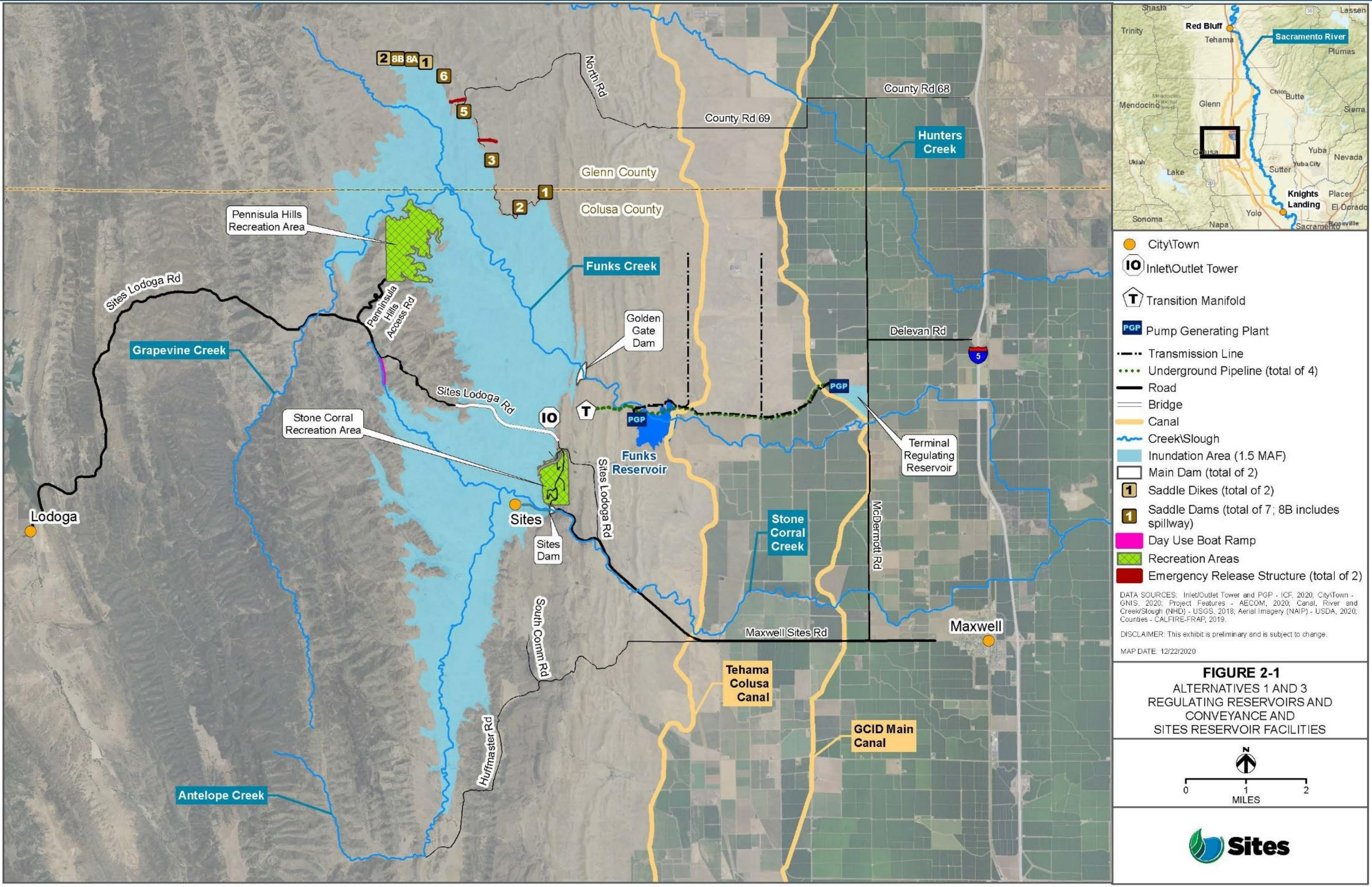
Thank you!

Sites

Method Analysis Overview

Mechanisms by which Sites Reservoir Operations Could Affect Water Quality	Main Constituents Considered	Qualitative	Quantitative	Model Results Considered
Temporal Shift	Metals Pesticides Salinity	X	X	CalSim
Evapoconcentration	Metals Salinity		X	CalSim
In-Reservoir Processes	Mercury HABs Nutrients/OC/DO Temperature	X	X	Reservoir temperature modeling (CE QUAL W2)
Change in System Reservoir Operations	Temperature HABs Mercury	X	X	CalSim, HEC5Q and Reclamation temperature model
Change in Delta Operations	Salinity Chloride	X	X	CalSim and DSM2 QUAL
Redirection of CBD Flow to Yolo Bypass	Pesticides Nutrients/OC/DO HABs Mercury Temperature	X	X	CalSim

