California Water Boards

Gavin Newsom, Governor

Jared Blumenfeld, Secretary for Environmental Protection

North Coast Regional Water Quality Control Board

Regional Water Board Comments on
Eureka ERWWTP Evaluation of Ammonia Toxicity Technical Memorandum
Dated November 25, 2019

Regional Water Board staff have reviewed the City's November 19, 2019 Technical Memorandum 1, *Evaluation of Ammonia Toxicity during Elk River Wastewater Effluent Mixing in Humboldt Bay* (Technical Memorandum). Regional Board staff appreciate the City's ongoing efforts to comply with the NPDES permit requirements and to protect Humboldt Bay. This email conveys Regional Board staffs' initial comments on the Technical Memorandum.

The modeling assessment of the City's discharge must be robust and well-supported. It must include sufficient detail to demonstrate that the resulting findings are defensible and show that Eureka's discharge to Humboldt Bay ~~has~~ will result in ammonia concentrations that are below the required ammonia criteria in all locations outside those set aside for mixing, ~~and~~ at all times, thus posing no toxicity risk outside the zone of mixing.

The Regional Water Board has the following specific comments based on the modeling effort completed to date and presented in the Technical Memorandum.

1. The selection of a modeling platform should be carefully considered.

   The modeling platform must provide the capability to incorporate all factors necessary to fully evaluate ammonia toxicity in Humboldt Bay. The selected software must be able to model all conditions and ensure conservative values and/or assumptions are used to mitigate the limitations of the model. The Technical Memorandum must clearly discuss how limitations of the model were mitigated.

   For example, Visual Plumes does not evaluate the potential effects of plume interaction with ~~is not sophisticated enough to model~~ complex bottom shape, nearby shorelines, and tidal currents and how they change over time, all of which may reasonably be expected to affect the discharge into Humboldt Bay. These limitations must be addressed, all assumptions shown, and fully explained.

   If these limitations cannot be fully addressed using Visual Plumes, a more sophisticated program capable of incorporating these factors, such as CORMIX, may need to be used.

Commented [MP1]: Cathy – you may want to make this wording more narrow, as taken at face value it would forbid ANY dilution. Requiring that the criteria be met by the "discharge…in all locations and at all times" is functionally equivalent to setting a limit that must be met at end-of-pipe.

The only exception would be if "the required ammonia criteria" is specifically *defined* to incorporate a dilution-factor multiplier, which I don't think was your intended meaning. Could you clarify for me whether you intend "criteria" to refer to a permit limit with dilution already "baked in", instead of the relevant WQS I'm thinking it refers to?

Since the consultant's report deliberately avoids describing the desired dilution credit in terms of a "mixing zone", no-one seems to have defined the specific "location"/ spatial extent within which exceedance of the WQS should be permissible as the physical diluting actually occurs.
If the discharger and their consultant are silent on that detail, you could choose to specify the allowable area from the regulator's end.

Note that failing to define a "mixing zone" would not be a showstopper by itself. 2010 NPDES Permit Writers' Manual describes in section 6.2.2 (page 6-15) that "dilution allowance" and mixing zone can be an either-or proposition – the discharger doesn't have to use the (spatial) mixing zone approach. However, the "dilution allowance" as defined there (proportion of stream flow) doesn' seem to fit the circumstances of a discharge into Humboldt bay.

Commented [GC2]: Pascal – is this a correct statement?

Commented [MP3R2]: In general, yes. I'm suggesting a re-wording just to leave the door open to using Visual Plumes with adequate caution around its limitations (e.g. conservative assumptions and clear on-the-record justifications), instead of outright forcing them to use another model.

2. The intended conditions being modeled must be clearly stated.

   For example, clarify that the Visual Plumes model is intended for buoyant-plume mixing (initial dilution) only and would not be used to model any other mixing or dilution dynamic (e.g. far-field). Alternative Models such as CORMIX should be considered if there is a need to understand more complex mixing or dilution dynamics than what Visual Plumes can model.

