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CITY OF STOCKTON AND COUNTY OF SAN JOAQUIN CLARIFICATIONS AND ADDITIONAL CONTEXT FOR THE DELTA METHYLMERCURY CONTROL PROGRAM PHASE 1 METHYLMERCURY CONTROL STUDIES INDEPENDENT SCIENTIFIC REVIEW

Dear Ms. Henneberry:

The City of Stockton (City) and County of San Joaquin (County) appreciate the opportunity to provide clarification and context regarding the August 2019 *Delta Mercury Control Program Phase 1 Methylmercury Control Studies Independent Scientific Review*[1] prepared by the Independent Scientific Review Panel (Review Panel) and facilitated by the Delta Science Program for the Central Valley Regional Water Quality Control Board (Regional Water Board). We understand that the Review Panel was requested to assess:

a) Whether or not the work plans were successfully completed; and
b) The scientific validity of studies' findings.

We appreciate the specific comments from the Review Panel on the City and County's October 2018 Delta Methylmercury Control Study Final Report (Final Report) and will consider how the technical recommendations may be used to improve future monitoring and assessment of the contributions of methylmercury from urban runoff.

We also appreciate the overall assessment of the seven control studies that have been completed and understand that an Advisory Panel and the Regional Water Board will take this review into consideration and use the information to help guide recommendations regarding the implementation of the Mercury Control Program during Phase II of the TMDL. In particular, the City and County agree with the following key conclusions and included a similar conclusion and/or consistent recommendations within the Final Report:

[1] https://deltacouncil.ca.gov/pdf/science-program/2019-08-22-delta-methylmercury-review-part-1.pdf

- *None of the facilities/areas can reduce their methylmercury loading to meaningfully offset any other sources of methylmercury in the Delta*. (Executive Summary)
- *The Control Studies report on a collectively very small proportion of the total methylmercury load to the Delta, consistent with the original TMDL estimates and WLAs*. (Executive Summary)
- *Given the relatively small contributions to the overall load one could argue that further investigation into methymercury sources associated with the control studies are not warranted…..(*Section 5)
- *The Control Study results suggest that the TMDL allocations to these sources may not be in alignment with the size of their contributions. The Review Panel agrees with the findings of the Control Studies taken together – LID approaches to stormwater management, and planned upgrades to wastewater treatment plants to teritary-plus technologies will reduce mercury loading to surface waters in the Delta. The Review Panel is also comfortable with the conclusion that (despite the relatively weak studies that were undertaken) small-scale control issues (e.g. storm drains) are not a significant source of methylmercury relative to other sources documented as part of the TMDL inventory….* (Section 5)
- *Given the small proportion of methylmercury loads to the Delta from the sources considered here, the Review Panel is quite definitive in its conclusion that the expected methylmercury load reductions will probably not have measurable effects.* (Section 5)

The primary purpose of this document is to provide specific responses and clarifications to the issues raised by the Review Panel with regard to the City and County's Final Report and confirm that no modifications to the Final Report are necessary at this time. Rather, the Findings from the Review Panel may be used as applicable within Phase 2 of the Delta Methylmercury TMDL and/or within the City and County's monitoring program. Below is a brief background for the City and County approved Methylmercury Control Study as well as responses to the Key Findings from the Review Panel.

Background for City and County Methylmercury Control Study

For overall context, below is a brief summary of the key aspects of the City and County's Control Study including the focus of the study, hypothesis, monitoring timeframe and process for the development, review, and approval of the Workplan.

Focus of the Control Study: The Control Study was established as a limited, targeted project to evaluate one aspect of detention basin removal effectiveness that could supplement a larger body of work that has been completed for detention basins. A detention basin located in the urbanized area, the Airport Business Center Basin (ABC Basin) was the focus of the evaluation.

