Real-Time Monitoring of the Lake Combie Reservoir Sediment and Mercury Removal Project:

Mercury Proxy for Adaptive Management Capabilities

DTMC, February 9th, 2021

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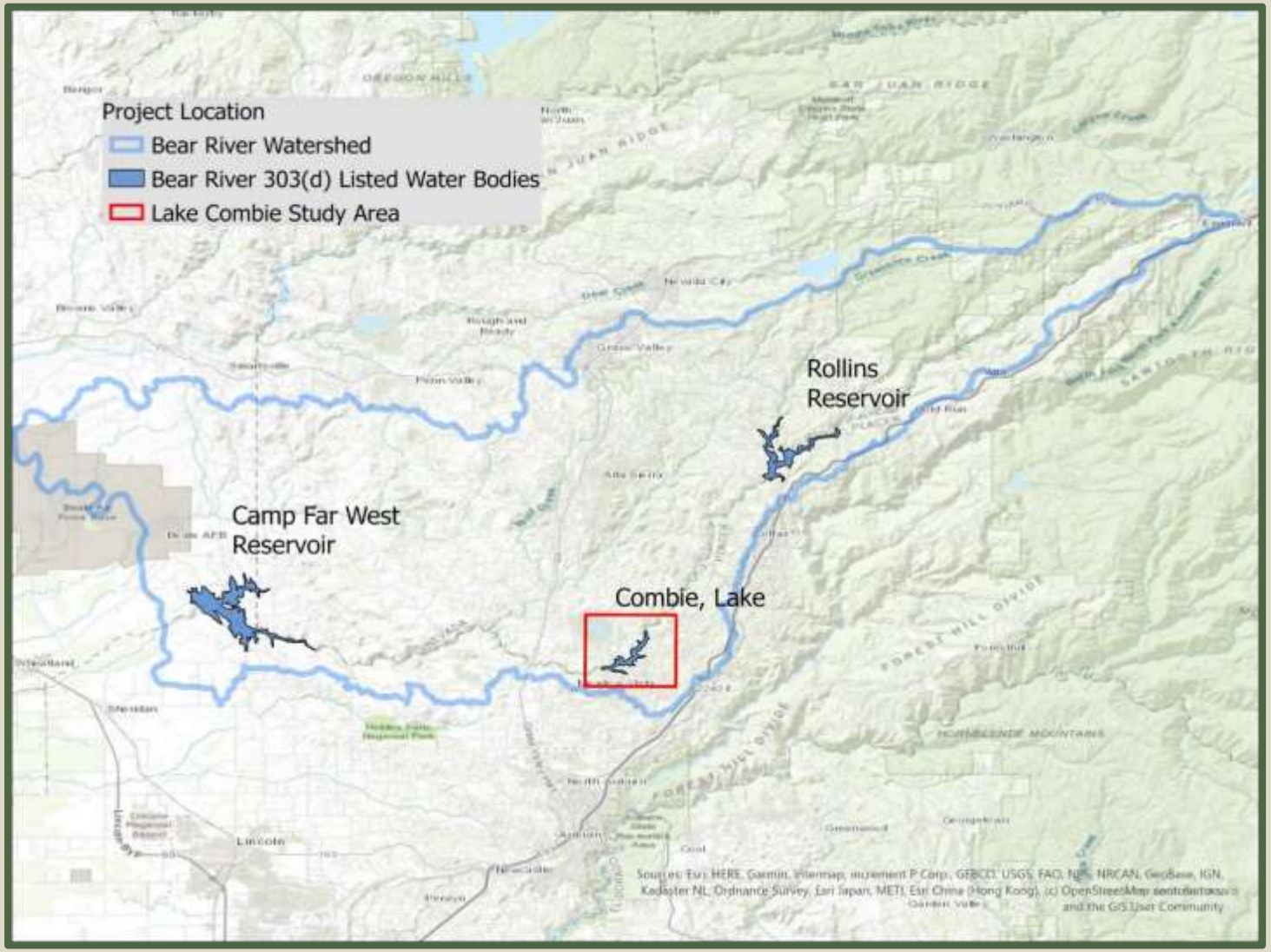
Background

Bear River and Mercury

- One of the Sierra Nevada watersheds most severely impacted by hydraulic mining and mercury contamination (May et al., 1999; Alpers et al., 2018).
- The Bear River and its three impoundments; Rollins, Combie, and Camp Far West Reservoirs are 303(d)-listed as impaired for mercury by (CVRWQCB) and have Site Specific Fish Consumption Advisories for mercury (OEHHA, 2009)