3. All assumptions need to be clearly stated and explained, adequate factors of safety applied, and all work and supporting calculations and documentation provided.

   a. The Technical Memorandum must explain all modeling errors encountered and how they were addressed. It must also explain how which assumptions where made and demonstrate that they are conservative in their impact on the resulting model output. This includes modeling coinciding worst case conditions, such as the effect of high background ammonia levels, high effluent ammonia concentration, and worst-case tidal mixing conditions should these all occur simultaneously, or clear evidence that specific sets of worst-case conditions cannot coincide. See also item (4) below requesting inclusion of a sensitivity analysis based on further model runs.

   b. The model assumed no ammonia was present in Humboldt Bay, a "zero background concentration". Given the enclosed nature of the Bay, the findings of the 2014 Study that not all effluent exits the Bay on the outgoing tide, and the possibility of other sources of ammonia to the Bay, this assumption does not be appear to be correct or conservative. The City is encouraged to perform a literature search and utilize any ambient ammonia data that may exist and/or conduct additional sampling to support and verify this assumption before using it in the model. If no data is are available, a conservative assumption should be used and fully explained and justified.

   c. The model was run with an effluent ammonia concentration that is lower than values that have been recorded in the discharge. The model should be run with the a more conservative ammonia concentration based on a statistical analysis of the effluent ammonia data from the last five years, e.g. a Reasonable Potential analysis. At a minimum, the model should use the maximum effluent concentration of ammonia detected during the last five years. The concentration selected should be fully explained.

   d. The Technical Memorandum does not adequately consider the impact of the ammonia in the City's discharge on ambient ammonia concentrations within the area being modelled.

Commented [MP4]: Just because I've tripped over the same issue in the past: don't start thinking of CORMIX as a "strictly better" option or accidentally become an advocate for it specifically. It's safer, and looks less like government endorsement of a for-profit product, to write "Alternative models such as CORMIX should be considered..."

Commented [MP5]: You may want to cite/refer to a specific definition of "modeling error" as this term can mean different things to [HYPERLINK "http://scott.fortmann-roe.com/docs/MeasuringError.html"] vs regulators. Maybe write "Modeling challenges" instead since that doesn't have a pre-existing technical definition? Feel free to call and talk me through your intended meaning if you think it would help refine the wording.

Commented [MP6]: You may get a response that amounts to "but we think XYZ proves they don't ever actually occur simultaneously". In that case the onus is on the applicant to *demonstrate* that not overlapping all the "worst case" factors is still conservative in terms of real-world conditions, but you might save yourself some work by putting that onus on the applicant up-front.

Commented [MP7]: You may want to specify one of daily / hourly / instantaneous maximum (etc.).

e. The model was run for effluent flow rates of 6 mgd and 30 mgd but appears to assume a continuous discharge. The Technical Memorandum should explicitly describe how the actual pattern of discharge flows (two pulses per day) and their interaction with the tidal current cycle in the bay was considered. ~~Does the model adequately consider that the discharge is not continuous and occurs over two discharge periods each day?~~

f. Page 1 of the Technical Memorandum contains a statement regarding late summer/early fall conditions, implying that this represents the most sensitive conditions with regard to dilution and impacts on aquatic species. The Technical Memorandum should clearly document why this represents the most sensitive conditions.

g. The Technical Memorandum should discuss whether there are ammonia sensitive species present ~~on or near the outfall~~near the diffuser and within areas likely to be affected by the effluent plume .

h. The Technical Memorandum should include the entire data set from the Fall 2019 sampling event.

i. The analysis and discussion should demonstrate that the plume doesn't ~~run into~~interact with any boundaries such as bottom or shoreline, and does not affect designated uses at the water's surface despite being predicted by the existing model to rise to a depth of less than 3 feet.

j. The analysis should address currents by performing model runs that include tidal effects~~currents~~ or give a defensible explanation as to why it is reasonable not to consider ~~currents~~the ambient flow reversals over the tidal cycle.

k. The Technical Memorandum should include the Excel spreadsheet for Table 3-2 in digital format, to allow Regional Water Board staff to review all calculations in the table, particularly the calculations for unionized and total ammonia criteria. The values in the un-ionized criterion columns appear ~~to~~ less stringent than the values that result from using the formulas in the U.S. EPA 1989 *Ambient Aquatic Life Water Quality Criteria for Ammonia (Salt Water)*.

l. In Table 3-2, The values in the Total Ammonia Criterion column for temperatures of 15 degrees appear to be the values that correspond to 20 degrees C. Please confirm that the formulas in the spreadsheet are correct.