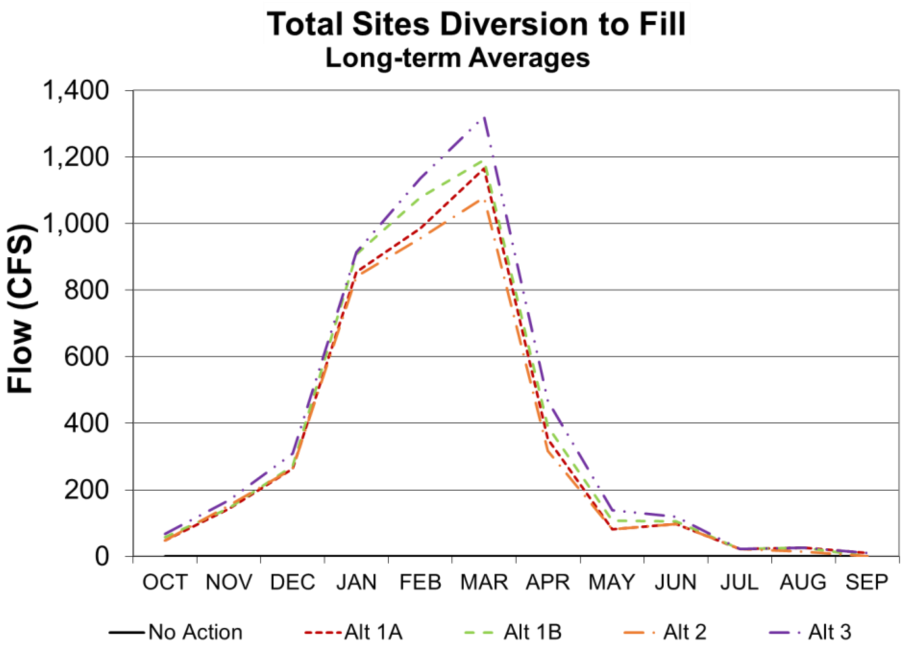
Alt 1 – Preferred Project

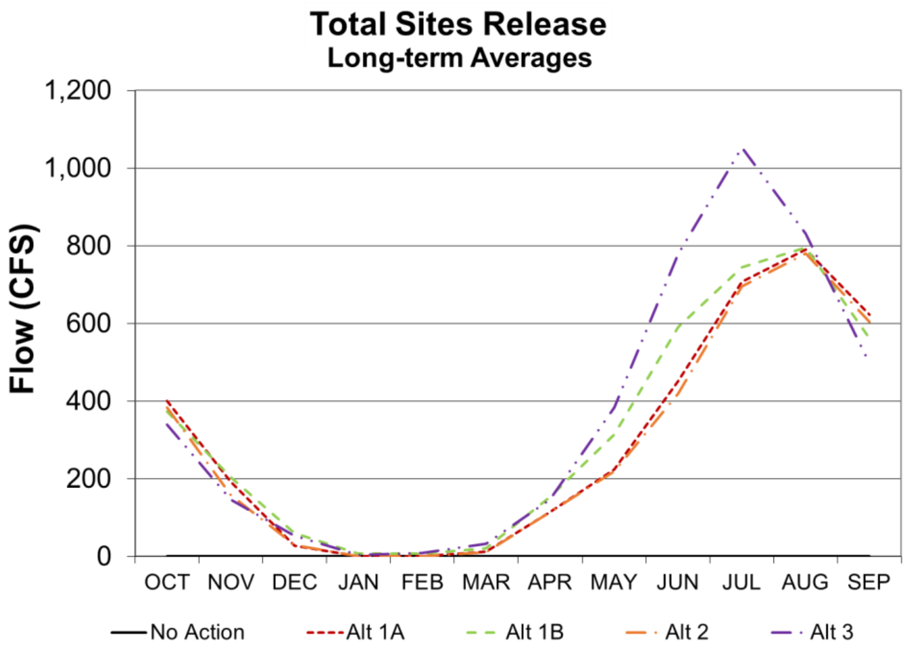


Total Mercury Concentrations (ug/L)

Location	Station	n	Mean Concentration	Maximum Concentration	75th Percentile	Data Range (years)	Source
Funks Creek	Golden Gate	2	0.35	1.2	0.93	2006-2007	DWR Data Library
Stone Coral Creek	-	3	0.85	2.3	1.61	2007	DWR Data Library
Colusa Basin Drain	Knights Landing	26	8.6	19.3	10.8	1996-1998	USGS 2000
Colusa Basin Drain	Knights Landing	66	4.5	75	5.9	1999-2007	CEDEN
Sacramento River	Red Bluff	66	1.3	14.4	1.6	1999-2007	CEDEN
Sacramento River	Hamilton City	66	2.2	54	2.6	1999-2016	CEDEN
Sacramento River	Freeport	217	4.5	89	8.8	1994-2015	CEDEN
Yolo Bypass	Prospect Slough	28	73.2	696	-	1995-2003	Central Valley RWQCB 2010

