Comments on
"'Working Draft'
DRAFT MONITORING AND REPORTING PROGRAM -ORDER NO. R5-2007-_____FOR COALITION GROUPS UNDER AMENDED ORDER NO. R5-2006-0053 COALTION GROUP CONDITIONAL WAIVER OF WASTE DISCHARGE REQUIREMENTS FOR DISCHARGES FROM IRRIGATED LANDS
dated March 29, 2007"

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Presented herein are comments on the preliminary working draft entitled, "CONDITIONAL WAIVER OF WASTE DISCHARGE REQUIREMENTS FOR DISCHARGES FROM IRRIGATED LANDS" ("ag waiver") water quality monitoring program for the Central Valley Regional Water Quality Control Board's (CVRWQCB) proposed revised Monitoring and Reporting Program (MRP).

Overall Assessment

The stated objectives of the Conditional Waiver of Waste Discharge requirements are to adequately and reliably define the water quality impacts (beneficial use impairments) of stormwater runoff and irrigated agriculture tailwater discharges (runoff/discharges) from irrigated lands in the Central Valley of California. The proposed revised MRP is significantly deficient in prescribing an ag waiver water quality monitoring program that will provide the information needed to achieve those objectives.

The issues of greatest concern are the following.

- The approach for siting monitoring locations does not ensure reliable examination of the potential water quality impacts of agricultural runoff/discharges.
- The Assessment Monitoring program of one grab sample per month over a three-year period is not adequate to reliably detect and evaluate general, or especially worst-case, conditions that could cause significant water quality impacts of runoff/discharges from irrigated agricultural areas.
- A single grab sample during each of two stormwater runoff events per year cannot be relied upon to provide a meaningful glimpse into the character, behavior, or potential water quality impact of an event, much less provide a basis for extrapolation to the general case impact for a discharge.
- The listing of Long-Term Monitoring Strategy (LTMS) monitoring parameters has deficiencies that diminish the monitoring program's reliability for producing data that can be used to evaluate violations of the CVRWQCB Basin Plan numeric and narrative water quality objectives (WQOs).

Ag Waiver Monitoring Program Objectives

Lee and Jones-Lee (2002a) discussed recommendations to the CVRWQCB to develop a reliable water quality monitoring approach for non-point source pollutants. That approach emphasized the importance of clearly defining the objectives of the monitoring program and then developing the monitoring program needed to achieve those objectives with a defined degree of reliability. Page 2 of the proposed, revised MRP lists the "Objectives" of the MRP as,

> *"QUESTION No.1: Are conditions in waters of the State that receive agricultural drainage or are affected by other irrigated agriculture activities within Coalition Group boundaries protective, or likely to be protective, of beneficial uses?*
>
> *QUESTION No.2: What is the magnitude and extent of current or potential water quality problems in waters of the State that receive agricultural drainage or are affected by other irrigated agriculture activities within Coalition Group boundaries, as determined using monitoring information?*
>
> *QUESTION No.3: What are the contributing source(s) from irrigated agriculture to the water quality problems in waters of the State that receive agricultural drainage or are affected by other irrigated agriculture activities within Coalition Group boundaries?*
>
> *QUESTION No.4: What are the management practices that are being implemented to reduce the impacts of irrigated agriculture on waters of the State within the Coalition Group boundaries and where are they being applied?*
>
> *QUESTION No.5: Are conditions in waters of the State within Coalition Group boundaries getting better or worse through implementation of management practices?"*

The draft MRP also states,

"The Coalition Group MRP Plans shall be designed to answer these five key questions, by documenting the implementation of the following steps:

> *1. Evaluate the Coalition Group's ability to answer each of the five key questions with the information presently available to them.*
>
> *2. Identify critical gaps in knowledge (e.g., inability to document impacts, lack of knowledge about potential sources, absence of trend monitoring components) relevant to the Coalition Group's circumstances.*
>
> *3. Use the MRP Order as a framework for filling in the data gaps and for developing monitoring components suited to each Coalition Group's circumstances, documenting how the six* [five?] *key management questions will be answered."*

The proposed revised draft MRP objectives and conditions are essentially the same as the current MRP objectives. Those objectives are appropriate and need to be achieved in order to begin to control the discharge of pollutants from irrigated lands in the Central Valley. However, as discussed below, there are deficiencies in the MRP that preclude the achievement of those objectives in the foreseeable future.

Discussion

The currently proposed MRP will not achieve the objectives of the CVRWQCB agricultural water quality management program in the foreseeable future. The MRP will ultimately need to be significantly expanded and upgraded in specific aspects in order to achieve the program objectives.

The proposed approach for siting monitoring locations does not ensure reliable examination of the potential water quality impacts of agricultural runoff/discharges. Beginning on page 4, section B. REQUIREMENTS FOR MONITORING SITE INFORMATION through most of page 7 in the proposed, revised MRP, there is considerable detail on the characteristics of the locations that should be monitored. That prescribed approach to defining monitoring locations is not necessarily adequate for detecting some of the worst-case situations that are occurring in association with irrigated agriculture runoff/discharges. For example, they do not adequately address edge-of-the-field and nearby-waterbody situations that could be the most significant areas of water quality impairment by irrigated agriculture discharges/runoff since the greatest concentrations of pollutants likely occur near their point of discharge.

