5 September 2019

Andrea Matzke, Basin Coordinator
Oregon Department of Environmental Quality
700 NE Multnomah Street, Suite 600
Portland, Oregon 97232

Sent via e-mail to WillametteMercuryTMDL@deq.state.or.us

Re: Comments regarding the Revised Willamette Basin Mercury TMDL, Draft for Public Comment

Dear Ms. Matzke:

The Oregon Farm Bureau (OFB), Oregon Forest and Industries Council (OFIC), and Oregon Association of Nurseries (OAN) submit this letter jointly to convey our comments pertaining to the draft Willamette Basin Mercury TMDL prepared by the Oregon Department of Environmental Quality (ODEQ). Our comments are based on our review of this document, our participation as members of the Advisory Committee for this TMDL, and the very real impact this TMDL could have on our memberships.

By way of background, OFB is a nonprofit organization that has been a voice for Oregon’s family farmers and ranchers for 100 years. The OFB has nearly 7,000 members statewide. Over 3,000 of those members are located within the Willamette Valley. In the Willamette Valley, OFB members raise nearly 225 types of crops and livestock. OFIC is a nonprofit organization that represents over 50 Oregon forestland owners and forest products manufacturers who manage over 5 million acres of Oregon forestlands and employ nearly 60,000 Oregonians. The OAN is a nonprofit organization that provides a voice for over 700 nursery stock producers, retailers, landscapers, and other companies across the state.

Since the inception of our nonpoint source water quality programs, and for years before, our members have worked to protect, maintain and enhance water quality throughout the Willamette Valley.

**Agriculture and Forestry are not the Source of Mercury Exceedances**

The agricultural and forestry sectors have always been proactive about protecting, maintaining and enhancing water quality on agricultural and forestry lands, which combined represent by far the
largest land use in the Willamette Valley. Indeed, our industries were proactive in developing the Agricultural Water Quality Management Program and Forest Practices Act years before most states had thought of developing their nonpoint source programs. Since that time, we have invested millions in studies, on-the-ground work, and compliance with our respective programs. We will continue to be proactive into the future, as evidenced by the millions invested by each of our sectors each year in proactive water quality improvements.

Section 14.2 of the TMDL document states clearly that atmospheric deposition of mercury is the dominant source of mercury reaching Willamette Basin streams and that air emissions from Oregon are small relative to global sources. The fact that Oregonians are not the source of mercury exceedances has made writing this TMDL exceedingly challenging, and we do not envy ODEQ’s work to address a source of pollutant outside its control. Although the mercury entering the Willamette River system from our land originated from the atmosphere, and not from our activities, we will continue to invest in water quality on our lands and meet the rigorous requirements under our respective programs. However, without addressing the real cause of the mercury exceedances, this TMDL may request reductions that are larger than any basin stakeholder can manage.

Oregon’s farmers and foresters are doing an exceptional job investing in water quality improvements, studying water quality on our lands, and meeting the requirements of our programs, and we will continue to do so after this TMDL is adopted. That said, we have concerns about the modeling that we set forth below, and which we would like to see you address prior to adopting the TMDL. The myriad of significant issues with the modeling underlying the TMDL, combined with the fact that our sectors are not responsible for the mercury emissions causing the mercury exceedances, has resulted in the agriculture and forestry sectors being unable to support the load allocations and reductions requested through the TMDL. As always, we will continue to work with our designated management agencies (DMAs) to continue to invest in and improve water quality across Oregon.

There are Significant Technical Issues with the TMDL

Our technical comments cover three main topics. First, we have many concerns about specific dimensions of the modeling that underlies the TMDL allocations. Second, we comment on the loading capacity and the ensuing load allocations. Third, we request several enhancements to the questionable and incomplete analysis offered by ODEQ in support of total suspended sediment (TSS) concentrations as a surrogate for the concentration of total mercury (THg) in the Willamette River and its tributaries, which is itself a surrogate for methylmercury in the water column, which is in turn used to derive mercury concentrations in fish tissue via a complex food web model.
Shortcomings and Uncertainties in the Modeling

Your team has created a TMDL that allocates daily loads and wasteloads of mercury from nonpoint source areas and point source dischargers to the Willamette River system. These will be based on the results of six separate computer models. Each of these models introduces uncertainty into the allocations, and some of these models have been developed with disputable modeling practices. We describe below the major uncertainties and shortcomings.