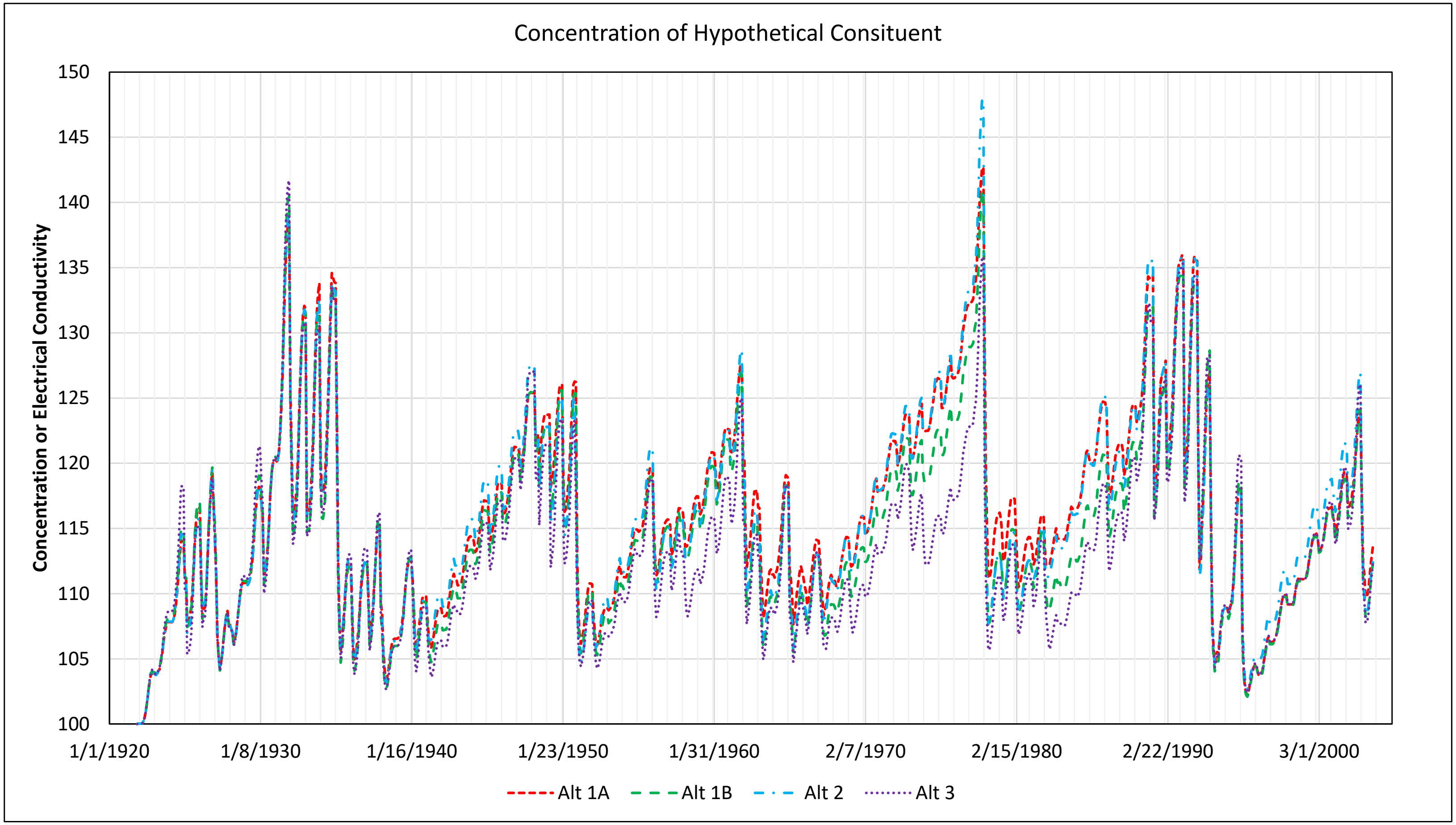
Diversions and Releases



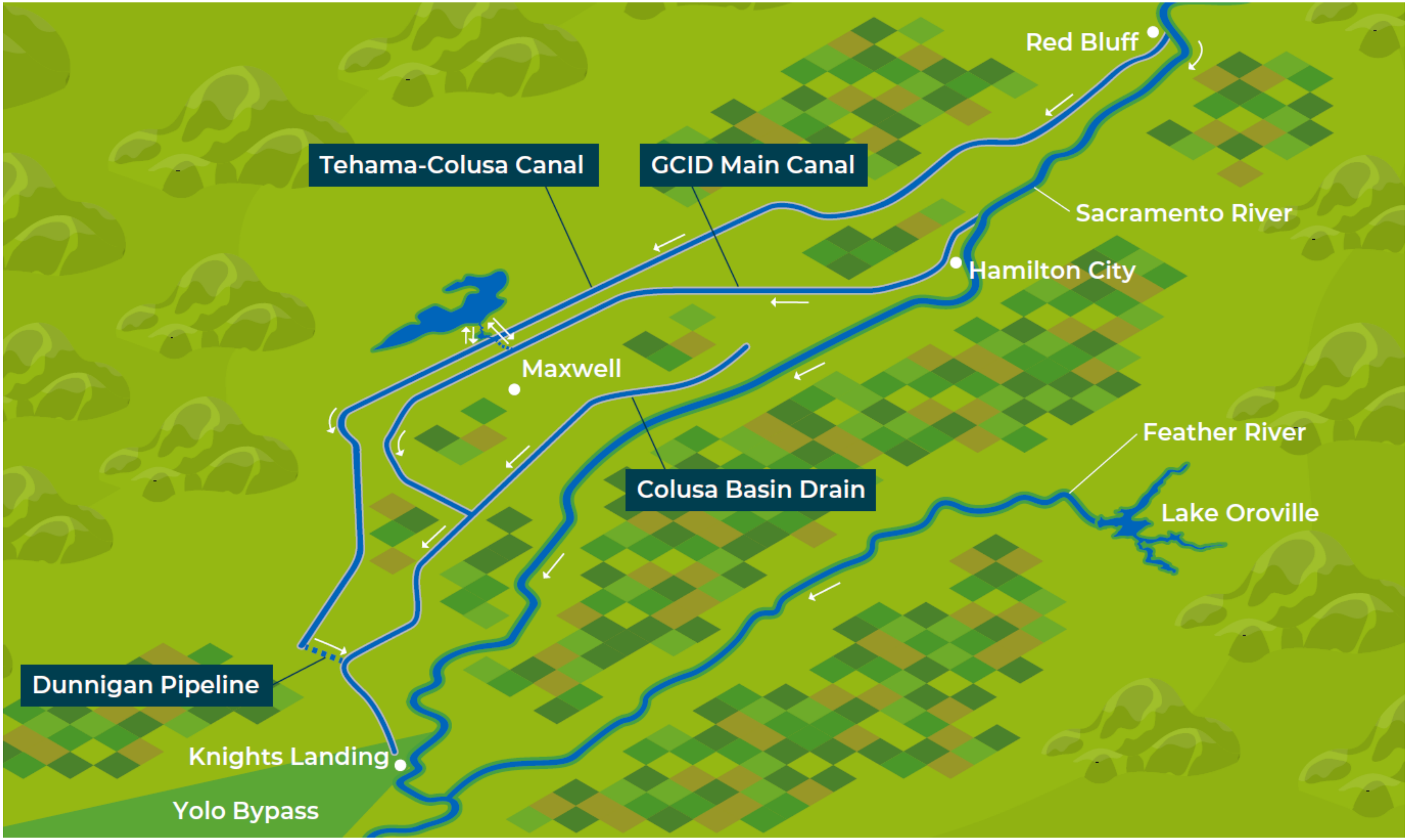


Evapoconcentration

- Calculations using water balance information from CALSIM



Project Water Operations



Main Data Sources

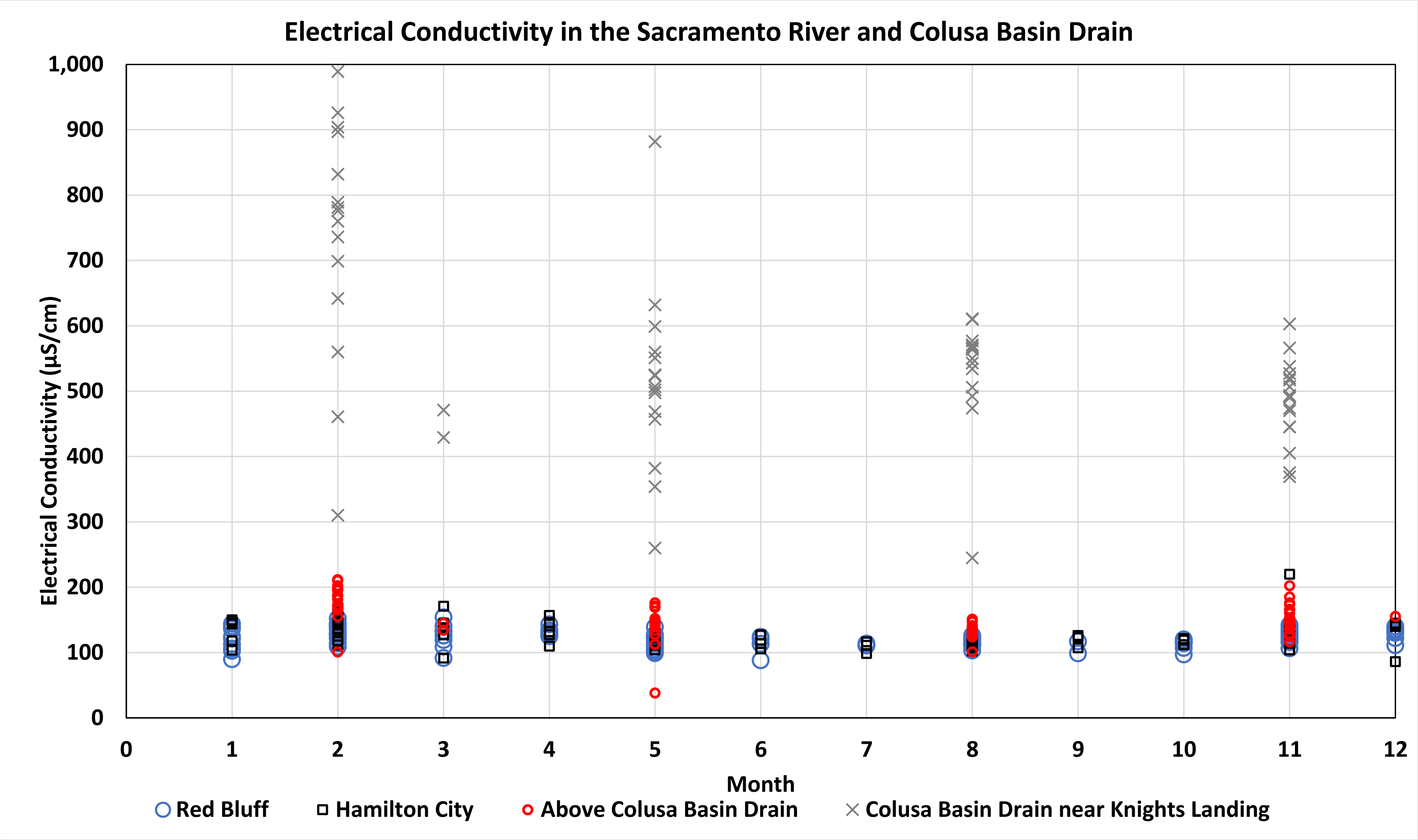
Constituent Group	Data Source	Location
Metals Electrical Conductivity Nutrients	DWR Water Data Library (WDL)	Sacramento River below Red Bluff Sacramento River at Hamilton City Sacramento River above CBD CBD near Knights Landing Stone Corral Creek near Sites
Flow	USGS WDL CA Data Exchange Center	Sacramento River at Keswick Sacramento River above Bend Bridge
Pesticides	CA Dept of Pesticide Regulation Surface Water Database (CDPR SURF)	Sacramento River near Hamilton City Sacramento River at Colusa CBD above Knights Landing Yolo Bypass Toe Drain near Babel Slough