Dutch Flat 1857-1870

Project Overview



Lake Combie Reservoir Sediment and Mercury Removal

Project Development

Combie Reservoir
Sediment and Mercury Removal

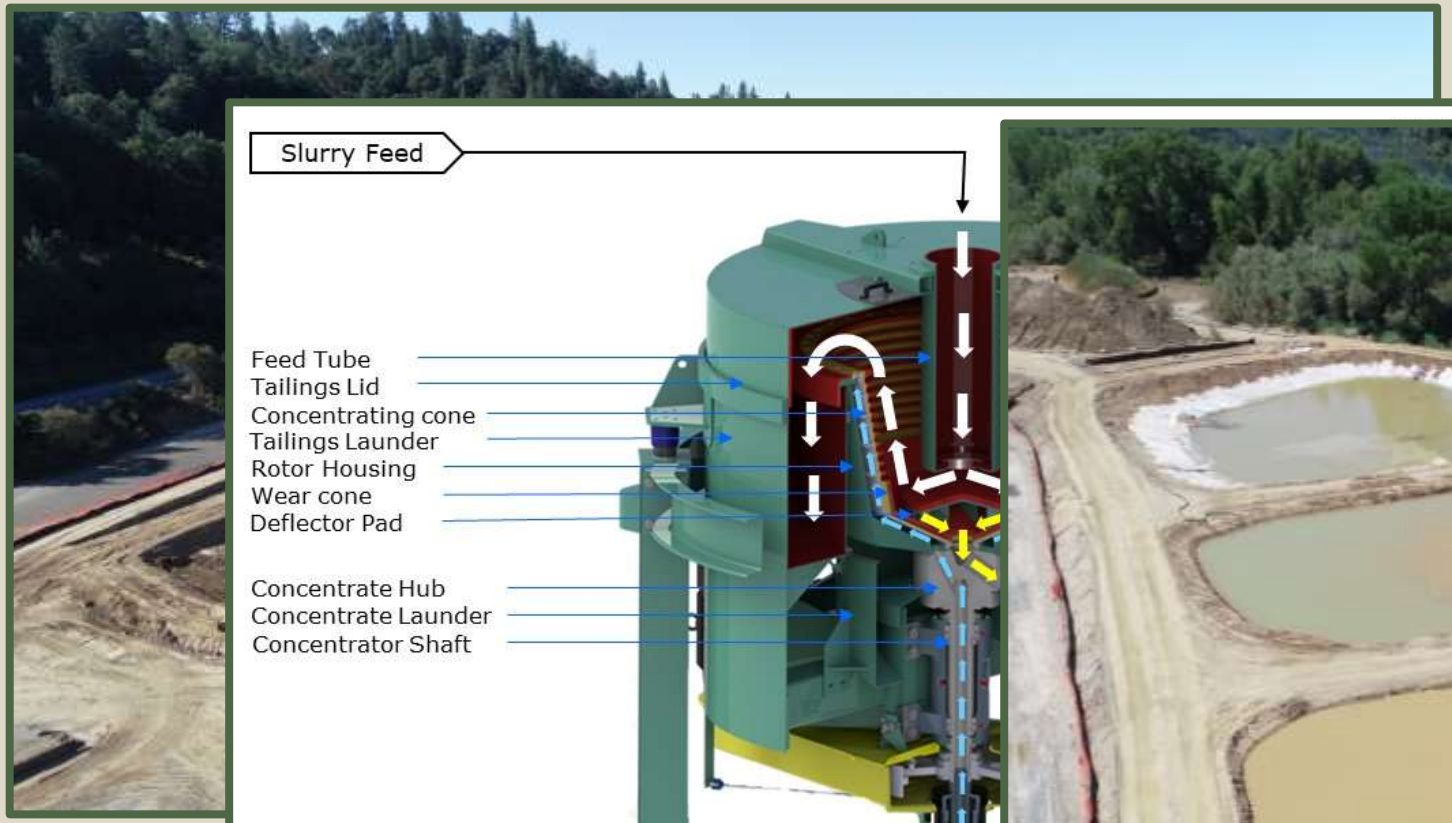
Project Purpose

- **Remove** accumulated sediment and mercury from Combie Reservoir, thus restoring reservoir capacity for agriculture, domestic drinking, hydroelectric power generation and recreation use.
- **Measure** and analyze ecological effects of MeHg concentrations in Combie prior and post removal activities.
- **Develop** an efficient, compliant and sustainable combination of processes for sediment removal at similar mercury-impacted reservoirs within the state.