Modeling Practice

The consultants contracted by the EPA for this TMDL study have made multiple questionable modeling decisions that depart from best practices used in work of this nature. Notably:

- Appendix A of the TMDL document, the Technical Support Document, describes no sensitivity analyses of the model output to reasonable variations in model input data sets or parameters. For example, no sensitivity analyses have been performed to determine how the values of the biomagnification factor of the Food Web Model (FWM) might vary given other modeling decisions or how its variation might affect the calibration of the FWM. This implies that other reasonable values for this and other important modeling input parameters might also lead to satisfactory model calibrations. However, these different values would also lead to different outcomes for the target mercury concentration that drives the load and wasteload allocations.

- The Margin of Safety (MOS) provided by the modeling has not been quantified. Section 11 of the draft TMDL document describes an implicit MOS due to the use of the northern pikeminnow as the fish species whose bioaccumulation determines the target concentration of mercury in the river system, the use of the median concentration from the FWM as the TMDL target concentration, and the use of total mercury concentration in fish tissue. These are conservative assumptions that provide a MOS, but the degree of conservativism achieved by these assumptions has not been described quantitatively. It is therefore possible that the TMDL study may have produced an overly conservative target THg concentration for the Willamette River that has led to unnecessarily low load and wasteload allocations in the TMDL.

Food Web Model

The FWM links methylmercury exposure of fish to fish tissue concentrations based on an understanding of the Willamette River food web and the bioaccumulation and biomagnification within it. This model is calibrated so the concentrations of mercury in fish tissue match the concentrations measured in fish tissue samples collected from the Willamette River and its tributaries. However, once calibrated, its main utility is to provide one of its parameters, the biomagnification factor, to the mercury translator model (discussed below). This approach
introduces significant and compounded uncertainty to the target THg concentration in the Willamette River. Additionally:

- The FWM calibration is marginal for the northern pikeminnow. This is the only fish whose parameterization is used in the determination of the target concentration of THg in the river system. Although no statistical evaluation of the quality of the calibration was provided in the contractor’s modeling report, inspection of Figure 3-4 in the Technical Support Document (i.e., TMDL Appendix A) reveals that the cumulative distribution function of modeled fish tissue mercury concentrations in the northern pikeminnow agrees with the distribution of observed data only around the 60th percentile concentration. Most of the rest of the modeled distribution is outside the 95% confidence interval of the distribution based on observed data. With this marginal and unquantified model calibration (and the lack of sensitivity analyses described above), we cannot be confident in the target THg concentration.

- We understand that the model input parameters pertaining to three main processes were used to calibrate the FWM: the fish ingestion rate of mercury, the fish assimilation rate of mercury, and the fish elimination rate of mercury. From this approach, the necessary biomagnification factor is determined for the model to match observed fish tissue concentrations as closely as possible. We are concerned that there may be other reasonable values for these model input parameters that produce a decent match between the model output and observed fish tissue concentrations. If so, these would require different biomagnification factors for model output to match data. We acknowledge that this probabilistic model does not use single values for its model input parameters but instead expresses them as distributions. However, the median value of the distribution of biomagnification factor, not a range resulting from the distribution, is used in the calculation of the target THg concentration in the river. Therefore, there may be other reasonable distributions for the biomagnification factor (and, consequently, other median values) that can lead to an acceptable model calibration. This implies that the model could produce the “right” answer for the wrong reason. Consequently, we lack confidence in the target THg concentration that is calculated, in part, from the median biomagnification factor determined by the EPA contractor.