Average Metal/Metalloid Concentrations

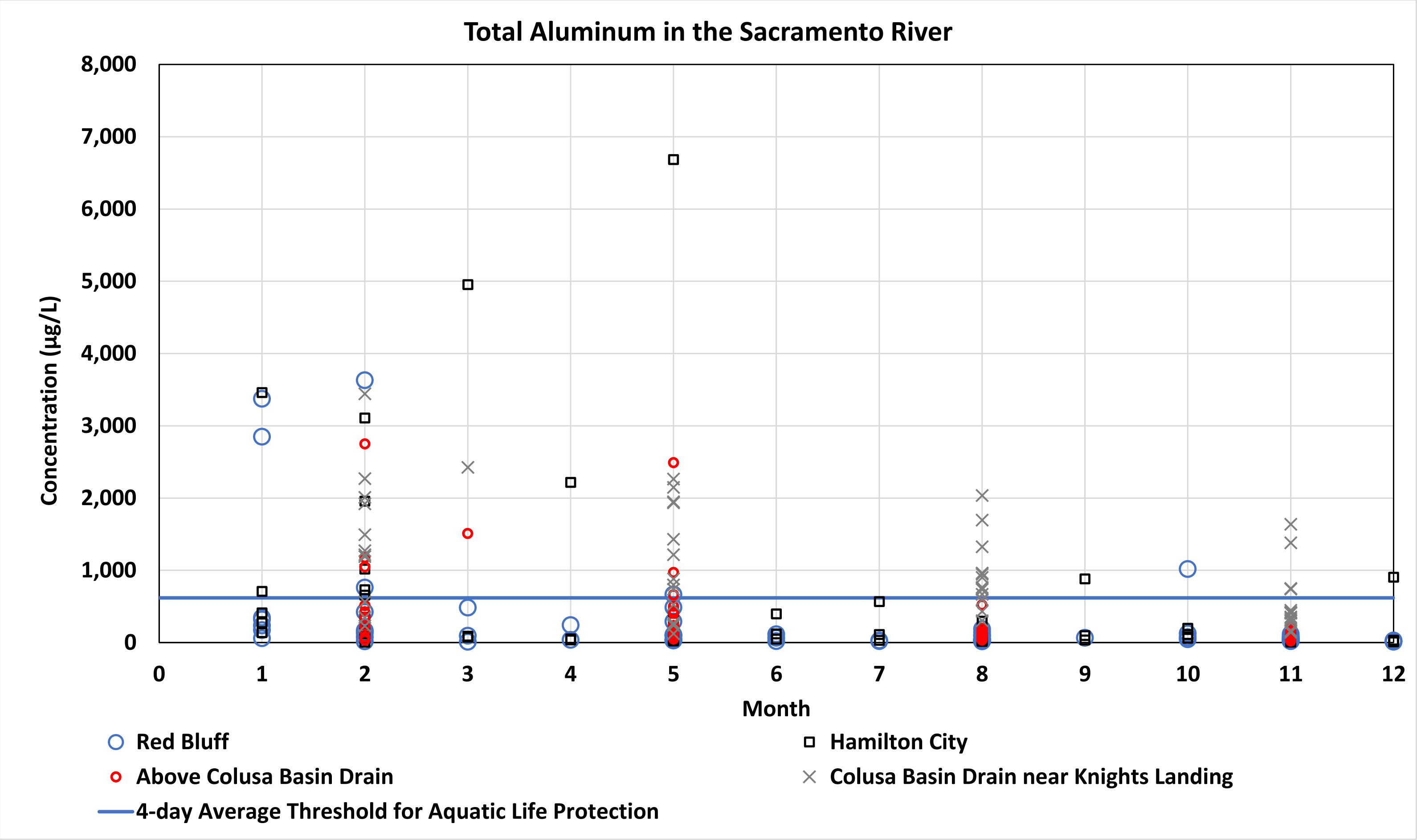
- Units are in micrograms per liter
- No available data for Funks Creek
- Source for Stone Corral Creek and Sacramento River = DWR Water Data Library. See Slide 14
- Source for groundwater is DWR NODOS study (2007)

Metal/Metalloid	Stone Corral Creek	Groundwater in Sites Reservoir Footprint	Sacramento River at Intake Locations
Dissolved Aluminum	149	3	94
Total Aluminum	562	12	359
Dissolved Arsenic	2.8	0.7	1.5
Total Arsenic	3.1	0.8	1.6
Dissolved Cadmium	0.05	0.02	0.04
Total Cadmium	0.06	0.05	0.04
Dissolved Chromium	2.9	2.6	0.7
Total Chromium	4.0	3.3	1.4
Dissolved Copper	2.8	2.7	1.3
Total Copper	3.9	3.4	2.3
Dissolved Iron	123	7	67
Total Iron	512	81	424
Dissolved Lead	0.08	0.12	0.03
Total Lead	0.31	0.27	0.20
Dissolved Manganese	12	18	2
Total Manganese	37	21	15
Dissolved Nickel	2.8	1.0	1.2
Total Nickel	4.0	1.3	2.2
Dissolved Selenium	6.1	4.6	1.2
Total Selenium	6.7	5.0	0.2
Dissolved Silver	0.03	0.00	0.01
Total Silver	0.05	0.01	0.03
Dissolved Zinc	1.4	112.5	0.9
Total Zinc	3.7	115.2	3.8