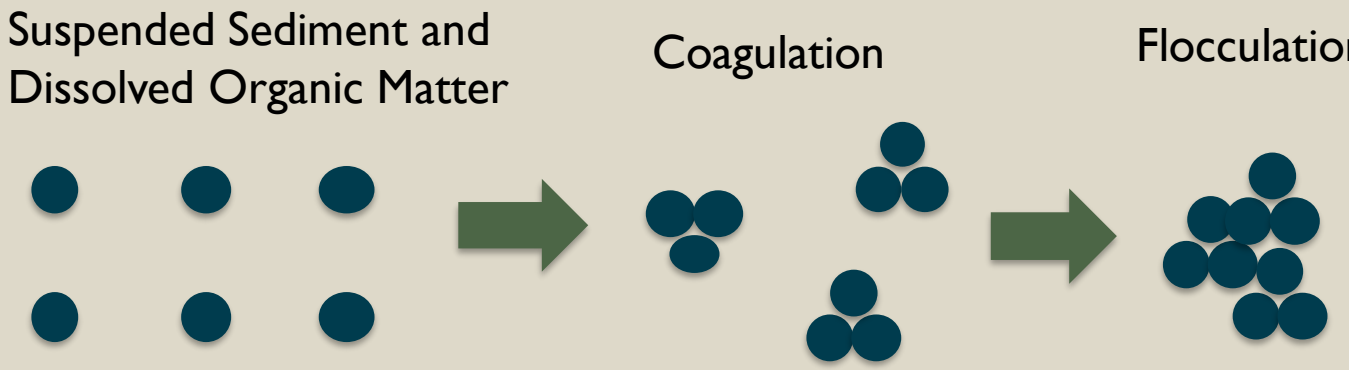
Dry Excavation-2018

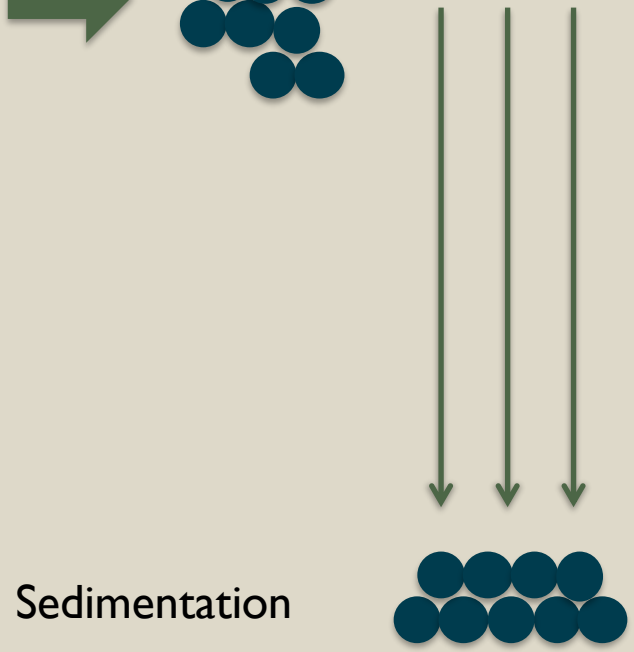
Dredging-2019

Processing-2019



Coagulation and Flocculation Water Treatment Process





Water Treatment, Settling Ponds and Real-Time Monitoring

Monitoring Overview

Lake Combie Sediment and Mercury Removal Project
Sampling Locations:

<u>USGS Established Monitoring Points:</u>

- CR1-A
- CR1-D

<u>The Sierra Fund Established Monitoring Points:</u>

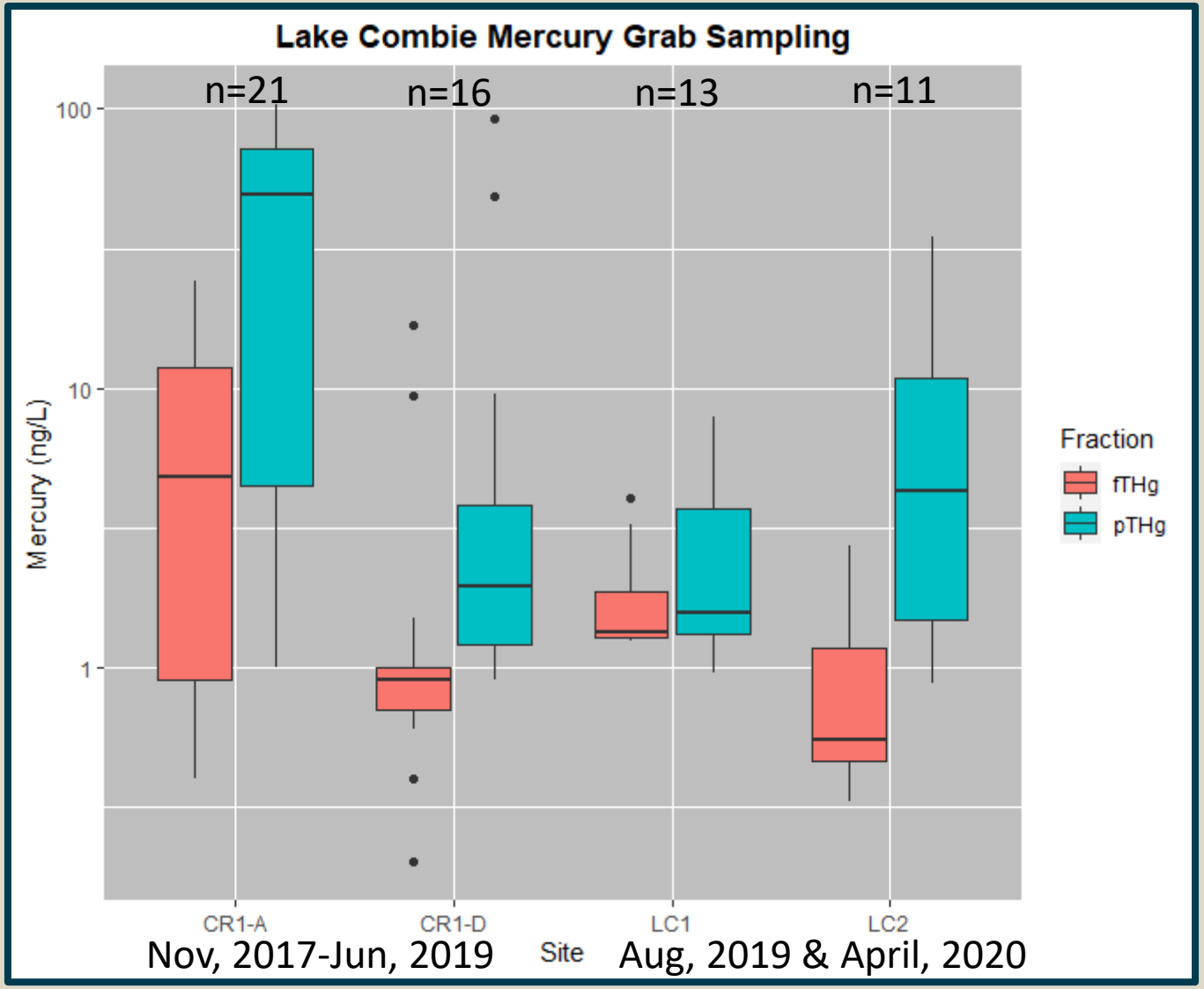
- LC1
- LC2

Real-Time Monitoring

LC1: Placement of this station ~100' upstream of the intake pump location represented background water quality levels, acting as the benchmark for the process effluent to be measured against.

LC2: Placement of this station inside a 3,000 gallon poly tank allowed for the water quality of the effluent to be monitored prior to release to Lake Combie Reservoir.

