Delta Independent Science Board
DELTA STEWARDSHIP COUNCIL

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MEMORANDUM

Date: September 18, 2023

To: Regional Water Quality Control Board
Central Valley Region
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Sent via email: Sajleen.Phagura@waterboards.ca.gov

From: Delta Independent Science Board

Subject: Comments on the Draft Pyrethroid Control Program and Research Plan

Summary

The Delta Independent Science Board (Delta ISB) commends the Central Valley Regional Water Quality Control Board (Regional Board) for the development of the Pyrethroid Control Program and Research Plan (Plan). The draft Plan, aimed at mitigating the impacts of offsite discharge of six pyrethroids from urban and agricultural areas, which affect the ecology of receiving water and potentially public health, lays out several clear management questions and identifies some important research gaps. Nevertheless, the Delta ISB feels that there should be a stronger linkage between management needs and the proposed research and a stronger focus on monitoring and adaptive management. It is not clear how new research or monitoring would directly inform the management questions laid out in the draft Plan. The Delta ISB also questions the usefulness of the draft Plan for resolving management questions in a timely manner and thereby recommends some focused approaches. Additionally, evaluating the effectiveness of mitigation measures, including costs, should be considered as an overarching theme.

Background

Section 303 of the federal Clean Water Act requires the Regional Board to *"develop water quality objectives that are sufficient to protect beneficial uses"* for each water body within its region and to periodically review the Basin Plan to modify water quality objectives and/or beneficial uses as appropriate through a Triennial Review.

Pyrethroid insecticides, in particular bifenthrin, cyfluthrin, cypermethrin, esfenvalerate, lambda-cyhalothrin, and permethrin, have been detected at levels of concern for aquatic species in waters and sediments of the Sacramento and San Joaquin River watersheds. As required by the federal Clean Water Act, the Central Valley Regional Water Quality Control Board established a Control Program for Pyrethroid Pesticide Discharges in 2017 as well as a Total Maximum Daily Load for pyrethroid pesticides (TMDL; the maximum amount of a pollutant that a waterbody can accept and still meet the state's Water Quality Standards for public and environmental health).

The TMDL and a Pyrethroid Control Program became effective in 2019. The Program includes a "*conditional prohibition which does not allow pyrethroid discharges at concentrations above specified aquatic life protection-based concentration trigger values*" unless the discharger is implementing a management plan to reduce pyrethroid levels in their discharges.

However, the Regional Board found that *"adequate information was not available at the time to establish numeric water quality objectives for pyrethroids."* Therefore, the Pyrethroid Control Program included a commitment by the Regional Board to consider the adoption of numeric pyrethroid water quality objectives no later than *"15 years from the Pyrethroid Control Program effective date"* (i.e., in 2034).

The Regional Board was expected to work with stakeholders to develop a Pyrethroid Research Plan, which identifies and addresses knowledge gaps in order to achieve this goal. It is intended to serve as a basis upon which the science community may develop research proposals that will aid in addressing the Regional Board management questions. The Regional Board is required to coordinate and consult with the Delta Science Program, Delta Independent Science Board, Delta Stewardship Council, Department of Fish and Wildlife, and Delta Regional Monitoring Program, as appropriate.

General Comments

The Delta ISB review of the draft Plan was guided by four overarching questions to help assess whether they address recommendations from the Delta ISB's water quality review on nutrients and contaminants (Delta ISB 2018), which are described below.

1. Does the Research Plan optimally address management needs?

The Pyrethroid Control Program seeks to mitigate the impacts of offsite discharge of pyrethroids from urban and agricultural areas. While the draft Plan acknowledges many unknowns about the ecotoxicology of pyrethroids and the effectiveness of reduction and mitigation actions, the Delta ISB feels that relevant management needs are not well represented in the research questions. It is not clear how the proposed research would directly inform the management questions articulated in the draft Plan. For example, the Plan fails to describe monitoring approaches and evaluation criteria to inform Management Questions 1 to 4. In addition, it is important to gain reliable information on the cost effectiveness of mitigation measures.

Complying with the pyrethroid TMDL is likely to involve reducing use and/or discharge of target pollutants. For agricultural producers, reducing use of one pesticide may require substituting another pesticide to achieve desired control. So, a key research question is, will available substitutes for pyrethroids improve ecosystem conditions and if so, do they carry similar or other risks? Further, the draft Plan identified a data gap of "costs to dischargers" of meeting water quality objectives. However, no research questions on either topic were presented. Information about costs and the effectiveness of mitigation measures is needed to make informed decisions about discharge and runoff management in point and non-point source emission. Finally, the Plan could more clearly indicate how research will assist in establishing numeric targets, which was identified as an impediment to TMDL implementation.

