Comments on Establishing a Nutrient Runoff Water Quality Management Program

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The California Central Coast Regional Water Quality Control Board (CVRWQCB), like water quality regulatory agencies in many areas of the country, is focusing increased attention on the runoff of nutrients from agricultural land as it impacts eutrophication-related water quality in receiving waters. In this process, the CVRWQCB is developing an "Irrigation and Nutrient Management Program" to prescribe the monitoring of nutrients from agricultural fields. However, some technical aspects of the sampling approaches being discussed are of concern, to which the following comments are offered.

These comments are based on our experience in conducting studies on managing excessive fertilization of waterbodies caused by nutrient runoff from agricultural and urban lands. The senior author has been involved in evaluating nutrient runoff from agricultural and urban areas since the 1960s and has published extensively on these issues. These publications include Lee and Jones-Lee (2002a, b) developed under contract with the CA State Water Resources Control Board for the CVRWQCB. Other of our papers and reports on nutrient management issues are available on our website, www.gfredlee.com in the "Excessive Fertilization" subsection at http://www.gfredlee.com/pexfert2.htm.

Understanding the Characteristics of the Nutrient–Related Water Quality Problems of Concern

A key component of developing a nutrient management program (or "best management practices" – BMPs) is a reliable assessment of the nutrient-related water quality problems in the receiving waters for each watershed of interest. Such an assessment requires greater definition than can be obtained by sporadic/periodic grab sampling. Issues that need to be characterized include: the nature of the water quality problem – such as the types of aquatic plant growth that are problematic (planktonic algae, attached algae, rotted aquatic plants); the physical and hydrologic characteristics of the receiving waters in which the excessive fertilization water quality problems are manifest. This understanding should be used to guide the nutrient runoff monitoring programs and the subsequent assessment of the efficacy of management approaches adopted for agricultural fields in a particular watershed. It is critical that the loading of available forms of nutrients be coupled in a cause-and-effect basis relationship with the impact that is the subject of the management. Focus on reducing concentrations or loads of nutrients without proper coupling of the loading with the effect can be expected to result in ineffective and wasteful so-called management programs.

Nutrient runoff monitoring programs can and should be focused on assessing the nutrient loads from each of the major components of the watershed upstream of the areas where the nutrient

water quality programs are occurring. Developing nutrient runoff monitoring programs from agricultural fields without tailoring the monitoring to specific nutrient water quality problems are typically inefficient and misdirected.

Recommended Approach for Edge-of-the-Field Monitoring

In order to evaluate the effectiveness of specific agricultural nutrient management practices in reducing the load of available nutrients, the flow and associated concentrations of total and available forms of nitrogen and phosphorus in the runoff waters need to be reliably monitored over the course of a year. This monitoring should be directed to developing nutrient export coefficients for the particular land, i.e., mass of each nutrient exported from a unit area per unit time (e.g., grams phosphorus/sq meter/month). It is of value to compare such computed export coefficients to those already established in the literature (e.g., Rast and Lee, 1983).

Because of year-to-year variations, such measurement should be made at least over a three-year period. It is with a reliable assessment of pre-management characteristics that an assessment can be made of the effectiveness of an implemented management practice in reduction in nutrient load.

It is important that the flow measurements be made continuously. The frequency of grab samples for chemical analysis will depend on the site-specific characteristics of irrigation/runoff events and the characteristics of the receiving waters of concern. It is likely that the concentrations of nutrients will be highly variable during an irrigation or runoff event. The variability in nutrient concentrations and loads needs be evaluated and used to guide the development of the edge-of-the-field monitoring.

Total phosphorus and soluble orthophosphate concentrations should be monitored with proper recognition of the fact that the particulate phosphorus in runoff is difficult to monitor reliably; much of the particulate P may be transported as bed load or near-bed load. Nitrate plus nitrite, ammonia, and total organic N should be monitored. If it is found that that ammonia and organic N concentrations in representative runoff samples are insignificant compared with the levels/loads of nitrate and nitrite, those forms would not need to be measured in all samples.

Several other parameters should be measured to help evaluate the overall characteristics of the runoff waters. These include EC, turbidity, TSS, color, and temperature. Changes in those bulk parameters relative to nutrient concentrations/loads can provide insight into factors impacting nutrient discharges from an agricultural area.

Nutrient runoff should be measured over an annual cycle unless it can be demonstrated that the nutrient runoff/discharges at certain times of the year are not contributing to the nutrient-related water quality problems in the receiving waters.

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