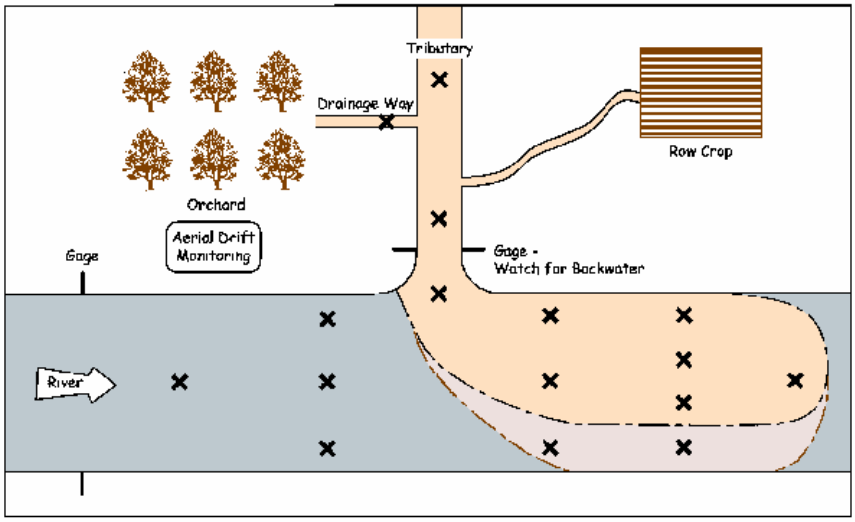
Initially, the ag waiver water quality monitoring program was designed to initiate a limited scope water quality monitoring program; coalitions of agricultural interests discharging in an area were to begin to undertake analysis of a limited number of samples on a limited number of streams receiving runoff/discharges from irrigated agricultural lands. The initial MRP focused on detecting aquatic life toxicity associated with pesticide use in agricultural practices. Under the current MRP, if a sample is found to be toxic then the coalition is to conduct a limited scope study in an attempt to determine the cause and the source of the chemical(s) causing the toxicity. Beginning in the spring of 2006 the list of monitored parameters was expanded; subsequently, the MRP was somewhat modified to correct some of the problems with the original list of monitoring parameters. However, that modified monitoring program was still significantly deficient in collecting the data needed to begin to effectively achieve the objectives of the MRP.

Basically, the current, and for that matter the proposed revised, MRP is a **"hit or miss"** approach to water quality monitoring. The current ag waiver water quality monitoring program might be nominally adequate for defined discharges to waters that have reasonably constant flow and chemical composition between the location of the runoff/discharge and the monitoring location. However, agricultural runoff/discharges have highly variable flow and composition and can be diluted by downstream inflow of tributaries before the monitoring location. In order to reliably evaluate the ag runoff/discharge-related water quality impacts that cause violations of Basin Plan numeric and narrative water quality objectives, it is necessary to significantly expand the downstream watershed monitoring as well as conduct a focused water quality monitoring program that is grounded in event/situation monitoring.

In a report to the CVRWQCB and the State Water Resources Control Board (SWRCB), Lee and Jones-Lee (2002a) discussed elements of the approach that should be adopted to reliably monitor non-point-source pollution from sources such as irrigated agricultural

runoff/discharges. They pointed to the need for a highly focused edge-of-the-field and nearby waterbody monitoring program that is designed to collect water samples during the times that the greatest concentrations of potential pollutants are being discharged or run off from the irrigated agricultural area. Such a program, schematically represented in Figure 1, would also be appropriate following application of chemicals such as pesticides or fertilizers, as well as during the first runoff after extended periods of little or no runoff/discharge.

Figure 1
Recommended Monitoring Approach for Toxicity and its Impacts in Agricultural Runoff/Discharges



(from Lee and Jones-Lee, "Issues in Developing a Nonpoint Source Water Quality Monitoring Program for Evaluation of the Water Quality - Beneficial Use Impacts of Stormwater Runoff and Discharges from Irrigated Agriculture in the Central Valley, CA," 2002a)

The single grab sample of runoff for each of two stormwater runoff events as required under the current and proposed revised MRP is a "hit-or-miss" approach. It is grossly inadequate to provide reliable monitoring of the potential occurrence of toxicity or other adverse impacts of ag runoff/discharges in a monitoring station watershed upstream of the monitoring location. Such an approach could be followed for years without ever defining the adverse impacts of upstream ag runoff discharges. Further, by its inherent unreliability, it could lead to erroneous conclusions and expenditures for pollutant control that do not, in fact, remedy the problems.

It is important to understand that a short-term "worst-case" runoff/discharge situation, such as a short-term pulse of pesticide-caused aquatic life toxicity, can go undetected under the current and proposed ag waiver water quality monitoring program yet have highly adverse impacts on aquatic life-related beneficial uses by killing larval fish or essential fish food organisms. This can also adversely impact a locally resident fish population as well as anadramous fish populations (salmon).

A reliable, focused water quality impact evaluation program requires an understanding of how and when potential pollutants are transported from irrigated lands, and how these pollutants adversely impact aquatic life and other beneficial uses of waterbodies receiving the ag runoff/discharge. At this time, this understanding does not typically exist in the Central Valley. The result is that it will likely be necessary to conduct some preliminary studies to evaluate how best to monitor in specific locations. The magnitude, duration, persistence and impacts of ag runoff-derived pollutants often depend on site-specific characteristics. By focusing on edge-of-the-field, worst-case situations it will be possible to fairly quickly identify those agricultural practices and conditions that are most likely to be adverse to water quality due to aquatic life toxicity, turbidity, changes in aquatic life habitat such as spawning areas, etc. Ultimately adopting this monitoring approach could prove to be less expensive for agricultural interests than the hit or miss monitoring set forth in the revised draft MRP.

It is important that the MRP specify that the monitoring for the initial round of focused monitoring be conducted at locations "representative" of the coalition's area of responsibility. In making this determination, consideration should be given to the range of factors that are expected to control or influence the water quality impact of the runoff/discharges. Again, the emphasis should be on gaining a technical understanding of key issues that are likely to influence the manifestation of aquatic life toxicity or other adverse impacts at a particular location.

As discussed by Lee and Jones-Lee (2002b) the edge-of-the-field and nearby waterbody monitoring will be needed to reliably evaluate the efficacy of management practices that are implemented to control violations of water quality objectives. Adoption of the edge-of-field monitoring will provide valuable background data for evaluation of the efficacy of management practices that will be examined to control pollutant runoff/discharge that are causing WQO violations in the nearby waters.