Detention basins are a common Best Management Practice (BMP) in the Stockton Urbanized Area (SUA) for both flood control and water quality control purposes. In fact,

there are almost 30 detention basins currently within the SUA. The objective of the Control Study was to evaluate the mercury and methylmercury removal effectiveness of the ABC Basin, along with the potential for methylmercury formation in the basin.

Hypothesis: The Control Study was structured to test the following hypothesis:

> The ABC Basin will reduce mercury and methylmercury loadings in the San Joaquin subarea. Sedimentation is the primary pollutant removal mechanism in detention basins, and as a result, detention basins will remove total mercury from the system, reducing the amount of mercury available for methylation.

Monitoring: Conducted over three years, from October 1, 2013, to September 30, 2016.

Development and Approval of the Workplan: The process to develop and receive approval for the Methylmercury Control Study Workplan was as follows:

- Workplan preliminary concept proposal to Regional Water Board – August 2012
- Received and addressed comments from the Technical Advisory Committee (TAC)
- Original Workplan submitted to Regional Water Board – April 20, 2013
- Received and addressed comments from the TAC
- Revised Workplan submitted to Regional Water Board – September 25, 2013
- Control Study initiated – October 2013

Review of City and County Methylmercury Control Study (Section 6.1 of the Report)

The key findings from the Review Panel are noted below in *italics* with the additional clarification and responses from the City and County below.

Review Q1a. Were the scientific objectives of the approved control study workplan fulfilled?

> *The approved original control study workplan was adequately executed, but in the Reviewers' opinions, the original approved control study workplan was inadequate to meet its stated scientific objectives, primarily because of the examination of only inlet and outlet mercury and methylmercury concentrations without any consideration of flow data (in order to calculate loads).*

The first portion of the comment fundamentally questions the basis of the approved control study workplan, which is outside of the scope of what can be addressed by the City and the County at this time. However, it should be clarified that flow data was collected at the inlet locations, in order to evaluate flow-weighted composite samples, as noted in the workplan.

> *The hypothesis reflects an incomplete consideration of well-understood aspects of the mercury cycle. The hypothesis assumes that removing THg by sedimentation from the water column takes it out of the methylating pathway. In reality, sedimentation*

transfers inorganic Hg to places where it in fact may be methylated. Therefore, simple sedimentation is not a singular mechanism for reducing MeHg loads.

As is noted above, due to time and budget considerations, the Control Study was established as a limited, targeted research project to evaluate one aspect of detention basin removal effectiveness. The Control Study summarizes the set of underlying assumptions as well as the detention basin mechanisms for mercury removal as they pertain to the use of these types of BMPs and the scope of this short-term study (Section 4).

More importantly, the Control Study also recognizes that it is not just the settling of the sediment that is important for mercury removal, but the actual removal of the sediment from the detention basins as a part of the routine operations and maintenance to prevent methylation[2]. Thus, the most effective removal of Hg from the system consists of both the settling of the sediment as well as the removal of the settled sediment from the basin.

Moreover, the study did not include an analysis of key information such as suspended sediment concentration data, which would be required to test the hypothesis as written (not simply filtered vs unfiltered concentrations).

Although the study primarily focused on evaluating methylmercury and total mercury concentrations between influent and effluent, total suspended solids were collected as well as suspended sediment. Additional constituents were collected so that they could be evaluated if there was an increase in concentrations noted across the basin, or if future, additional effort is identified as important in understanding detention basin mechanisms. However, given that the results did not indicate methylation within the basin, and the limited scope of the study, the additional constituents were not evaluated.

Review Q1b. Were the data quality control/quality assurance measures outlined in the report adequate?

Sample data are included in several tables in appendices at the end of the workplan, but there is no compilation of QA/QC data nor an indication that this was closely examined.

QA/QC data (field blank, field duplicate, and MS/MSD samples) were collected and evaluated during the execution of the study to inform whether any modifications were needed to sample collection or analysis procedures. This data is available and can be provided, as needed.