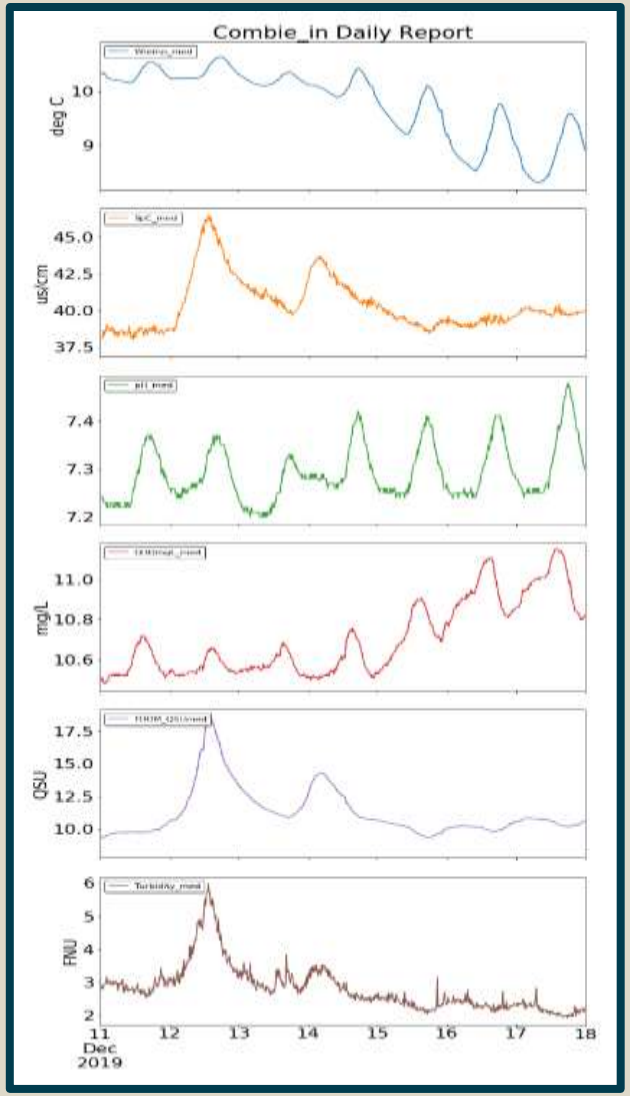
Grab Sampling



Nov, 2017-Jun, 2019

Aug, 2019 & April, 2020

Data Collection & Maintenance

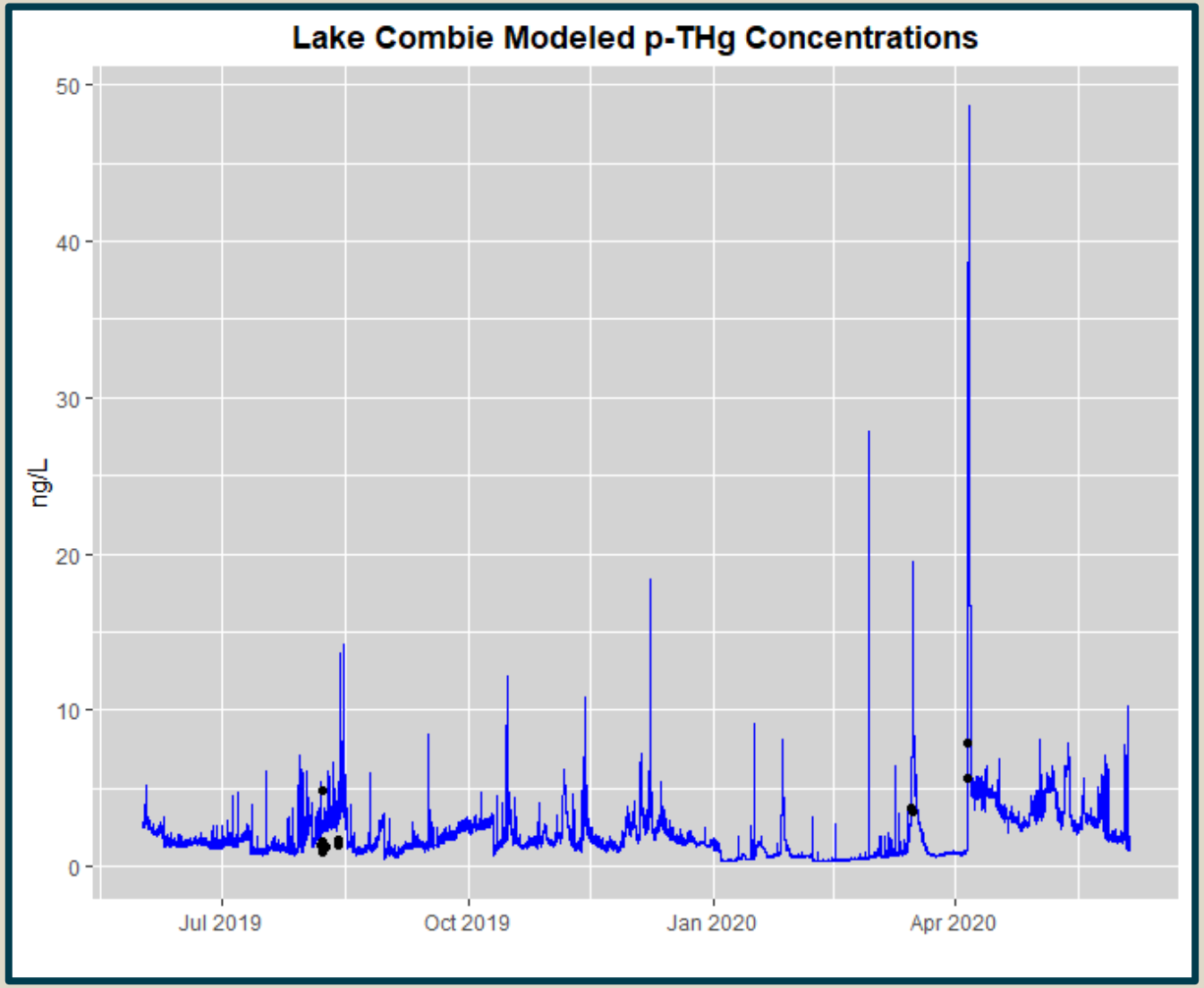


Data collection platforms were programed to send daily reports to mangers and stakeholders of the previous 7 days of data on a scheduled interval, "Combie Daily Report."

EXO's at LC1 and LC2 were cleaned and calibrated monthly. Figure shows the amount of bio-fouling on the EXO following one month of deployment at LC1.

EXO deployment tubes were also scrubbed free of growth both inside and out reduce micro climate bias.

LC1 p-THg Proxy Concentrations



Predictive p-THg Proxy:

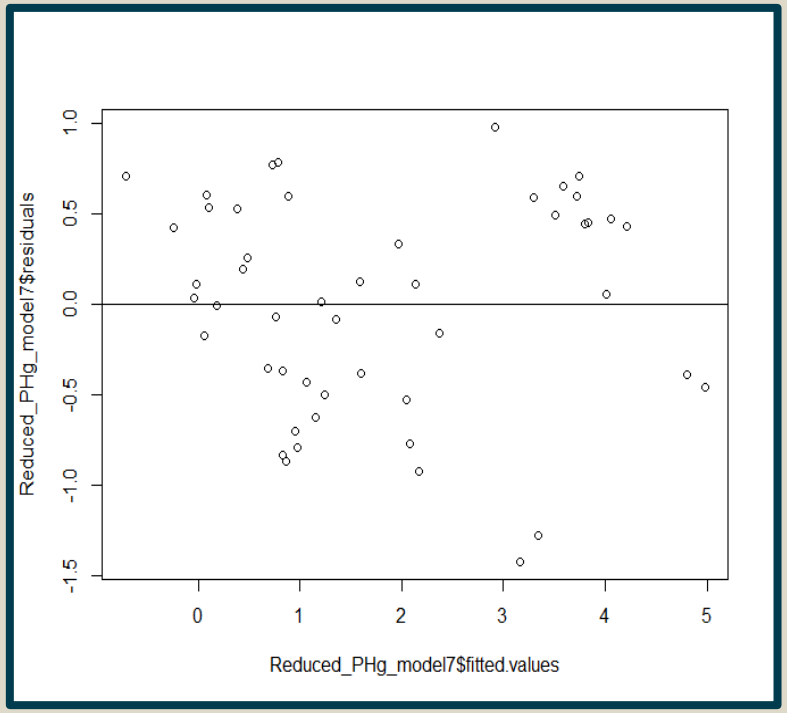
$$p-THg\left(\frac{ng}{L}\right) = e^{3.37608+1.26408(\ln(X_1))-1.16008(ln(X_2))}$$

Where:

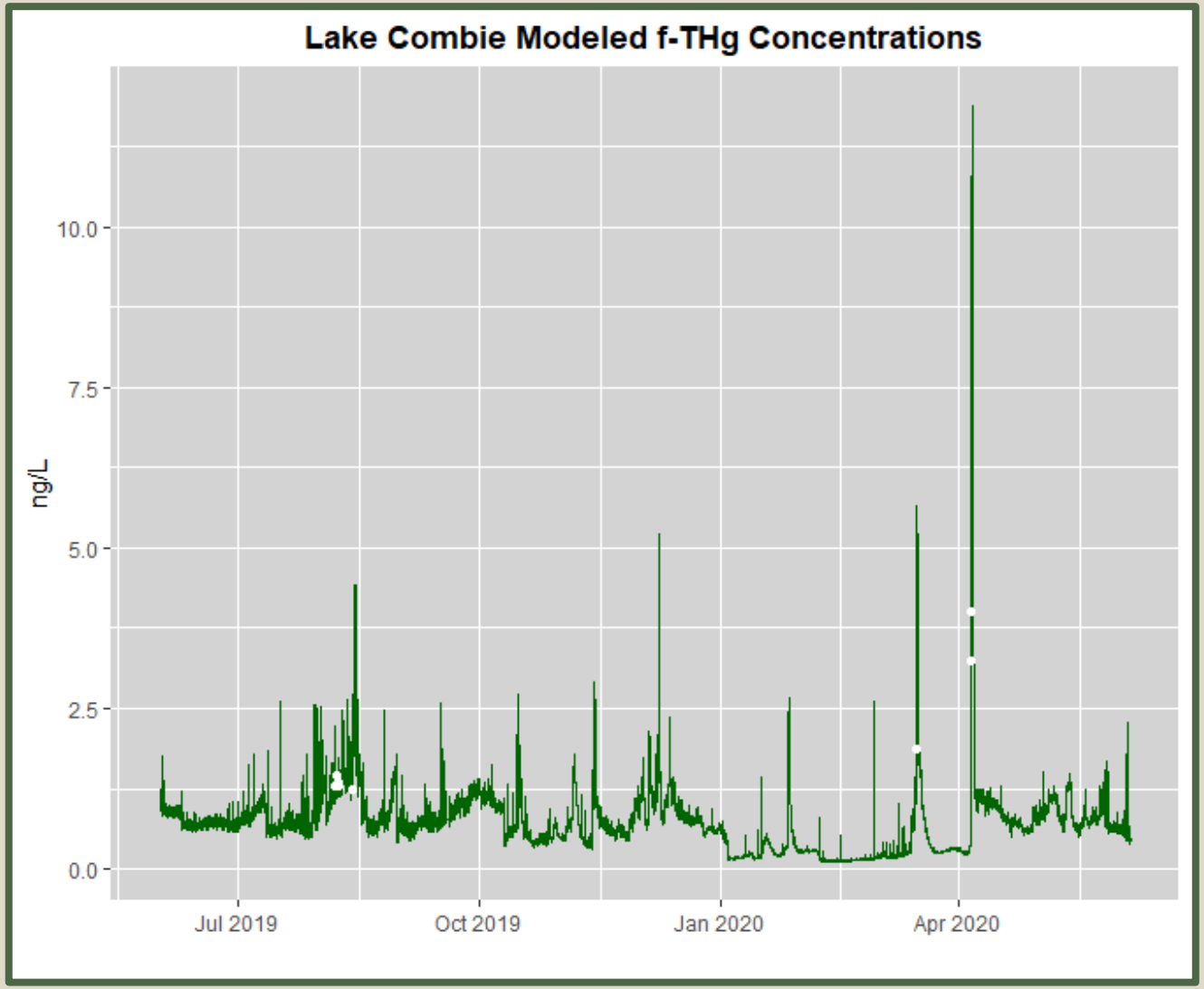
X_1 = Turbidity (FNU)

X_2 = Total Dissolved Solids (mg/L)

Model resulted in a R^2 value of 0.79 with a residual standard error of 0.71 on 58 degrees of freedom.



LC1 f-THg Proxy Concentrations



Predictive f-THg Proxy:

$$f-THg\left(\frac{ng}{L}\right) = e^{3.78314+0.7103(ln(X_1))+0.928(ln(X_2))-1.9553(\ln(X_3))}$$

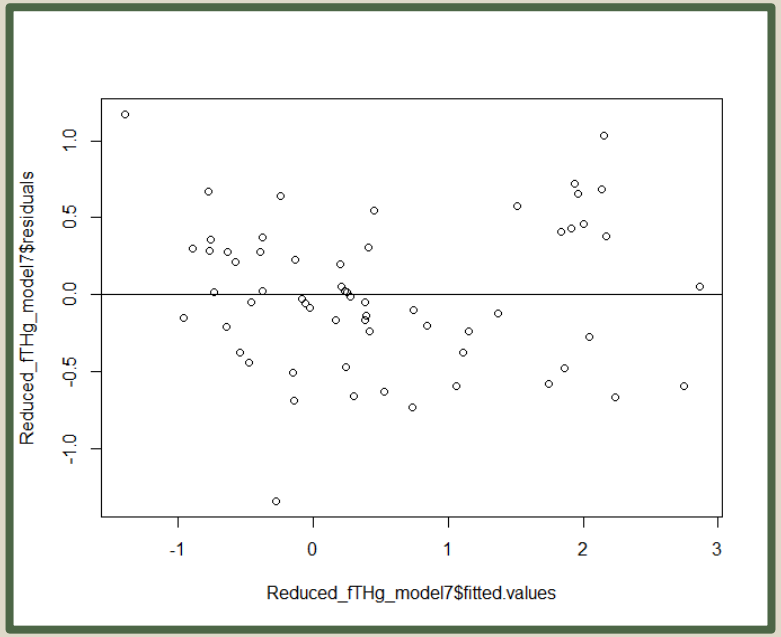
Where:

X_1= fDOM (QSE)

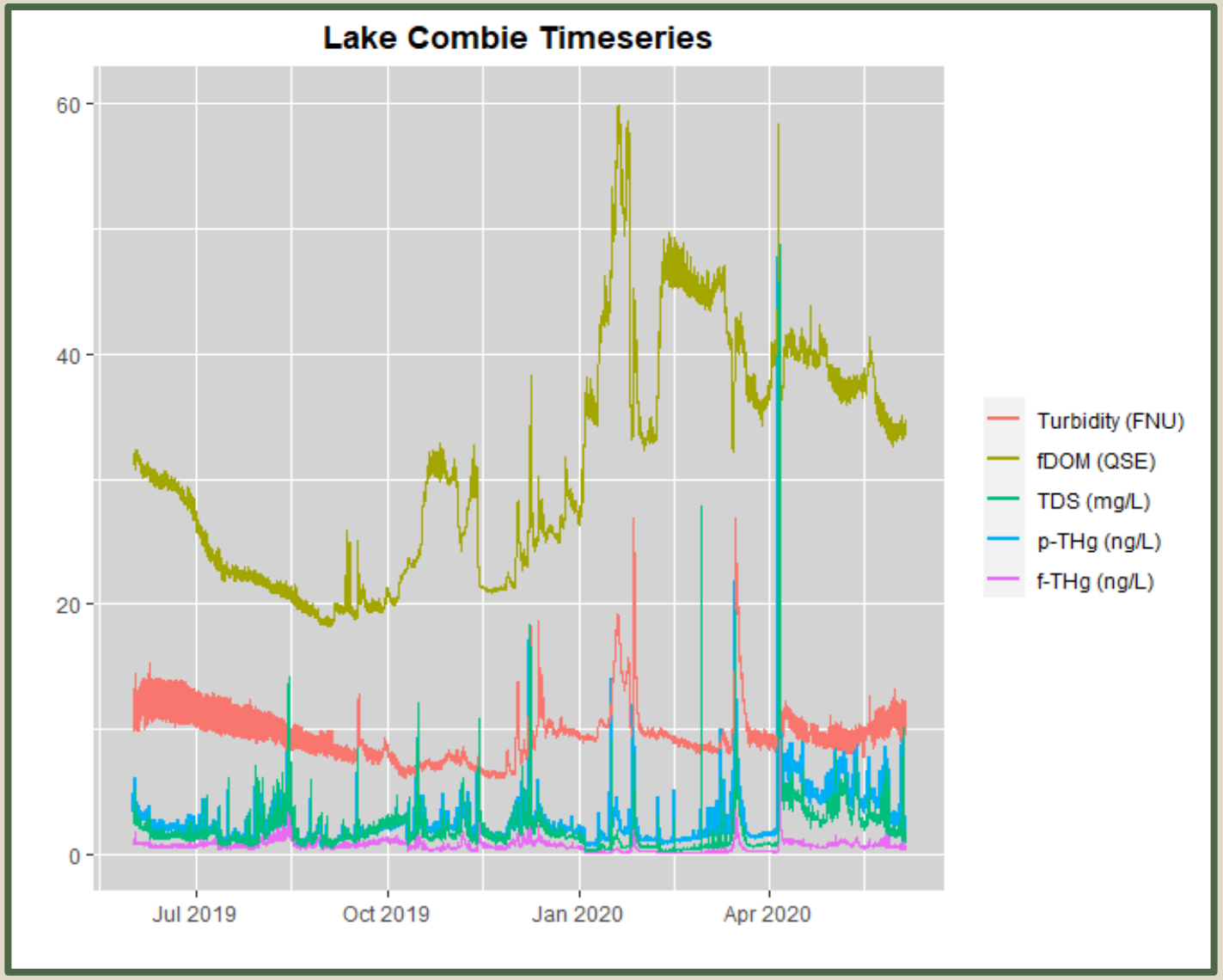
X_2= Turbidity (FNU)

X_3= Total Dissolved Solids (mg/L)