**Mercury Translator Model**

The Mercury Translator Model uses the biomagnification factor from the FWM and a mercury translator value to calculate a target concentration of THg in the water column from the concentration of dissolved methylmercury used as an input variable to the FWM. In this model, the slope of the regression line calculated from the aggregation of individual pairs of measured THg and methylmercury concentrations in the water column is heavily influenced by three pairs of observations. The remaining pairs of observations in Figure 6-3 do not fall in a line. We question whether linear regression is an appropriate statistical method for calculating the translator value.
It may be more appropriate to present the translator value for each HUC8 basin and then average the 12 values while expressing the uncertainty of that mean. The use of linear regression on a data set that is neither linear nor normally distributed leads us to question the validity of the target THg concentration.

**Mass Balance Model**

The Mass Balance Model (MBM) exists separately from the FWM and the Translator Model. Whereas the FWM and Translator Model are used together to determine the target THg concentration in the water column, the MBM determines the present-day contributions of THg to the Willamette River system from a variety of sources. These values are compared to the THg loading capacity (discussed below) when developing the load allocations of the TMDL. The representation of nonpoint sources in the MBM raises the following concerns:

- Results of three other models serve as important inputs or points of comparison for the contributions of nonpoint sources to the Willamette River system. These models are:
  - the hydrology model of the Willamette Basin created by the EPA contractor several years ago using the software package HSPF,
  - the model of dry atmospheric deposition of mercury used by Domagalski et al. (2016), and
  - the USGS LOADEST model from which the EPA contractor calculated THg concentrations in the Willamette River that were then used as a calibration target for the MBM.

For this reason, the TMDL will be based on six models, not the three commonly described by your team, the EPA, and its contractor. Using the output of two models as inputs of the MBM compounds uncertainty. Calibrating to the results of a separate model implies that the MBM is calibrated to match a number with its own, presently unquantified, uncertainty. While this may be unavoidable, we do not find an acknowledgement of these uncertainties in the calculation of existing loads in the TMDL. It would be appropriate to perform additional model simulations with reasonable upper and lower bounds of, for example, atmospheric deposition or soil mercury concentrations. No such calculations are described in the TMDL document (or the Technical Support Document), which reports single numbers (i.e., values with no associated uncertainties) in Table 6-7. The lack of an acknowledgement of the uncertainty in the MBM decreases our confidence in the existing loads and the subsequent calculations that use them.

- The HSPF model raises some additional concerns:
  - Our experience suggests the model’s representation of agricultural land may be poor. We are unsure of the impact of any inaccuracies on the final modeling results.
We have not seen an explanation of the justification of infiltration rates in this model. This is critical for the distinction used by your team between mercury attributable to atmospheric sources and to groundwater.

- The soil mercury concentrations interpolated from a 2013 USGS study appear to be highly uncertain due to a low spatial resolution of the observed data and a lack of detail in the interpolation (Tetra Tech, 2018a).

### Loading Capacity and Load Allocations

The calculation of the daily loading capacity of THg in the Willamette River system is presented in Section 7.2. The load determined is 42.17 g/day. This value is critical for developing the load and wasteload allocations in Section 10. However, this calculation is unclear. Below Table 7-1, the text states that the quantity $L_{Current}$ is “estimated to be 361 g/day”, a value consistent with Table 6-7. However, in the ensuing equations that calculate the quantities $L_{Excess}$ and $Load Capacity$, the value 351.42 g/day is used for $L_{Current}$. Using the value of 361 g/day leads to a slightly higher load capacity. If this is an error, please correct it. If 351.42 g/day is the correct value for $L_{Current}$, please alter this passage to resolve the confusion we express here.

The TMDL allocations depend on the categorization of source sectors in Table 10-1. In this categorization, atmospheric deposition appears both as part of the “General Nonpoint Source and Background” that is to be reduced by 88% and as its own category that will be reduced by 11%. The former is an aggregation of categories used in the Technical Support Document: sediment erosion, surface runoff, groundwater, and atmospheric deposition directly to water. We do not understand what the second atmospheric deposition category can be if it is not delivering mercury that reaches the river system via sediment erosion, surface runoff, groundwater, or direct deposition. Why does the assumed 11% decrease in future atmospheric deposition not contribute to the required reduction to the General Nonpoint Source and Background category?