For some pollutants such as aquatic plant nutrients (nitrogen and phosphorus compounds) the focus of the monitoring program must include not only the receiving waters near the discharge/runoff point but also the downstream waterbodies since nutrients can cause significant water quality problems in waters located long distances from the monitoring location. For example, taste and odor problems caused by excessive growths of algae occur in San Francisco Bay area and southern California water supply reservoirs whose water is derived from the Delta. Lee and Jones-Lee (2005a; 2006a,b,c) have discussed the elements of the approach that needs to be followed to reliably assess the water quality impacts of aquatic plant nutrients.

For pollutants that tend to bioaccumulate to excessive concentrations in edible aquatic life, it will be necessary to monitor water and fish not only near the point of discharge but also downstream where the pollutant(s) could tend to accumulate in sediments. Sediment-associated pollutants can be a source of bioaccumulating chemicals. The development of reliable monitoring programs for pollutants that tend to bioaccumulate in edible aquatic organisms has been discussed in a report to the CVRWQCB/SWRCB by Lee and Jones-Lee (2002c).

Since the concentrations of potential pollutants in agricultural runoff/discharges are likely to be highly variable during a runoff/discharge event, it is important to understand that a single grab-sample of the type allowed by the current MRP and specified in the proposed revised MRP, can produce data that are not representative of the concentrations or loads present in the runoff/discharge. In order to reliably assess the potential impacts of ag runoff/discharge-associated pollutants it is necessary to collect samples and measure flow periodically during the runoff event.

The effectiveness of focused monitoring is demonstrated by studies that G. F. Lee and his graduate students conducted to evaluate the potential impacts of urban stormwater runoff as a source of aquatic plants nutrients that lead to excessive fertilization of receiving waterbodies. Summarized by Lee in the Stormwater Runoff Water Quality Newsletter, NL 10-2 (http://www.members.aol.com/LFandWQ/swnews102.pdf), those studies have served as the technical basis for evaluating the potential significance of urban stormwater runoff as a source of aquatic plant nutrients. As a result of their developing urban area nutrient export coefficients, they were able to evaluate whether an urban area is a potential source of N and P compounds that are a significant cause of waterbody excessive fertilization. Their studies determined that urban stormwater runoff contributed about 10 times more phosphorus per unit area and time than typical agriculture row crop runoff. Further, it was found through those focused studies that much of the urban and agricultural stormwater runoff-associated particulate phosphorus was not available to support algal growth. That finding has important implications for developing management practices to control the impacts of phosphorus in urban stormwater runoff since it shows that the typical detention basin approach for settling particulate phosphorus is not effective in controlling algal-available P in the runoff. As discussed by Lee (2006) similar conclusions could readily be found for agricultural runoff of phosphorus in the Central Valley of California.

An issue that continues to need more attention in the MRP is the development of monitoring data that can be interpreted in terms of the Basin Plan objectives that are to be used to evaluate a WQO violation for the parameter being measured. Some of the constituents of greatest concern in this regard are the nutrients, turbidity, TOC, suspended solids, and bioaccumulatable chemicals such as legacy pesticides. In order to make judicious use of agricultural monitoring funds it is important that the monitoring focus on the generation of data that can be used to evaluate water quality impacts. For certain parameters, such as nutrients that are regulated as biostimulatory substances, simply collecting concentration data is not adequate to evaluate water quality impacts; additional

measurements are needed to make this evaluation. In their guidance on developing water quality monitoring programs, Lee and Jones-Lee (2002a) have discussed a number of these issues; they have also been discussed by Lee (2003; 2004a) and Lee and Jones-Lee (2003a; 2005b) in previous comments on ag waiver MRP issues. Key elements are summarized below.

Previously, G. F. Lee suggested at the Technical Issues Committee (TIC) meeting, the CVRWQCB develop synthetic example data for all required monitoring parameters that could be used to demonstrate how the CVRWQCB plans to interpret the data being generated with respect to assessing violations of WQO objectives by ag runoff/discharges. This still needs to be done. Adoption of this approach will reveal the need for the CVRWQCB to modify Basin Plan objectives for certain parameters so that violations of these objectives can be assessed through a water quality monitoring program.

The CVRWQCB needs to address the approach that is to be used to define the beneficial uses of waterbodies in each coalition's area. This is a regulatory issue that cannot be defined by the coalitions.

The draft revised MRP proposes to allow the CVRWQCB executive officer considerable authority to make decisions on important issues without public review. The MRP should specify that all executive officer actions on regulatory issues be posted on the CVRWQCB website where the public can review and comment on them.

The CVRWQCB needs to expand the monitoring of Central Valley waterbodies that receive agricultural runoff/discharges to include monitoring of discharges from all sources, including urban stormwater runoff and fugitive water releases from uses of water in urban areas. Agricultural interests are justifiably concerned that these urban areas are allowed to discharge, without monitoring, pollutants to waterbodies that are under investigation as being adversely impacted by agricultural runoff/discharges.

Specific Comments

Page 8 of the proposed revised MRP presents Table II A Assessment Monitoring Schedule indicating that the revised MRP will specify that the

> *"Assessment monitoring shall consist of monthly sampling for general water quality parameters, nutrients and pathogens. Assessment Monitoring will also include water column and toxicity monitoring, as well as the series of pesticides, metals and nutrients described in Table A."*

Page 8 also states,

> *"Core site monitoring shall utilize a baseline monitoring approach at sites where assessment monitoring has already been conducted and that have been adequately characterized. Core site monitoring will be used to track compliance with specific regulatory water quality standards, and/or to track trends in water conditions over time. Thus the core monitoring sites must include frequent and routine monitoring on a predetermined schedule, as summarized below:*

*"**Parameters***
(See Table A for details)
Monitoring Frequency *

Assessment Monitoring	*Once every three years**
Nutrients	*Monthly*
General Physical Parameters (including Flow)	*Monthly*
Pathogens	*Monthly*
Photo monitoring (digital)	*Every monitoring site with every monitoring event*
*Parameter(s) of Concern***	*Monthly*

** Every third year of Core Site Monitoring shall include all Assessment Monitoring parameters and be conducted monthly for a period of 12 months.*
***Parameters of Concern may be selected by Central Valley Water Board Executive Officer from toxicity, pesticides or metals that resulted in an exceedance or near-exceedance during Assessment Monitoring."*

The Assessment Monitoring program of one sample per month over a three year period is not adequate to reliably detect the worst-case conditions of the potentially most significant impacts for toxic runoff/discharges from irrigated agricultural areas.