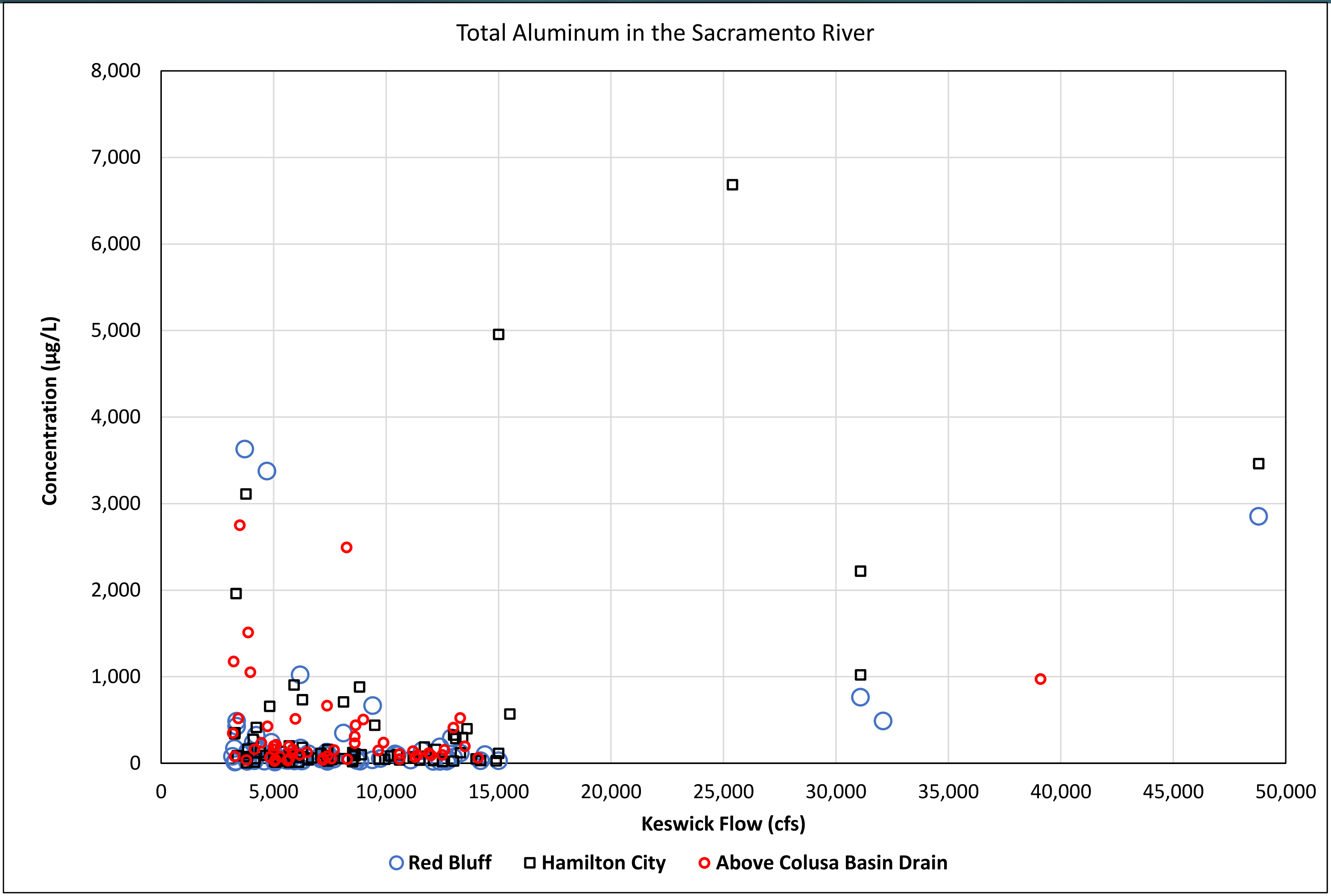
Electrical Conductivity



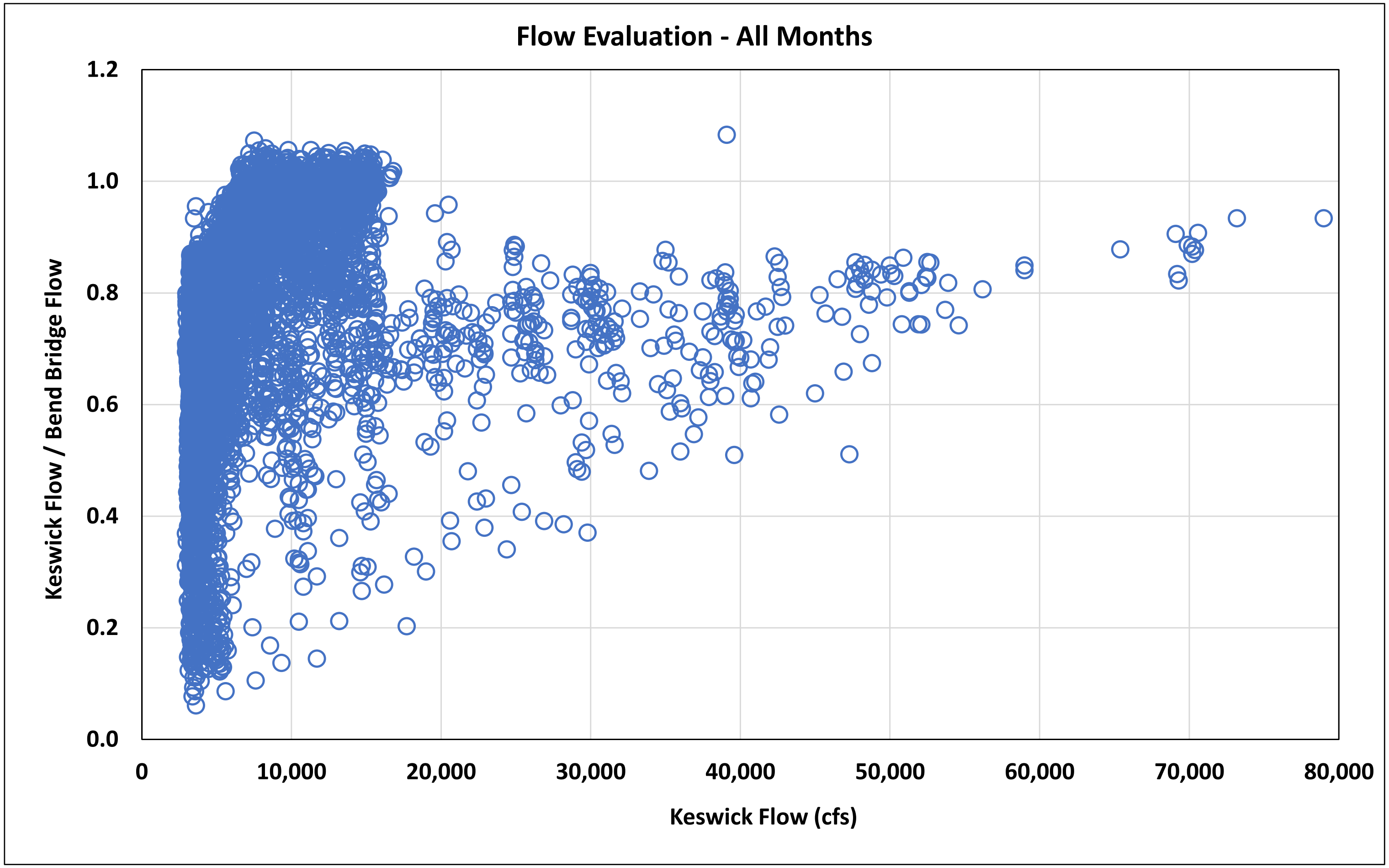
Metals – Aluminum Example