Commented [MP8]: Since the modelers didn't seem to "catch" or address this factor on their own, I would recommend being very specific here about the extra detail you want to see. Otherwise you might get only a 1-paragraph "we thought about it and don't think it matters" rather than the *why*.

Commented [MP9]: "on or near the outfall" suggests that it's proximity to the (long) outfall *pipe* that's of concern. I'd suggest writing "near the diffuser and within areas likely to be affected by the effluent plume." It's wordier, but it's more precise.

Commented [MP10]: Thanks to the complex nature of fluid dynamics, the plume doesn't have to outright "run into" a boundary to be affected by it; getting hydrodynamically "close" can already do a lot to muck with its behavior.

Also, if you want to see the evidence behind that bit about "rising to less than 3ft deep", look at the model outputs on the last 2 pages of the memorandum. Note that in both cases the "Depth (ft)" column drops (climbs?) to less than 3 ft, even though the bottom row represents a time less than 60 seconds after being discharged ("Time (s)" column reads 56.27 or even 42.07 seconds, respectively). Further, "x-posn(ft)" is the horizontal travel in the same period and also doesn't get above 21.44 ft before the effluent is as shallow as 3ft. This effluent appears to quickly get to depths where seabirds and human swimmers might be affected by it, and it's on the discharger to prove otherwise (e.g. too far from shore).

Commented [MP11]: There needs to be a distinction here. *Tidal* currents are a concern, because their back-and-forth oscillation y might drag the effluent plume back towards the diffuser and effectively reduce dilution.
For "Currents" in the general sense (i.e. consistent flow in one direction, often wind-driven), it's actually more conservative *not* to include them! That sort of consistent flow generally increases the energy in the system and thus raises dilution. Even an older model like Visual Plumes lets you add a 'current' to the modeling, and the dilution is always higher when you do, so they made the right/conservative assumption by not including "currents". It's the *Tidal* effects that they didn't show their homework on.

Commented [MP12]: Cite what source table you're getting the 20ºC values from, for completeness.

m. The modelling should consider transformation of ammonia once it is discharged into the Bay.

Commented [MP13]: Since this "chemical transformation" modeling can be a big lift, especially getting valid input values, you should consider including a caveat that lets them justify in writing why this isn't necessary or get around it with a conservative assumption – it could potentially require a special study, including detailed receiving water data collection, all of its own, and that might unreasonably delay the permit.

4. A sensitivity analysis should be conducted in the model over a wide variety of conditions and with varied assumptions.

   Multiple model runs should be evaluated and discussed in the Technical Memorandum along with supporting details. This effort in necessary to demonstrate that the most appropriate and conservative conditions and factor were covered by the modeling efforted.

   For example, the model should consider a wide range of discharge rates, temperatures, pH levels, ammonia concentrations in both the discharge and Humboldt Bay, and tidal conditions and how these factors may vary with depth.

5. Sampling may be needed to validate the model results if adequate data does not already exist, or if the results do not closely correlate to measured values. This ground truthing effort should be considered early in the process.

Regional Water Board staff appreciate the City's work to thoroughly analyze the impacts (or lack thereof) of ammonia in discharges from the wastewater plant. We anticipate that the additional information requested in these comments will result in the robust analysis that will be needed to defend the results before the Regional Water Board and interested public and stakeholders.

Regional Water Board staff are available to discuss these comments with you. In order to have this requested re-evaluation of ammonia effluent limitations considered in the next permit renewal, the revised modelling evaluation should be submitted by August 1, 2020 to provide sufficient time for Regional Water Board staff review.

Commented [MP14]: Be prepared in case it's not possible to collect data for *all* the requested refinements within 3 months, especially if there are any seasonal / time-of-year sensitivities that need to be measured in the receiving water. It's entirely possible we'll need to compromise on what's possible to validate within the time available, and leave any "non-showstopper" lingering modeling issues to special studies under the permit itself if the initial results look good enough.