Further, the proposed three-year cycle for the Assessment Monitoring is not adequate to reliably detect the impacts of changes made in agricultural practices such as changing the type and use patterns of pesticides that can significantly adversely impact aquatic life-related beneficial uses of the state's waters. It is also not adequate to evaluate the influence of climatological factors in the manifestation of adverse impacts. The US EPA Office of Pesticide Programs (OPP) and CA Department of Pesticide Regulation (DPR) allow the use of pesticides that are highly toxic to aquatic life and that can readily be present in stormwater runoff and/or tailwater discharges from areas of use, and thereby cause toxicity in the waters receiving the runoff/discharges. Allowing a three-year assessment monitoring cycle is not protective; highly toxic/adverse conditions could exist for several years before they are potentially detected in the next three-year Assessment Monitoring period.

The MRP should specify that if, during the three-year period between Assessment Monitorings, an agricultural activity changes pesticide type or use pattern, an evaluation should be made of whether the new pesticide or change in pesticide use leads to aquatic life toxicity in the state's waters. Jones-Lee and Lee (2000) and Lee (2001) and have describe a "pro-active" approach for evaluating the use of new/different pesticides or use approach to detect adverse impacts before widespread adverse impacts occur. This approach requires that the agricultural interests conduct site-specific studies that are approved by the CVRWQCB to determine if the change in pesticide used/use causes aquatic life toxicity in the receiving waters for the runoff/discharges.

Special Project Monitoring
The current revised draft MRP states,
"Special project monitoring includes specific targeted studies that are being incorporated into a Coalition Group's MRP Plan due to a Coalition Group's implementation of a TMDL, or for the implementation of a Coalition Group Management Plan that results from exceedances.

Management Plans shall be required when more than one exceedance of the same constituent has occurred at a given site within a period of three years."

This language could be interpreted to mean that the upstream edge-of-field monitoring would be required only if a WQO violation is found at downstream monitoring locations. This approach is not protective of the state's waters in situations where irrigated agriculture runoff/discharges cause localized impacts on aquatic life and/or other designated beneficial uses upstream of the monitoring location that do not persist as far downstream as the selected monitoring locations.

The one exceedance allowed every three years applies only to pollutants that cause adverse impacts to aquatic life. As discussed in the Appendix to these comments, in comments made by C. Delos, Health and Ecological Criteria, Division Office of Science and Technology, Office of Water US EPA in Washington DC for constituents that are adverse to human health, such as through affecting domestic water supply water quality and excessive bioaccumulation of hazardous chemicals in edible organisms, as well as for contact recreation, the allowed frequency of exceedance of the WQO are determined on different bases. This should be acknowledged and clearly indicated in the revised MRP.

Duration of MRP Applicability

The currently proposed MRP does not indicate its projected period of applicability. At a recent Technical Issues Committee (TIC) meeting, G.F. Lee asked the CVRWQCB staff for information on the expected duration of the period of applicability for the revised proposed MRP. W. Croyle responded that the period of applicability is not defined, but indicated that it could be a considerable period of time, such as five to ten years before consideration for revision. This is of concern since if the CVRWQCB adopts the proposed MRP with its "hit-or-miss" monitoring approach, it could be a very long period of time before the MRP is revised so that it could achieve its stated objectives.

Addressing Disparity between MRP Objectives and Proposed Revised MRP

As discussed herein, there is significant disparity between the stated objectives of the MRP and the monitoring approach proposed in the MRP.

In order to achieve the stated objectives of the MRP within the foreseeable future, the "hit-or-miss" monthly monitoring program currently set forth in the draft MRP must be expanded to include a more comprehensive downstream monitoring program and, especially, representative edge-of-the-field monitoring of the type described herein. As an alternative, the CVRWQCB could change the objectives of the MRP to remove the expectation that the MRP will provide adequate definition of the adverse impacts of runoff/discharges of pollutants from irrigated agriculture.

Either the objectives of this program should be changed or the revised MRP be significantly improved to develop the data/information needed to achieve the objective of this program. Failure to make such changes will cause the CVRWQCB ag waiver management program to continue to provide an unreliable assessment of the role of irrigated agricultural discharges/runoff in impairing the water quality/designated beneficial uses of the state's waters.

D. Monitoring Parameters

Page 10 begins Table II.D, the listing of the LTMS monitoring parameters. Like the previous versions of tables of this type in the current MRP, this table incorporates a number of problems in specifying monitoring parameters for the generation of data that can be used to evaluate violations of the CVRWQCB Basin Plan numeric and narrative WQOs. These problems have been brought to the attention of the CVRWQCB/SWRCB by Lee (2003; 2004a) and Lee and Jones-Lee (2003a; 2005b), yet they continue to occur in the proposed revised MRP. A summary of these issues is presented below.

"Physical Parameters." Table II.D continues to incorrectly list pH, DO, TDS, EC, TSS as "Physical Parameters." These are chemical parameters. The CVRWQCB staff has recommended that the CVRWQCB not enforce Basin Plan objectives for the so-called "physical parameters" listed in the Draft MRP. This is an invalid approach for protection of water quality. Further, since pH and DO have US EPA water quality criteria, failure to enforce those objectives could result in violations of the Basin Plan objective and may not be allowed by the US EPA.

It is important that violations of water quality objectives for the so-called "physical parameters" be properly assessed and reported. As discussed below, a number of these parameters are important in assessing a waterbody's water quality/beneficial uses.