### Total Suspended Solids as a Surrogate for Total Mercury

ODEQ evaluated the use of the concentration of TSS as a surrogate for the concentration of THg in water. If the relationship between the concentrations of TSS and THg is statistically robust, then TSS could be measured in place of THg, thus reducing the costs of assessment and monitoring related to this TMDL. As presently drafted, the analysis presented in Section 10.3 and Appendix H raises several concerns about whether the concentration of TSS can defensibly be adopted as a surrogate for the concentration THg in this system.

In a memo from the EPA contractor that was provided to the Willamette Basin TMDL Advisory Committee in an e-mail from Priscilla Woolverton on 14 June 2019, TSS is ranked as the least preferable of four surrogates analyzed, behind suspended sediment concentration and two separate...
turbidity measurements (Tetra Tech 2018b). This analysis was not mentioned in the TMDL document or Appendix H. Please explain why TSS has been chosen by ODEQ as a surrogate rather than other options that have been judged as preferable.

The use of TSS as a surrogate is justified with a citation in Section 1.1 of Appendix H to a paper about urban stormwater runoff. Please justify this use of TSS as a surrogate by providing and explaining in detail the findings of any papers that show a relationship between TSS and THg in a river system that resembles the Willamette River and its tributaries.

The statistical relationship described in Appendix H (known as a Linear Mixed Effects, or “LME” statistical model), shows that measurements of TSS and the specification of the location of that measurement can explain 81% of the variation in the THg data set. Thus, estimating THg concentrations with a surrogate introduces uncertainty into measurements of THg. This is especially true because of the low concentrations of THg, which imply that even small absolute uncertainty can have a large relative importance. Please describe how this uncertainty will be addressed if TSS is to be used as a surrogate during allocation, compliance, or field monitoring.

Please demonstrate that the data used for the LME model are:

- Sufficient: Why does ODEQ believe that 63 paired observations are enough for this analysis? How many samples are generally used to develop strong LME models?
- Adequate: Please show the results of statistical tests that evaluate the normality of the TSS and THg data sets following the logarithmic transformation that was performed.

The LME model is complicated. Please justify the use of the LME model by explaining:

- why a simpler model (such as a multivariate model using TSS and sampling location) cannot be used here,
- why it is valid to assume that observations from the same sampling site are not independent (this is implied by the choice of “sites” as a random effect in the LME model), and
- how the “sites” variable was represented in the LME model. Is it categorical or continuous?

The results of this analysis are unclear. Please clarify by:

- Stating the intercepts for the fixed and random effects separately in Equation 3 of Appendix H. This will make the random effects due to the variable “sites” clearer.
- Showing both the adjusted R² and conditional R² in Table 9 and discussing each separately.
- Providing examples in which “sites”, which you have identified as a random predictor variable, are used along with TSS to predict concentrations of THg.

Please resolve concerns about the quality of this analysis, specifically those related to:
• Example 1 in Section 1.5 uses the LME model to indicate that a THg concentration of 0.14 ng/L is predicted by a TSS concentration of $4.272 \times 10^{-14}$ mg/L. The former is a low but plausible concentration for THg in a river, but the latter is many orders of magnitude lower than the lowest TSS concentration one could ever hope to measure in a large river like the Willamette River.

• Example 2 in Section 1.5 uses the LME model to relate a TSS concentration of 100 mg/L, which is high yet reasonable for a large river, to a concentration of THg of 8.38 mg/L, which is implausibly high relative to all observations presented in Table 1 of Appendix H.

Finally, if the above concerns can be resolved, we request that ODEQ clarify how a complicated LME model can guide mercury management by ODEQ or Designated Management Agencies. Does including “sites” as a random effect imply that each surrogate relationship will need to be site-specific? How can a surrogate relationship be used in practice to monitor THg concentrations (via measuring TSS concentration) when the relationship includes random effects?