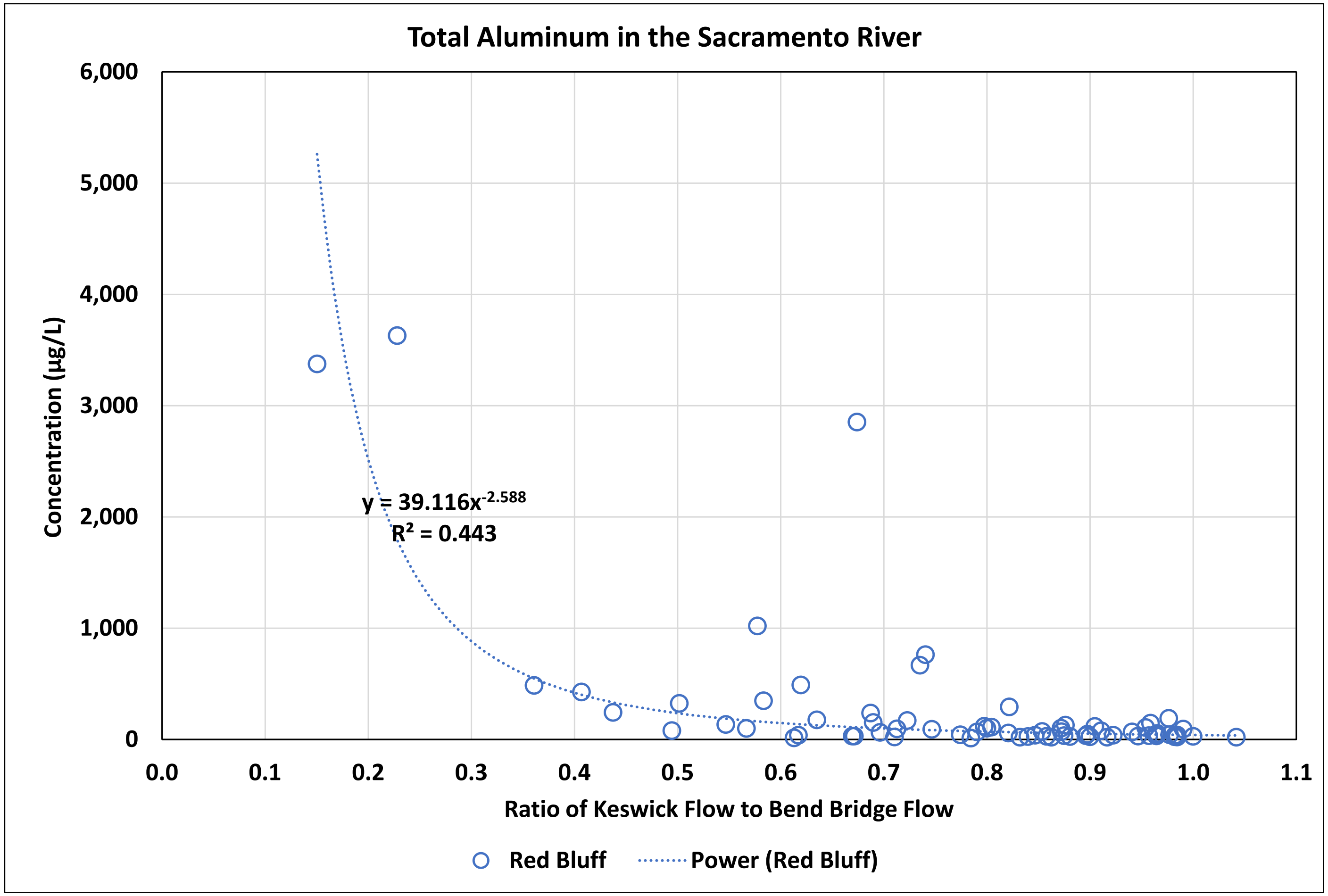
Compared to Flow



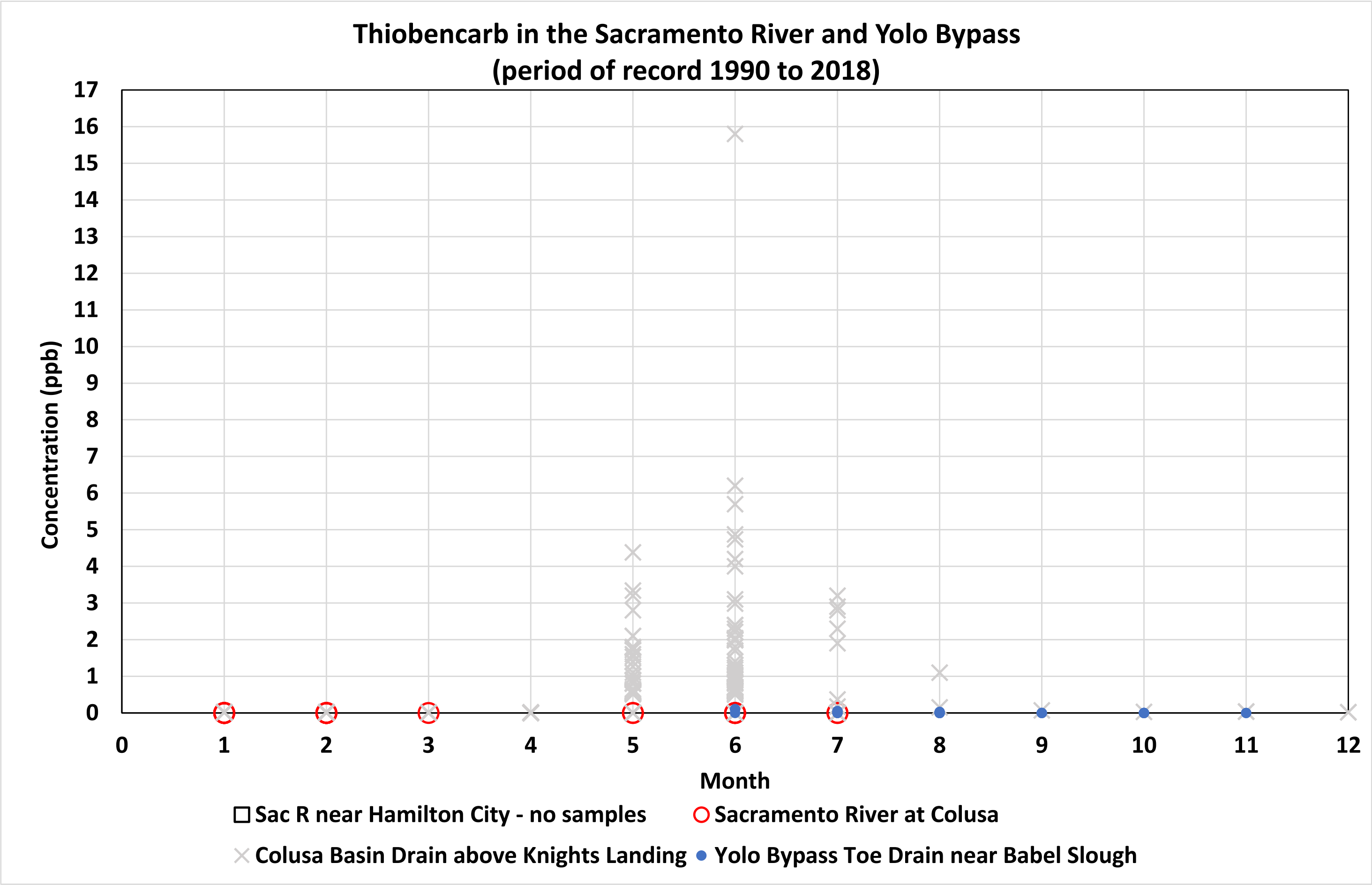
Sacramento River Indicator of Local Runoff vs Flow