Flow. The CVRWQCB ag waiver water quality monitoring guidance states that flow measurements are to be made at the time of sampling. As has been discussed (Lee, 2006a) one grab sample and one flow estimate (independent of its reliability) is grossly inadequate to reliably assess the flux (load), and changes in flux, of a parameter in a water at a monitoring location. This approach could lead to unreliable estimates of loads of constituents if the data collected on concentrations are applied to an assumed flow, which is the average of the flows between samplings. It is well-established (see Lee and Jones-Lee, 2002a) that continuous flow measurements should be made if reliable load estimates are to be obtained. This is especially important for sampling runoff where the flow can change rapidly during a runoff event.

***pH*.** While the CVRWQCB requires that pH be measured, no guidance is provided as to the time of day or depth in the water column at which the measurements are to be made. As discussed in previous comments on the MRPs (Lee, 2003; 2004a; and Lee and Jones-Lee, 2003a; 2005b), samples collected near the surface in the early morning hours may show no violations of the pH WQO, while samples collected at the same location several hours later, in the early afternoon, could show violations of the pH objective. This is because of the increase in pH that occurs with the removal of CO_2 by photosynthetic activity. Unless this issue of timing and location of pH monitoring is addressed specifically in a meaningful way in the MRP, the CVRWQCB should acknowledge that the CVRWQCB pH monitoring program may not detect exceedances of the pH WQO.

The "p" in "pH" is always lower-case, even at the beginning of a sentence. The "p" stands for the "negative log of."

Dissolved Oxygen. Dissolved oxygen (DO) measurements are required. However, as discussed in previous comments (Lee 2003, 2004a; and Lee and Jones-Lee 2003a, 2005b), the time of day when DO measurements are to be made is not specified. Measurements made in late afternoon could show that there is no DO problem, yet in the early morning, there could be a severe DO problem, which could cause fish kills through overnight low DO.

As with the pH monitoring, unless the timing and location of DO monitoring are addressed specifically in a meaningful way in the MRP, the CVRWQCB should acknowledge that the CVRWQCB DO monitoring program may not detect exceedances of the WQOs.

Color. The WORKING DRAFT DOCUMENT INFORMATION SHEET (information sheet associated with the proposed revised MRP) on Page 8 in the section, VII. OTHER CHANGES IN MRP MINIMUM MONITORING REQUIREMENTS states,

"Monitoring for Color was required under MRP Order RB5-2003-0833 was moved (sic) *required in existing MRP) due to the fact that more applicable measurements are Total Suspended Sediments, and turbidity."* Contrary to the implications of that statement, TSS and turbidity are not 'more applicable replacements' for color. Each of these parameters, including color, measures different properties.

The Basin Plan specified: *"**Color** - Water shall be free of discoloration that causes nuisances or adversely affects beneficial uses."* In order to implement this objective, color must be measured.

Both True (filtered) and Apparent (unfiltered) color should be measured. There are situations in which color is a significant water quality parameter; it can affect light penetration which can, in turn, affect photosynthesis in the water column and sediments. This, in turn, can affect DO and domestic water supply water quality. As discussed by Lee and Jones-Lee (2003b), an example of this situation occurred in the San Joaquin River Deep Water Ship Channel near the Port of Stockton.

Color is also related to TOC/DOC. Further, color is an important pollutant that is discharges from wetlands such as the State and Federal refuges and duck clubs. The units for color should be the chloroplatinate units (CPU) set forth in Standard Methods for the Examination of Water and Waste Water (APHA, et al. latest edition.).

Alkalinity. Alkalinity is an important water quality parameters that should be measured in any comprehensive water quality monitoring program. This parameter is important in the interpretation of other water quality data. For a discussion of this issue see Lee and Jones-Lee (2002a). Alkalinity should be added to the revised proposed MRP as a measured parameter.

Turbidity, Suspended Solids and Sediment. The discharge of sediment from irrigated agriculture causes increased turbidity/suspended solids in Central Valley waterbodies

significantly impacting their beneficial uses. The CVRWQCB requires that turbidity be monitored as part of the ag waiver monitoring program. While turbidity approximates suspended solids concentration, it is not a reliable approach for assessing all of the water quality impacts of suspended solids, such as the shoaling in waterbodies that impacts navigation. The CVRWQCB Basin Plan lists as the WQO for turbidity,

> *"**Turbidity***
> *Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:*
> - *Where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), increases shall not exceed 1 NTU.*
> - *Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent.*
> - *Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs.*
> - *Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.*
>
> *In determining compliance with the above limits, appropriate averaging periods may be applied provided that beneficial uses will be fully protected."*

Unless measurements are made before the discharge/runoff occurs to establish the background turbidity just before the runoff event, there is no way to implement the Basin Plan WQO to judge a violation of the water quality objective by turbidity. The CVRWQCB needs to address this issue so that turbidity data can be interpreted with respect to conformance to Basin Plan objectives.

Electrical Conductivity. Electrical conductivity (EC) is a measure of the total salt content of a water. As discussed in previous comments on MRPs, the measured EC is highly temperature-dependent. It is therefore essential that if the equipment used for measuring EC does not automatically correct the measurements to 20 C, that a correction of about 2%/degree be made of the measured value to the 20 C level. The temperature of the water should be made at the time of EC measurement. The EC should be reported as the "value at 20C."

Total Organic Carbon and Dissolved Organic Carbon. The proposed MRP monitoring program requires that total organic carbon (TOC) be monitored. Dissolved organic carbon (DOC) should also be measured since the relationship between TOC and DOC is an important characteristic. Data that have been available for some time have shown that there are elevated concentrations of TOC and DOC in agricultural drains, in tributaries to the Delta and in the Delta, compared to those that are known to cause excessive trihalomethane formation under conventional domestic water supply treatment involving chlorination for disinfection. However the CVRWQCB does not have a Basin Plan objective for TOC/DOC. Further the US EPA does not have a fixed numeric value for what constitutes excessive TOC in a domestic water supply intake. Such a value would depend on a variety of factors, including methods of treatment, etc. Without a Basin Plan objective for TOC or DOC, it is not possible to determine the critical concentrations of these constituents in ag runoff/discharges for regulatory purposes. The net result is that

another of the key parameters of concern with respect to ag runoff/discharges, for which data will be generated by the ag waiver water quality monitoring, will be uninterpretable with respect to a WQO violation because of a lack of regulatory limits.

