March 26, 2018
CIWQS Place No. 717685

Sent via electronic mail to vgin@valleywater.org – no hard copy to follow

Santa Clara Valley Water District
Attn.: Vincent Gin, Deputy Operating Officer
Watersheds Stewardship and Planning Division
5750 Almaden Expressway
San Jose, CA 95118

Subject: Comments on 2016–2017 Progress Report on Methylmercury Production and Control Measures

Dear Mr. Gin:

This letter provides our comments on Santa Clara Valley Water District's (District's) recent progress report. We appreciated discussing this report with District staff on January 16 and February 8. These comments are made in the spirit of finding the best and most efficient means for the District to address the mercury problem in its reservoirs, and not to take away from the excellent work done by District staff in preparing this report.

Thank you for timely submission of the technically excellent and comprehensive report: Guadalupe River Watershed Mercury TMDL: 2016–2017 Progress Report on Methylmercury Production and Control Measures. Each section of the report opens with a helpful technical explanation, and flows well from one section to the next. The technical and statistical analysis is complex and thorough, and yet presented in a very readable manner. The conclusions are well-supported. All this from staff who are new to mercury and managing reservoir water quality—a significant accomplishment.

The District submitted this report for voluntary compliance with the Guadalupe River Watershed Mercury TMDL. In summary, the District is meeting its commitment to voluntarily undertake the following:

- Technical studies of methylmercury production and control;
- Monitoring of mercury and methylmercury loads discharged from reservoirs and lakes to demonstrate progress in reducing loads;
- Monitoring of fish tissue mercury to assess progress in attaining targets;
- Special studies 1 and 2 in Basin Plan section 7.7.1.6 [*Link*].

The following comments address Section 10, Recommendations:

Current District Study

- Water Board staff agree with proposal to eliminate Sampling Sites 2–5 at Lake Almaden. Please add the following to the report, suggest as footnotes:
    - Reference the 2014–2015 biennial report, pp. 5-6 and 5-7, that at Site 1 mid-depth methylmercury concentrations were immediately reduced following installation of circulator, see Figure 27.
    - Explain change in mid-depth water column data collection method.
- Water Board staff agree with the proposal to discontinue manganese and iron sampling in reservoirs. Please document the poor correlation of manganese and iron to dissolved oxygen in hypolimnion in Calero Reservoir. Please also document in the report that redox potential in hypolimnia was unchanged, but became more reducing in epilimnia.
- Water Board staff concur with the proposal to discontinue outlet sampling at Almaden, Calero, and Stevens Creek reservoirs because hypolimnia data will continue to be collected and is demonstrated by analysis in this report to be statistically indistinguishable from outlet data.
- Water Board staff agree with proposal to discontinue monitoring of the following analytes: Ammonia, Total Phosphorus, Nitrate, and Nitrite.

Future Studies

- Please re-word the first bullet (dry-season methylmercury in photic zone) to clarify if the District is considering pursuing this in 2018–2019 or if this recommendation is intended for a different purpose.
- Water Board staff concur that line diffuser systems may not be ideal for controlling methylation in some reservoirs.
- In regards to the third bullet (effects of outlet structure), please note that as part of the Calero Dam Seismic Retrofit Project, the District may modify or replace Calero Reservoir outlet works, and so may be able to make this comparison in the future for Calero.
- Thank you for the well-supported suggestion to use less predatory fish as “biosentinels” or “remediation effectiveness indicators” in the Statewide Mercury Control Program for Reservoirs.

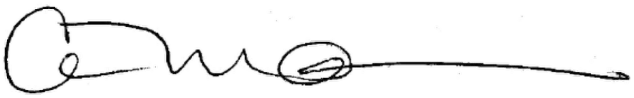
The following are over-arching comments on the report:

1. Prior to installation, what were the expected measurable benefits from oxygenation in each of the reservoirs? Please add to section 8.3, Dissolved Oxygen Saturation, whether the oxygenation systems performed as expected in 2016 and 2017. Please also add a discussion regarding the horizontal extent of oxygen dispersal.
2. What changes to operations and/or monitoring do you recommend for the next two years? Please include these recommendations in Section 10.
3. Add to the recommendations section that Special Study 1 is resolved and request to discontinue it.
4. Please document what is and what is not completed from Water Board's May 3, 2016 letter, in section titled "Comments on Work Plan for 2016 & 2017 and December 2017 Progress Report." (This may be a letter separate from progress report.)
5. Please clarify what data were used in sections 7 and 8 (see comment 11).
6. The report is missing a section that presents and discusses methylmercury data; please add a new section 7.13 on Methylmercury. This will support the section on Methylation Efficiency, which is defined as the ratio of methylmercury to total mercury.
7. The report is missing a section that presents and discusses depth profiles, importantly including redox potential and dissolved oxygen. Please include (in Section 7) for each waterbody, August of one year, a depth profile of temperature and dissolved oxygen, and discuss thermocline and oxycline. (See related comment 8 regarding quantify stratification. Additionally, this will support your statement in discussion in section 7.5 regarding strong and weak thermoclines and oxyclines.)
8. Add quantitative analysis of stratification to section 7.5. If insufficient data are available for these metrics, add to recommendations to collect and evaluate data in the next biennial report. Some metrics for stratification are provided in Attachment 2.
9. Section 8.1, please expand the description of hypolimnetic oxygenation systems to describe how far above the reservoir bottom the lines are placed, if there is different vertical placement in different reservoirs, and if placement changed vertically or otherwise over time. Discuss whether line diffusers are effective at oxygenating the sediment-water interface in each reservoir.
10. Please state early in the Executive Summary, Introduction, and in Recommendations that the District is committed to continuing this work.