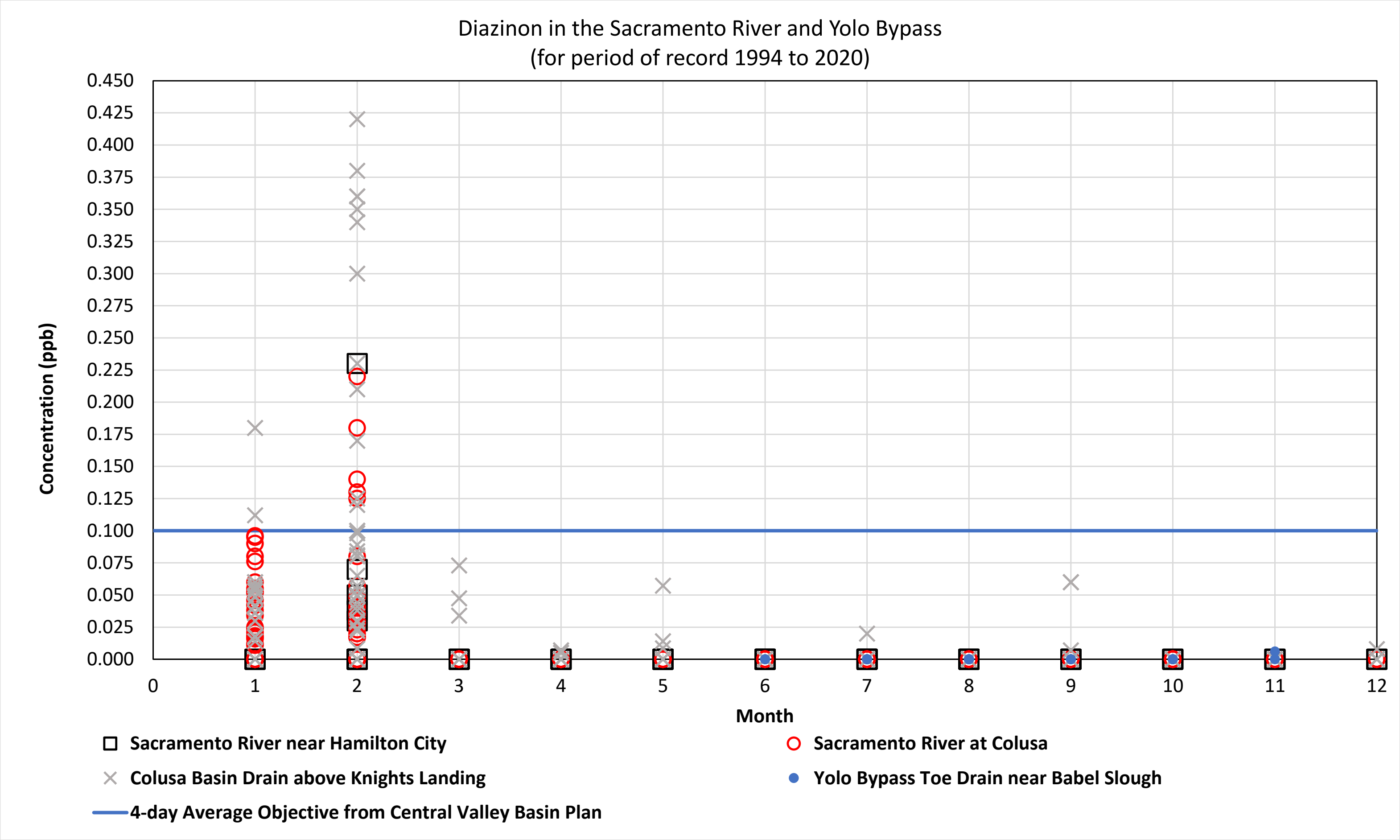
Example Quantitative Approach



Thiobencarb – typical pesticide pattern



Diazinon – atypical pesticide pattern



Other Topics: Salt Pond

- Salt Pond Evaluation:

Estimated Electrical Conductivity (EC in µS/cm) of reservoir release assuming 0.1 cfs salt spring flow is continually mixed with reservoir release and that Sacramento River EC is 130 µS/cm.

Spring EC	Reservoir Release (cfs)	
(µS/cm)[a]	10 cfs	1,200 cfs
7,200	201	131
194,100	2,070	146

[a] Spring EC between these two values.