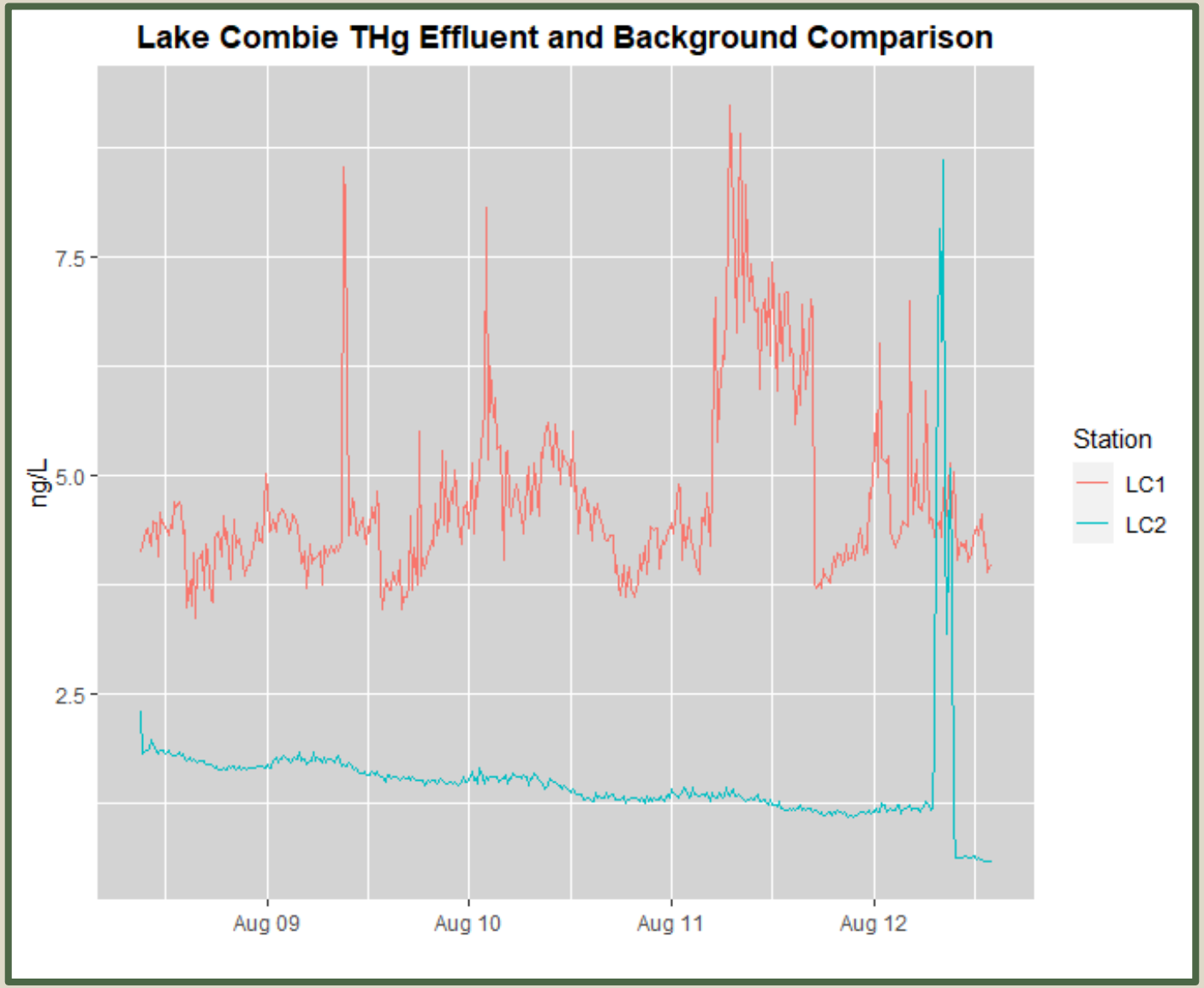
Model resulted in a R^2 value of 0.82 with a residual standard error of 0.48 on 58 degrees of freedom.



Parameter Comparisons



Process Effect



Conclusions

- Model outputs for the prediction of p-THg and f-THg suggest that the use of real-time monitoring at the Lake Combie Sediment Removal Project can provide NID and its partners with adaptive management capabilities for both compliance and mercury monitoring during operation.
- Having pre-project grab sampling data for Hg analysis and paired ancillary water quality data across a range conditions is key to model(s) creation and use at project initiation.
- Adding flow monitoring equipment to the data collections platforms would facilitate the quantification of Hg loading at and between the "Background" and "Effluent."
- Particulate (p-THg) and filtered (f-THg) mercury prediction models were developed for the Lake Combie Reservoir, similar relationships are expected in areas affected by legacy mercury contamination. This framework for model generation will have to be developed on a site by site basis.
- Having the ability to calculate statistically significant p-THg and f-THg concentrations instantaneously is revolutionary in the realm of trace metal sampling. This framework of data collection will facilitate the growth and scale of addressing Hg-contaminated sediments within reservoirs, lakes and rivers.

Citations

May, J.T., Hothem, R. L., Alpers, C. N., and Law, M. A., 1999. Mercury Bioaccumulation in Fish in a Region Affected by Historical Gold Mining: The South Yuba River, Deer Creek, and Bear River Watersheds, California, 1999. U.S. Geological Survey Open-File Report 00-367.

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USEPA (U.S. Environmental Protection Agency.) 2005. Method 415.3 determination of total organic carbon and specific UV absorbance at 254 nm in source water and drinking water, EPA Document #: EPA/600/R-05/055.

Thank You Project Partners and Funders!

PROJECT OWNER

NID

MISSION STATEMENT

The District will provide a dependable, quality water supply; continue to be good stewards of the watersheds, while conserving the available resources in our care.

For more information regarding this project, please visit: www.nidwater.com/projects

PROJECT CONTRACTOR

GREAT LAKES ENVIRONMENTAL & INFRASTRUCTURE

MISSION STATEMENT

Committed to minimizing your risk and liability, through a culture of safety, innovation, and excellence.

PROJECT PARTNERS

NV5

USGS science for a changing world

PERMITTING AGENCIES

US Army Corps of Engineers.

PROJECT FUNDING

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Contact Us!

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