Additional technical comments are provided in Attachments 1 and 2. We request that the District provide a revised final 2016–2017 progress report by the end of April 2018. We look forward to reviewing and discussing with District staff the subsequent document, Sampling and Operations Plan for 2018–2019.

In closing, Water Board staff again commends District staff on the technically excellent and comprehensive 2016–2017 progress report. Should you have any questions about these comments, please do not hesitate to contact me at (510) 622-1015 or via e-mail to Carrie.Austin@WaterBoards.ca.gov.

Sincerely,



Carrie M. Austin, P.E.
Environmental Engineer

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Attachment 1: Additional Technical Comments

Numbering of comments continues from main body of letter.

11. Section 7. Please clarify what data are included in Sections 7 and 8.
    a. It is not entirely clear what water data were used. Please edit for clarity as discussed in February 2018 (i.e., efficient way to illustrate in the report what water data were used in Sections 7 and 8).
    b. Please make the following edit: "In this section, we report data collected through 2005, prior to the installation of the solar circulators in Almaden Lake in 2006."
    a. The caption for Figure 3 does not match the description of data in section 7 (PDF p. 19). But having the same caption that describes data on every applicable figure in Section 7 (and similarly for Section 8) would be very helpful.
12. Section 7.13: "Almaden Reservoir may experience enhanced methylmercury production in its water column due to the erosive nature of its catchment area, which delivers high-mercury soils that could support methylation in littoral and marginal sediments." Please edit for clarity as discussed in February 2018 (i.e., Franciscan mélange compared to ore).
13. Section 7.16 Fish Growth Rates
    a. Figures 15 and 16: Please add an explanation regarding what data are displayed (i.e., only 2016 and 2017?).
    b. Appreciate the change in fish diet provided on PDF p. 37.
14. Section 7.17, regarding: "… suggesting that the impoundment's presence does not retain contaminated sediments or reduce inorganic mercury concentrations downstream." Please edit to clarify that this section pertains to mercury in water not in sediment.
15. Figure 18 is a very nice summary of findings presented in section 7.
16. For section 8, we appreciate February discussion with Water District staff that clarified how water data from 2015, when systems operated intermittently, were included in "Off/Pre" or "On/Post" data sets. In the future, if systems operations are intermittent, please evaluate if data should be lumped into same sets as were used in this evaluation, or if there should be a third data set of "intermittent."
17. Figure 20 is a very effective graphic.
18. Section 8.2: Please remind us of years of drought and that in 2015 operations were intermittent due to drought-induced low water levels.
19. Section 8.3: As with other sections, we appreciate the detailed technical explanations.

20. Section 8.4.1 Trend Evaluation Method:
    a. This is very sophisticated statistical analysis. If you know of others who have done similar statistical analysis, please cite their work. Please clarify how variables were selected.
    b. Figure 33 (and similar reservoir fish tissue result figures): we agree with proposal to indicate graphically which fish sampling dates fall in dry or wet season.
21. Timing of fish sampling: we concur with collecting prey fish during the bird breeding season from February 1 through July 31.
22. Section 9 Mercury Loads from Points of Discharge:
    a. Provide time trend plots of discharge from reservoirs in Guadalupe River watershed and Stevens Creek Reservoir, and indicate sample dates and reservoir spills, which are not gauged. The time trend plot will help to explain how well storms were sampled/characterized.
    b. Particularly for total mercury, add text regarding underestimate of loads from large storm events, particularly two large storms in early 2017. We believe that loads are greatly underestimated because it was not safe for District staff to sample during large storms, such as those that occurred in early 2017. Please also expand text on the comparison of loads from Stevens Creek to loads from other reservoirs to reflect underestimates from large storm events. We acknowledge that it is unsafe to adequately characterize concentrations using current sampling protocols during large storm events. At this time, we do not perceive a reason to change the sampling protocol.
    c. Early in section, define flow weighted mean concentration and describe how it was used in analysis.

Attachment 2: Some Metrics for Stratification

Osgood Index of mixing

The Osgood Index of mixing (OI = mean depth/$\sqrt{km^2}$; Osgood, 1988) is a measure of the lake volume in relation to wind fetch. As the ratio decreases, the chance for mixing hypolimnetic with epilimnetic water increases. … This index works in some stratified lakes, but not others. Where wind mixing is effective low OIs are consistent with significant transport of hypolimnetic P to surface water. Book: Restoration and Management of Lakes and Reservoirs, third edition, Cooke et al., 2005, page 73 of PDF

Richardson number is described in staff report for scientific peer review for Statewide Mercury Control Program for Reservoirs, page 4-17.

Anoxic Factor

The anoxic factor was developed by Nürnberg (1995) as a measure of the extent and duration of anoxia in stratified lakes. Dave Matthews cited Gertrud Nurnberg's anoxia factor in Onondaga paper, *Whole-lake nitrate addition for control of methylmercury in mercury-contaminated Onondaga Lake, NY.* See: Nürnberg, G.K.,1995. Quantifying anoxia in lakes. Limnol. Oceanogr. 29, 111–124.

Schmidt stability

Gertrud Nurnberg uses Schmidt stability, and it is available in R "rLakeAnalyzer" subroutine

See p. 79, upper right, Statistical and numerical analysis:

Gertrud K. Nürnberg & Bruce D. LaZerte (2016) Trophic state decrease after lanthanum-modified bentonite (Phoslock) application to a hyper-eutrophic polymictic urban lake
frequented by Canada geese (Branta canadensis), Lake and Reservoir Management, 32:1, 74-88,
DOI: 10.1080/10402381.2015.1133739

Wedderburn number

Svetla Todorova used Wedderburn number (Wn) to quantify upwelling in Onondaga paper, Wn is described in Wikipedia, and Wn is available in R "rLakeAnalyzer" subroutine.