Overall, the Delta ISB questions the usefulness of the draft Plan for resolving management questions in a timely manner. We suspect that adequate information is currently available to establish numeric water quality objectives for pyrethroids, as other countries are rapidly moving forward to regulate these chemicals. It is difficult to understand why the Regional Board requires another 15 years of research to establish such numeric water quality objectives while the European Union (EU) finalized the scientific process and review of a number pyrethroids (cypermethrin, bifenthrin, deltamethrin, esfenvalerate, and permethrin) in 2022

(see revised Directive for Environmental Quality Standards; European Commission 2022). The EU is expected to adopt Environmental Quality Standards (chronic and acute) in 2024.

Recommendations:

A. The Plan would benefit from articulating the practical and logistical steps for meeting the data and research needs, as well as the timeline to inform management questions.

B. An effective adaptive management strategy should be developed that includes stronger linkages between management needs, proposed research, and monitoring. Given the known harms of pyrethroids, an adaptive management framework, such as the one described in the Delta ISB's monitoring enterprise review (see Delta ISB 2022), should be used to help set priorities and provide linkages between research and management decisions. Management decisions that can be addressed with key research in the short term, i.e., before the 15-year time frame, should be identified. A simple diagram or decision-tree linking information gaps to process drivers and management would be very useful for shaping the actual research and decisions.

C. Given the many unknowns for pyrethroid management, it is also worth considering a dynamic adaptive planning approach (Hasnoot et al. 2013; Marchau et al. 2019), rather than waiting for perfect information. This type of decision making under deep uncertainty can be used to create cost-effective interim management approaches and strategies for future adaptation, while additional data are collected that evaluate potential system tipping points and the long-term outlook. For example, the cost-effectiveness and potential implementation scale of alternative pyrethroid reduction options could be systematically compared. If relatively low-cost management options showed promise for reducing concentrations of pyrethroids, they could be strategically implemented and monitored for effectiveness, while research is ongoing to establish the full management requirements for the TMDL. The process of developing such a system also can reveal which research needs are critical to specific decisions, including monitoring needs.

D. A review of the EU Environmental Quality Standards (see above), combined with an update of the water quality criteria already derived by the Regional Board and UC Davis (e.g., Fojut 2015a; Fojut 2015b, Fojut 2015c, Fojut 2015d; Fojut and Tjeerdema 2010; Palumbo et al. 2010), could provide numeric

water quality objectives in a timely manner, thereby allowing for immediate management actions to control pyrethroids. Regular review and update of these objectives, as well as a well-designed monitoring program, should be part of the adaptive management framework.

2. Will the draft Plan adequately address open questions concerning ecosystem effects of pyrethroids?

The overarching goal of pyrethroid control measures is the reduction or elimination of harmful environmental effects. The draft Plan addresses broad, fundamental research questions in ecotoxicology and environmental chemistry focused on this group of insecticides. While data generated will aid in the interpretation of monitoring data in an ecosystem context, the draft Plan includes a number of highly complex scientific efforts. Addressing any one of these (e.g., sublethal effects, mixture and multiple stressor effects, bioaccumulation/biomagnification) could take many years of coordinated efforts to identify the KEY factors. Potential funding sources and cost estimates are not provided. As a result, the Delta ISB wonders how the research will be prioritized, and how the data will be used to determine management actions.

A reasonable assessment of the of the environmental consequences of pyrethroids in the Delta requires a credible comparison of baseline and future conditions. The draft Plan does not seem to provide a strategy for collecting such monitoring data.

Recommendations

A. The Plan would benefit from a clear articulation of what type of data on pyrethroid concentrations, including their spatial and temporal distributions, are currently available. Further, the authors need to explain how these data can be used to assess the impact of different management practices currently employed to control the release of pyrethroids into surface waters.

B. In its 2018 water quality review, the Delta ISB recommended holistic monitoring studies (e.g., ones that combine toxicity testing and chemical analyses with fish and food-web monitoring) and increased temporal and spatial coverage of monitoring activities (see Delta ISB 2018). We recommend inclusion of a monitoring component in the draft Plan to inform management and to provide adequate baseline data for future management actions. This should include all pyrethroids registered for use in California as well as the potential replacement pesticides. Agricultural as well as urban sources should be considered.

C. In Management Question 3 of the Plan, the authors ask if current pyrethroid management practices are effective. A better question is to ask how effective they are.

3. How will research efforts be coordinated with other agencies?

The program includes a provision that the Regional Board will work with stakeholders to develop the Plan. The document, however, does not identify the stakeholders clearly nor does it show clear evidence of engagement with other agencies and stakeholders for the preparation of this draft Plan.