In some respects, the analysis of the composite versus 'grab' samples constitutes a consideration of QA/QC. Hg concentrations in composite samples were compared grab samples but it is not clear if 'grab' samples are by hand or by autosampler.

[2] Methylmercury Control Study Workplan, September 25, 2013, pages 10-11

For clarification, "grab" samples are single samples that were collected by hand.

It is also unclear how the timing of grab samples is coordinated with composite samples, although it is presumed that they are in some way.

Composite and grab samples were collected for total mercury, total methylmercury, and dissolved methylmercury. As noted in the Workplan, grab samples were collected during peak flow, during the first portion of the storm event as flow rates were increasing into the basin [3].

The comparison in Table 8 shows relatively large differences in concentration among individual samples, but not really directional bias such that mean concentrations across all events work out. This however does not support the overall conclusion that individual grab samples are not significantly different from composite. The grab sample concentrations will have been significantly affected by the timing of their collection. What this exercise did show however, was the level of uncertainty inherent in mixing composite and grab samples into the same loading analysis (~ +/- 75%).

We agree, and the Final Report acknowledges, that the timing of the grab sample collection may have a direct effect on the concentration [4]. Although grab samples were timed to be collected during peak flow, it was understood that the overall duration of storms and runoff patterns may influence the concentrations. Due to the limited timeframe for the Study, a robust analysis of grab samples versus composite samples could not be completed.

<u>Review Q2. Were the methods used in the study adequate to assess the scientific objectives?</u>

The methods used were not fully adequate to assess the scientific objectives. Loadings were not examined – only concentrations. They used flow weighted composite samples (not clear how good the flow-weighting was) and then used analytical results as "event mean concentrations". They then used the inflow and outflow concentrations to calculate a rather simplistic removal "efficiency".

Consistent with the approved Workplan, total Hg/MeHg was collected as grab samples at all locations; total Hg/MeHg and dissolved MeHg were also collected via composite sampler (with TDS, TSS, turbidity, SSC, total phosphorus, total sulfate, and total iron) as comparison samples to the grabs.

The Workplan also identified that flow data would be collected at the influent stations in order to flow-weight composite the influent, which was based on flow sensors at the monitoring locations. The Workplan also identified that the method to evaluate removal

[3] Methylmercury Control Study Workplan, September 25, 2013, pages 25-26

[4] Methylmercury Control Study Final Report, October 20, 2018, pg 3-11

efficiency of the basin would be based on Event Mean Concentrations (EMCs) and cited the basis for using this evaluation method.

Lastly, we respectfully disagree with the conclusion that loadings were not examined. As a clarification and consistent with the requirements of the Final Report, the Final Control Study Report examined the attainment of the waste load allocations in Section 4.2 and specifically, the five-year average annual loads from 2007 - 2018 (Table 11) as well as the methylmercury loads by year in Figure 10.

> *In the workplan, it is unclear why one would add acid preservative to sediment samples and not simply freeze them (Table 6 on pdf page 75).*

While the Workplan indicated that sediment samples for methylmercury would be acid preserved, analogous to the preservation for water samples, the samples were actually preserved on ice during execution of the study. Samples were received by the laboratory on ice and analyzed within the required holding times. Remaining samples were frozen by the laboratory after analysis.

> *The data were all presented in a "lumped" manner, showing the distribution of concentrations at a particular site over the entire 3 year period. This assumes that the sampling is representative of the entire time period. Just three times per year and grab samples more often than composites, this is not clearly representative in my opinion.*

Given the limited budget, scope and timeframe for this study, the data that was collected was assumed to be representative and, thus, was combined for the analysis. If additional data is collected in the future it may be possible to parse it out into additional temporal categories for comparison and/or additional analyses.