In addition to measuring TOC, DOC should be measured since this is the parameter of greatest concern with respect to water supply impacts that lead to excessive trihalomethane formation. Further, since in some cases (especially in some ag drains) an appreciable part of the TOC is in a labile form – i.e., will decompose by the time it reaches the water supply intake – there is need to measure BOD and planktonic algal chlorophyll associated with any TOC measurements. Lee and Jones-Lee (2003c) and Lee (2004b) discuss these issues; TOC measurements alone will not provide the kind of information that is needed to begin to properly regulate excessive TOC/DOC.

Aquatic Life Toxicity. Page 8 bottom and top of page 9 of the draft information sheet states,
"Pyrethroids in water, which were removed due to the hydrophobic nature of the pesticides. Their detection is much greater in the sediment." This is not a valid approach especially if the water near agricultural runoff/discharges from areas where pyrethroid pesticides are used is monitored as it should be. The Lee and Taylor (2001a, b) studies conducted in the Upper Newport Bay watershed in the late 1990s showed that pyrethroid-based pesticides (based on PBO activation of diluted samples) were the likely cause of aquatic life toxicity in stormwater runoff from agricultural areas in that area.

The draft information sheet also states,
"Water column monitoring for pyrethroids has been conducted and are detected relatively infrequently." – This is because the current MRP does not include monitoring of the state's waters near agricultural runoff/discharges from areas in which pyrethroid pesticides have been used. Further, Weston (UC Berkeley) indicated that his studies have shown that there are situations in which pyrethroid-based pesticides are used, and are likely present in runoff, but do not result in the presence of excessive concentrations of these pesticides in the sediments near discharge points. As he discussed, there is a number of factors that influence whether pyrethroid-based pesticides accumulate near discharge points to cause aquatic life toxicity. It is important to monitor both the watercolumn and the sediments for aquatic life toxicity. If toxicity is found, an evaluation should be made to determine if all or part of the toxicity is due to pyrethroid-based pesticides

"*Pyrethroids in sediment will be tested only when tests indicate the presence of significant toxicity.* "Significant toxicity" needs to be defined.

There appears to be confusion about whether or not the Basin Plan requires that any sediment toxicity be considered to be a violation of the Basin Plan. If it does, guidance needs to be provided on how the CVRWQCB will address sediment toxicity that is due to low DO, and hydrogen sulfide and ammonia that are not directly discharged by an identified source. Those constituents are the most common causes of sediment toxicity. Will this toxicity be ignored, as is typically done by regulatory agencies, or will there be need to evaluate and control the nutrient discharges in the watershed that lead to algae and other aquatic plants that settle, die and become a source of the oxygen demand that

leads to low DO and the subsequent development of hydrogen sulfide and ammonia in the sediments?

Another aquatic life aquatic toxicity issue that the CVRWQCB should address is the water quality significance of toxicity as measured in currently specified algal toxicity testing procedures. In most ag drain situations toxicity to algae is not adverse to the beneficial uses of the waterbody and downstream of the monitoring location. In some situations toxicity to algae is beneficial to a waterbody's water quality because it limits photosynthesis that could, in turn, lead to low DO and elevated pH levels in violation of WQOs.

Ammonia. Page 9 of the draft information sheet states,
"Unionized ammonia was added to the MRP list because the Tulare Lake Basin does have a numeric limit for unionized ammonia and not total ammonia. This does not constitute an additional analysis, as it is calculated from total ammonia using pH, temperature and hardness. All of those parameters are already on the monitoring list". One sample per month is not adequate frequency to properly assess if unionized ammonia is potentially affecting water quality through toxicity.

The US EPA has established an updated water quality criterion for ammonia as set forth in the *Federal Register, http://www.epa.gov/waterscience/criteria/ammonia/* that can be used to judge excessive concentrations of ammonia. The implementation of these criteria is that a series of measurements must be available to properly interpret ammonia toxicity data. One grab sample per month of a waterbody, where it is known that the ammonia concentrations are likely be highly variable, is not adequate.

E. coli. The CVRWQCB has specified that *E. coli* and fecal coliforms be monitored as part of the ag waiver water quality monitoring. The primary purpose for such measurements is the protection of the state's waters for contact and non-contact recreation. In accord with the US EPA recommendations, the CVRWQCB adopted *E. coli* as a proposed water quality objective for contact recreation. However, the SWRCB has yet to support this approach. Therefore the *E. coli* data cannot be evaluated with respect to violations of the water quality objective until the State Board approves the *E. coli* objective, and it is approved by the Office of Administrative Law. Until this occurs, fecal coliform is the water quality objective applicable to REC-1 waters.

Biostimulatory Substances. At this time chemicals such as nitrogen and phosphorus compounds that stimulate sufficient aquatic plant growth that impairs a waterbody's beneficial uses are regulated in the Basin Plan under "biostimulatory substances." According to the CVRWQCB 2007 Basin Plan,

> *"**Biostimulatory Substances***
> *Water shall not contain biostimulatory substances which promote aquatic growths in concentrations that cause nuisance or adversely affect beneficial uses."*

There are no numeric WQOs for biostimulatory substances. The Basin Plan requires that whatever stimulates excessive growths of aquatic plants be controlled. This means that it

is not possible to use the nutrient (nitrogen and phosphorus) data generated in the ag waiver water quality monitoring program to define what an excessive discharge of a biostimulatory substance is without studies beyond the nutrient measurements required in the MRP. As discussed by Lee and Jones-Lee (2002a) and Lee and Jones-Lee (2002b) in *"Review of Management Practices for Controlling the Water Quality Impacts of Potential Pollutants in Irrigated Agriculture Stormwater Runoff and Tailwater Discharges,"* in order to evaluate whether excessive biostimulatory substances occur in a water, it is necessary to conduct detailed monitoring/evaluation at the sampling site and downstream. Additional information on this issue has been provided by Lee and Jones-Lee (2005a; 2006a,b,c). As they discussed this requires a substantially different monitoring program than that set forth in the draft revised MRP. Planktonic algal chlorophyll, Secchi depth, as well as the extent of attached algae and water weeds should be assessed at the monitoring locations.