Recommendations:

A. The Plan would benefit from a description of how potential research partners will be incentivized to support the Plan, as well as who those partners likely will be. The proposed process by which the research efforts will be coordinated with other agencies, institutions, and private companies needs to be well-articulated.
B. The Plan would benefit from a discussion of other research plans for contaminants in the Delta or elsewhere and, should they exist and be shown to be effective, how they might be used as a model.

4. Are data management (including quality assurance), monitoring, and adaptive management part of the plan?

The draft Plan includes neither data management measures, which are an essential component of monitoring programs, nor an adaptive management strategy (see recommendations above). The plan does outline ongoing quality assurance measures (inter laboratory comparison) regarding establishing analytical methods for pyrethroids.

Recommendations:

A. The Delta ISB believes that a comprehensive focus on management, monitoring, data collection, and analysis as part of an adaptive management strategy is essential for an effective Plan to answer management questions (see Delta ISB 2022). These should be included as key components of the Plan.

Additional Specific Comments

During the Delta ISB discussions of the draft Plan, a number of additional questions and issues arose. These are summarized below so that they may be considered by the authors when revising the Plan.

1. Regulatory Actions:

It is unclear to the Delta ISB what regulatory actions are associated with the current Pyrethroid Control Program. For instance:

- Does the existing TMDL cover only the 6 pyrethroids named in the Plan, or all pyrethroids registered in California?
- Are there existing regulations limiting the use and discharge of pyrethroids from agricultural land and human communities? If so, are the polluting entities discharging concentrations exceeding the amounts allowed?
- What management strategies and actions are in place to bring the discharging entities into compliance?
- Would sanitation district facilities be actively involved in tracking human-based contributions?

2. Numeric Targets:

The draft Plan refers to TMDL numeric targets (including applicable water quality standards), water quality criteria, pyrethroid concentration goals and pyrethroid triggers, all of which are (more or less) defined as numeric concentration thresholds protective of beneficial uses. Please provide an explanation for why it was possible to establish these thresholds, while much more research appears to be needed to establish water quality objectives.

3. Partition Coefficients:

It is unclear how research on partition coefficients proposed in the Plan will be used to achieve management goals. While researchers have shown that bioavailability of pyrethroids can decrease in the presence of particles, it is highly dependent on environmental conditions and strongly species specific. For a review on this topic, see Knauer et al. (2017).

4. Analytical Method Development:

Monitoring of pyrethroids in the environment requires special analytical methods. Limits of detection in the parts per trillion (nanogram to picogram/L) range are required to cover proposed or existing water quality criteria for the protection of aquatic life. While the draft Plan describes the inter-laboratory comparison of

analytical methods, it does not address the sensitivity of methods (i.e., detection and reporting limits) used. Sensitive water column analytical methods have been published (see Rösch et al. 2019).

5. Pyrethroid Fate and Transport:

The fate and transport of pyrethroids in the environment are not addressed in the Plan, with the exception of the proposed research on partition coefficients. It is not clear to the Delta ISB if this information is already so well known that it does not need to be of concern. If so, then it should be acknowledged.

6. Co-Stressors:

The topic of co-stressors is addressed in the Plan, but the questions (including research on "other" species) are extremely broad. While these are important research topics, the proposed research on co-stressors (e.g., sublethal effects, additive/synergistic effects) requires a complex and extensive effort. Making the establishment of water quality objectives contingent upon the outcome of this co-stressor research appears unrealistic.

- Temperature: There is considerable information already available for pyrethroids; more than on many other chemicals. The question of how climate change/seasonal changes affect pyrethroid toxicity is important and could be used to address management questions in the future.
- Salinity: Compared to other factors affecting bioavailability of pyrethroids (e.g., species-specific differences, temperature), the impact of salinity on pyrethroid bioavailability appears to be of minor importance. Unlike metals, these organic chemicals do not change their chemical properties (i.e., chelation) depending on salinity. Species-specific differences in uptake and sensitivity are likely much more significant. Further, the authors state that "*However, the Pyrethroid Control Program does not consider the impacts of salinity in its numeric trigger derivation or application.*" If so, then why is this part of the Plan?
- Microplastics: The Delta ISB agrees that additional research on this topic is important but wonders if it is needed for the derivation of water quality objectives for pyrethroids. A rationale needs to be provided for prioritizing this emerging form of pollution.
- Synergistic and additive toxicity/chronic toxicity/bioaccumulation: While these are important topics, the research to fill management needs should be much more focused. It should be based on high quality monitoring data in

order to focus on real-world contaminant mixtures and their effects on key biological species. Existing modeling approaches could be used to address mixture effects and establish safety factors to account for uncertainties. Such methods are well established for risk assessment and TMDL design.

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