> *In the study, samples across all three seasons are pooled (all inlets are pooled and compared against all outlet samples pooled together) and then Mood's Median Test is applied in a single test for each chemical constituent. I think this is an erroneously over-simplified use of statistics to try to make a point. Moreover, in looking at the distribution of data and the very close median values for each (Table 9, page 31 of pdf), I find it hard to believe that these differences are statistically significant, even though the p-values given in table 10 are so low. For example, for dissolved MeHg, the inlet and outlet median values are 0.019 and 0.018 ng/l and determined to be significantly different at a p-value of 0.047. The p-value for the total MeHg difference (medians of 0.093 vs 0.088 ng/l) at p=0.01 seems plain incorrect to me.*

The Final Report noted that, using the paired T-test "The influent and outlet datasets for total mercury are distributed differently from each other, and the datasets for dissolved methylmercury contain many non-detected values. For this reason, the statistical T-test cannot determine the significance of the differences between the influent and outlet datasets." The Mood's Median Test noted significance in total mercury results from inlet to outlet. There was a difference in total mercury from inlet to outlet, but the overall concentrations were so low that it is difficult to discern the significance. This does not

indicate that the control measure was ineffective; just that it is difficult to determine because the concentrations were so low overall.

Related to this, the pooling of the data is the main problem. This really should be a "paired" exercise. Pooling the data assumes there is no control needed over season, year or storm size. The authors should have considered the Wilcoxon test.

Given the limited, targeted nature of the Control Study, there were not enough samples to conduct a paired test with pooled data based on season, year, or storm size. The approach proposed in the Workplan was to pool the data to use the average of the pooled influent and effluent EMCs, as they are not as sensitive to event-by-event performance or variability. This approach from the Workplan was followed in the analysis of Control Study data. If additional data is collected in the future it may be possible to parse it out into additional temporal categories for comparison and/or additional analyses.

Review Q3. Are the conclusions regarding the effectiveness of the control measures supported by the monitoring results in the report?

No, the report unreasonably extrapolates from what is effectively a single pilot study with a relatively sparse dataset. That said, it is still apparent that loads are small.

This Control Study is one, isolated and limited, study of the fate of methylmercury across a detention basin. It provides useful information when taken in the context of other studies of detention basin performance. We do not agree that the report unreasonably extrapolates from a single study but do recognize that the study was not designed to be extensive or representative of all detention basins.

Review Q4. Does the report adequately characterize the source's current and future predicted loads based on methylmercury controls? Did the study adequately address the uncertainty around the load reduction estimates?

No. A weakens of this study is that it does not examine loads at all.

- *See Figure 10 on page 38 of pdf. Mostly just under TMDL, but wetter more recent year (2017) is way above.*
- *The future predictions are predicated on new and re-development at a relatively known rate. It is thought that compliance will take longer than until 2030.*

We respectfully disagree with the conclusion that the study does not examine "loads at all". As a clarification and consistent with the requirements of the Final Report, the Final Control Study Report examined the attainment of the waste load allocations in Section 4.2 and specifically, the five-year annual loads from 2007 - 2018 (Table 11) as well as the methylmercury loads by year in Figure 10.

Review Q4a) If the study addressed existing controls, how well does the report evaluate existing control methods and, as needed, describe additional control methods (such as scaling up or combining controls) that could be implemented to achieve methylmercury

load and waste load allocations? How adequate were evaluation methods, given available resources and workplan scope, in assessing the feasibility of reducing sources more than the minimum amount needed to achieve allocations?

> *It does a rudimentary job of assessing an existing control. It refers to a few other studies in California that similarly found small reductions with use of detention ponds. It does not significantly contribute to knowledge about scaling up or combining controls. The scaling is considered in a very linear way in relation to new and re-development into the future. There was no assessment of the feasibility of reducing sources more than the minimum amount.*

As stated previously, the study was focused on the performance of an existing control measure in the SUA and was completed consistent with the approved Workplan. The Study was not designed to evaluate the scaling up or combining of control measures. Information from this study, along with other similar studies in California, could be used as a foundation for future, additional studies.