Organochlorine "Legacy" Pesticides, PCBs and Dioxins. One of the most significant problems associated with past and, likely to some extent, current irrigated agriculture in the Central Valley is the discharge of substances that lead to excessive bioaccumulation of the legacy organochlorine pesticides, such as DDT, chlordane, toxaphene and dieldrin, in edible fish tissue. As discussed by Lee and Jones-Lee (2002c) many of the major Central Valley waterbodies, including the Delta and Sacramento and San Joaquin Rivers and their tributaries, are listed as Clean Water Act 303(d) "impaired" because of excessive bioaccumulation of organochlorine pesticides and PCBs in fish. One of the issues that the CVRWQCB and SWRCB staff did not address, but that had been raised in previous comments (Lee, 2003, 2004a; and Lee and Jones-Lee 2003a, 2005b), was the inability to monitor the organochlorine pesticides at critical levels (i.e., US EPA-recommended Water Quality Criteria of December 2002 and CTR (California Toxics Rule) criteria) using chemical methods prescribed by the CVRWQCB staff. Concentrations of the organochlorine legacy pesticides in water can be "non-detect," yet bioaccumulate to excessive levels in fish tissue, causing the fish to be a hazard to those who use them as food. It is for this reason that G.F. Lee has been recommending, and now the US EPA is beginning to work toward, regulating these constituents based on fish tissue concentrations, not water concentrations. Excessive bioaccumulation of the organochlorine pesticides and PCBs in a waterbody can be reliably evaluated based on exceedance of the OEHHA fish tissue guidelines. This approach is a direct measure of a real, significant water quality/public health problem.

Another aspect of trying to use the water concentration approach as an indicator of excessive legacy pesticides and PCBs, which makes it unreliable, is that in many situations, most of the organochlorine pesticides and PCBs in water are associated with suspended solids, which renders them unavailable to fish in the water column. Therefore, with respect to a watercolumn concentration of total pesticide or PCBs in excess of a US EPA criterion, there can be exceedances without adverse impacts. It is for this reason, as well, that measurement of tissue concentrations in edible fish is the reliable approach for addressing one of the most important water quality problems in the Central Valley that is associated with past – and, likely, current – agricultural activities. In their report, *"Organochlorine Pesticide, PCB and Dioxin/Furan Excessive Bioaccumulation*

Management Guidance," Lee, and Jones-Lee (2002c), have discussed an approach that should be used to define the current sources of legacy pesticides and PCBs, with particular reference to distinguishing between current agricultural runoff from areas where these materials have been applied and residues that are derived from aquatic sediments. Since many ag drains and other waterbodies in the Central Valley have fish with excessive concentrations of the legacy pesticides, it will be necessary to follow an approach similar to that outlined by Lee and Jones-Lee (2002c) to address the excessive accumulation of these chemicals in edible fish tissue. Rather than trying to evaluate the discharge of the organochlorine legacy pesticides through measuring watercolumn concentrations, the measurement of fish tissue residues is a much more reliable and direct approach for defining whether irrigated agriculture is a significant current source of these pesticides and PCBs.

While PCBs are typically associated with industrial discharge or electrical transformers and not ordinarily considered to be associated with agricultural activities, fish in the Central Valley have been found to contain excessive concentrations of PCBs in areas where agricultural discharges are occurring and there is no readily apparent source of PCBs. Therefore, the monitoring of fish tissue should include measurement of PCB.

Rather than monitoring the watercolumn for the organochlorine legacy pesticides and PCBs, it is recommended that fish from the monitoring locations be collected in the fall of the year and their tissues be measured for these pesticides and PCBs. If, after a couple years of such monitoring, excessive levels of these chemicals are not detected in the fish, further monitoring should not be necessary.

Heavy Metals –Hg. The CVRWQCB has specified a set of heavy metals (see Table II.D) for water quality monitoring. The measured concentrations of the dissolved forms of these chemicals can be compared to CTR criteria. An important heavy metal that is not listed in the proposed revised MRP is mercury. This is a significant omission since excessive bioaccumulation of mercury in edible fish is a common problem in Central Valley waterbodies. Since mercury is present in irrigation waters that are diverted from Central Valley rivers, total and methyl mercury should be monitored in discharges/runoff from irrigated agriculture. Also, fish taken from the waterbodies impacted by ag runoff should be analyzed for mercury in edible tissue.

The CTR criteria are based on worst-case exposure to toxic/available forms of the heavy metals. Dissolved heavy metals would rarely be present in their most toxic, available forms in typical ag drain waters. Therefore, if an exceedance is found of a CTR criterion for a heavy metal listed in the revised proposed MRP, such as copper, cadmium, lead, nickel or zinc, consideration should be given to conducting site-specific investigations to determine if that exceedance causes aquatic life toxicity. As discussed by Lee and Jones-Lee (2002a), this can be readily done with the addition of EDTA to the toxicity test protocol. If the toxicity persists in an EDTA-amended sample, the toxicity is not due to the heavy metals. In that situation, a site-specific assessment of the water quality criterion should be made.