The present surrogate analysis leads us to three main concerns:

1. This surrogate analysis creates opacity for our members because the it does not incorporate available background information, adds uncertainty, and adds complexity without justification. It could easily lead to in-stream TSS requirements that seem arbitrary to our members.

2. The apparent flaws in the statistical model cause concern that its use by ODEQ or our Designated Management Agencies will require our members to do much more than necessary to control erosion and sediment runoff. One of the examples in Appendix H implies that the water must have unmeasurably low concentrations of suspended sediment to meet the target concentration of THg.

3. This surrogate analysis will be confusing to our members because we do not understand how a statistical model with random effects will be used in practice.

Further, Section 10.3 of the TMDL document justifies the use of a surrogate by citing Oregon Administrative Rule (OAR) 340-042-0040(5)(b), which permits the use of a surrogate “to estimate allocations for pollutants addressed in the TMDL”. However, Section 10.3 of the TMDL document presents a statistical relationship between TSS and THg and uses it to determine allocations of TSS that would correspond to the allocations of THg already developed. The TMDL document then states that these TSS allocations will be “used for evaluating effectiveness of the TMDL” because monitoring of “total mercury can be difficult and cost-prohibitive”. This indicates that ODEQ seeks to use TSS as a surrogate to facilitate monitoring following the allocations of mercury in Section 10.1, not to create the allocations themselves. This contradicts the allowed use of a surrogate in OAR 340-042-0040(5)(b).
Section 10.3 of the TMDL document and Section 1.1 of Appendix H state in general terms that monitoring for THg can be difficult and cost-prohibitive. However, monitoring of THg must have occurred to include Willamette River reaches and tributary reaches on the 303(d) list in the first place. If a surrogate will be used, what will be the appropriate mix of surrogate measurements and THg measurements? Will any THg measurements be made if a surrogate is used? What would be the cost savings gained from using TSS as a surrogate for THg, and why is this enough to justify the development of this statistical relationship and the uncertainties that will come with the use of a surrogate?

Finally, the structure of Appendix H, Table 12 makes this surrogate analysis start to look like a TSS reduction program rather than a THg reduction program. It would be more appropriate to write about the THg reductions ODEQ seeks and correlate that to TSS rather than discuss the TSS reductions ODEQ needs to see.

**Conclusion**

Our organizations and the foresters, farmers, and growers of Oregon have done much in recent decades to protect surface water quality. From new stream buffers to wet weather haul rules to strategic implementation areas, we have worked with DEQ and our DMAs to protect the waters of our state. We commit to continuing this close engagement on water quality issues into the future.

However, we have significant concerns about ODEQ’s development of this TMDL and the compounded uncertainties discussed above. Given that this pollution is largely outside of Oregon’s control, the concern with the TMDL outlined above will make it hard to create buy in on this TMDL from our members. Why should Oregon’s farmers and foresters be required to mitigate pollution they did not introduce? Likewise, the TMDL proposes to regulate Total Suspended Solids as a means of driving reductions in fish tissue methylmercury concentrations. The relationship between these two parameters is extremely remote, and requires the agency model several water quality parameter relationships with compounding uncertainty. This creates the very real risk that Oregon will require very expensive measures with no change relative to the actual water quality standard. This problem is due in part to the highly conservative water quality standard upon which this TMDL is based. When compounded by additional, unquantified, and conservative assumptions in the TMDL modeling, the margin of safety implicit in the load reductions specified by this TMDL are exceedingly cautious and divorced from reality.

Oregon farmers and foresters should not be asked to bear the risk of this uncertainty. We encourage ODEQ to address our concerns, and to work closely with the Designated Management Agencies (DMAs) on implementation to assess what is truly possible and necessary within localized areas.
We look forward to continuing to work together as the Willamette Basin Mercury TMDL and WQMP are finalized in the coming months.

Sincerely,

Dave Dillon  
Executive Director  
Oregon Farm Bureau

Kristina McNitt  
Executive Director  
Oregon Forest & Industries Council

Jeff Stone  
Executive Director  
Oregon Association of Nurseries

References