Review Q4b) If the study addressed additional controls necessary to achieve allocations, does the report adequately describe methylmercury and/or inorganic (total) mercury control practices identified by the study and evaluate the effectiveness, potential environmental effects, and overall technical feasibility of the control actions?

> *The study examined a single detention basin. There is no clear mechanistic understanding of the findings whatsoever. Although other constituents, such as suspended solids, were measured, these data were not presented and thus, an actual test of the study's main hypothesis was not completed. Because of this, it is not possible from the study to scale findings elsewhere or to other low impact designs.*

We respectfully disagree with this finding. As mentioned previously, consistent with the Workplan, the study focused primarily on evaluating methylmercury and total mercury concentrations between influent and effluent and additional constituents were measured so that they could be evaluated if there was an increase in concentrations noted across the basin, or if future additional effort is identified as important in understanding detention basin mechanisms. In addition, the Study (Section 4.2) evaluates the ability of the City and the County to achieve the waste load allocation incrementally over time as LID control measures and other infiltration and treatment BMPS (such as detention basins) are implemented through new and redevelopment actions.

> *Potential environmental effects and overall technical feasibility were not explored. However, given the recommendation to continue with development as currently planned, technical feasibility does not seem to be an issue.*

This assessment is correct. Environmental feasibility was not included as a part of or evaluated within the scope of this study.

Review Q4c) If the control study results indicate that achieving a given methylmercury allocation is infeasible, does the report adequately provide detailed technical information on why full compliance is not achievable and what methylmercury load reductions are achievable?

It is reasonably clear from the study that achieving the allocation during dry and/or near average rainfall years is probably feasible whereas it is not feasible during wet years.

This assessment is correct. Achievement of the allocation is feasible during dry and near average years, as stated in the Final Report.

The compliance scenario is explained in relation to new and redevelopment rates only. It is not overly clear why full compliance is or is not achievable, but the report does state it may not be likely to meet full compliance by 2030.

The Control Study considered attainment in terms of a range of dry to wet years. As noted above, attainment is feasible during dry and near average years, but the study considered the full range of water year scenarios as well. Implementation of LID during new and re-development will be needed to achieve attainment during wet years, however, the timeframe for implementation will extend beyond 2030 due to the nature of the development and redevelopment cycle.

Review Q4d) Does the report adequately describe how the controls could be adapted over time as climatic and other conditions in the Delta change?

No, this is not discussed or described in the report.

This is outside of the scope of the Control Study.

Review Q5. Do you have comments on any other scientific issues related to this study or mercury/methylmercury source?

It is accurate that at the time of this study and report, little was known about how detention basins handle MeHg. This was a particular void (at least at the time – see Strickman and Mitchell papers over last couple of years though) in the peer-reviewed scientific literature.

We agree and appreciate the comment. As noted in the Control Study (Section 4), at the time of the study, there was very little information in the published literature about detention basin performance for methylmercury removal. As a result, this limited, targeted research project evaluated one aspect of detention basin removal effectiveness that could be fed into the larger body of work.

Many reports, including this one, refer to the very small overall loading by municipal separate storm sewer systems (MS4) agencies. TMDLs are likely to be met via

existing and/or proposed low impact design and other stormwater best management practices.

We agree and appreciate the comment. As is noted within the Final Report, the City and County's methylmercury loads are *de minimis* in comparison to the total methylmercury loads in the Delta and represent only a fraction of the 0.36% if current methylmercury loads and 0.44% of the total waste load attributed to Phase I stormwater agencies. As such, the stormwater agency Final Control Studies collectively indicate that detention basins and LID-based controls, used as a part of the new development and redevelopment program is the preferred set of control measures for the implementation of the TMDL and should result in the attainment of the waste load allocations.

If you have any questions, please contact Jason Farnsworth of the City of Stockton at (209) 937-8155 or Jason.Farnsworth@stocktonca.gov or Matt Zidar of San Joaquin County at (209) 953-7460 or mzidar@sjgov.org.

Sincerely,

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