***Groundwater Quality Monitoring*.** Lee and Jones-Lee (2007a,b) have recently reviewed the situation with respect to protecting Central Valley groundwaters from pollution by permitted activities that take place on the land surface. They discussed that the CVRWQCB and the SWRCB have been permitting, and will apparently under the current approach continue to permit, land surface activities (such as land disposal of domestic wastewaters, wastewater sludges, cannery wastes, and solid wastes) that will lead to groundwater pollution. This is in violation of the Porter-Cologne Water Quality Control Act (SWRCB, 2006). Division 7, Chapter 1, section 13000 of that Act, states,

> *"The Legislature finds and declares that the people of the state have a primary interest in the conservation, control, and utilization of the water resources of the state, and that the quality of all the waters of the state shall be protected for use and enjoyment by the people of the state."*

Chapter 2, section 13050, paragraph (e) defines "waters of the state" as *"any water, surface or underground, including saline waters, within the boundaries of the state."*

One of the types of land surface activities of greatest concern with respect to groundwater pollution is irrigated agriculture. As Lee and Jones-Lee (2007 a,b) discussed based on the literature, irrigated agriculture cannot be practiced without some, and in some situations major, groundwater pollution by nitrate and salts. While it is not possible to practice irrigated agriculture without some groundwater pollution, it is possible to greatly reduce the amount of groundwater pollution that will occur. In order to begin to understand and potentially control groundwater pollution by the various types of irrigated agriculture that occur in the Central Valley, the MRP should specify that the coalitions be required to initiate groundwater monitoring to begin to determine whether the current agricultural practices lead to groundwater pollution that could potentially be minimized by changing agricultural practices.

Comments on
"IRRIGATED LANDS CONDITIONAL WAIVER PROGRAM QUALITY ASSURANCE PROJECT PLAN GUIDELINES"

Page 4 second paragraph states,
"The QAPP shall identify the procedures that will be used to assure that the monitoring data represents, as closely as possible the water quality conditions of the water body that is being sampled."
Add the words, "*at the time of sampling.*" The current and proposed MRP is significantly deficient in approach to define the water quality conditions of the water body without a greatly expanded water quality monitoring program of the type discussed herein.

Page 15 under (d) Algae Toxicity Testing states,
"Algae toxicity testing shall not be proceeded with treatment of the chelating agent, EDTA. The purpose of omitting this reagent is to ensure that metals used to control algae in the field are not removed from sample aliquots prior to analysis." EDTA does not "remove" heavy metals; it complexes them so that they are not toxic.

Page 15, the discussion under "(e) Alternative Analytical methods **(Lab Round Table Recommendation 1.0)**" is not appropriate since, as G. F. Lee commented at a TIC meeting, those familiar with the reliability of analytical methods in the sources listed in this section know that not all of the analytical methods listed in Standards Methods for a particular constituent are equally reliable in all types of waters. The wording of this section should be changed to reflect that the analytical method used should be evaluated for its appropriateness for the water being sampled.

The listing in Appendix A for Hardness has incorrect units.

The listing for Total Phosphorus of 1 mg/L is too high.

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Appendix

Approach to Evaluating WQO Violations

At the April 3, 2007 TIC meeting questions arose on the approach that is used to evaluate the allowed frequency of exceedance of a water quality objective with respect implementation of human health-based criteria. It is recognized that the allowed exceedance of a criterion/objective for aquatic life protection is one exceedance of any magnitude every three years. The USEPA currently recommended water quality criteria are at http://www.epa.gov/waterscience/criteria/wqcriteria.html.

Following the TIC meeting, I contacted Charles Delos, Environmental Scientist, Health and Ecological Criteria, Division Office of Science and Technology, Office of Water US EPA in Washington DC regarding the recommended approach for assessing allowed exceedance of human health-based criteria. His response is presented below.

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May 18,2007

Fred:

Allowed Frequency of Exceedance of Human Health Based Water Quality Criteria

Charles Delos, Environmental Scientist, Health and Ecological Criteria, Division Office of Science and Technology, Office of Water US EPA in Washington DC

The California Toxics Rule says that the design flow for all human health criteria is the harmonic mean flow (Federal Register Vol 65, No. 97, page 31701, May 18, 2000). This is based on attaining human health criteria as an arithmetic mean concentration.

EPA's 1991 Technical Support Document for Water Quality-based Toxics Control, pages 37 and 88-89 also discuss the question, explicitly mentioning the long-term arithmetic mean concentration for carcinogens (based on 70-year average exposure). For RfD-based criteria, the TSD understood that the averaging period would be fairly long but expressed some uncertainty about how long. By the time EPA promulgated the CTR that uncertainty had been cleared up, and EPA had decided that both carcinogens and non-carcinogens would use the same long-term averaging period.

Assuming a log normally skewed distribution for the ambient concentration, if 50% of the values exceeded the criterion, then the high-skewed values would pull the arithmetic mean over the criterion. Attaining the criterion as an arithmetic mean thus does not mean a 50% exceedance frequency. Rather, in this situation, the allowable frequency depends on the time-variability of the ambient concentrations. Here is an approach that Steve Saiz and I agree upon. It assumes a log normal distribution.

If Sigma is the standard deviation of the natural logs of concentration, then for a log normal distribution:

Geomean = Arith mean / exp(0.5 *Sigma^2)

Set the Arith Mean equal to the criterion. Solve for the Geomean (geometric mean), where the Geomean is the same as the Median.
Example: if Criterion = Arith Mean = 1.0, and Sigma=0.6, then Geomean = 0.8353.
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Now calculate the normal deviate z-value:

z = (ln(Criterion) - ln(Geomean)) / Sigma

where Criterion = Arith Mean = 1

For this situation z = 0.30

From the normal distribution table (or spreadsheet function for the normal distribution probabilities), it follows that 61.79% of representative samples must be under the criterion and 38.21% may be over the criterion.

Steve has provided the appropriate percentage of samples for other degrees of time variability (that is, other values for Sigma, the standard deviation of natural logs). They are in his spreadsheet, attached.

Although the above shows an approach for dealing with exceedance frequencies of (cancer potency-based or RfD-based) human health criteria, it is not obvious that it has any greater reliability than simply averaging all representative samples taken at a site over time, and comparing that long-term average concentration with the human health criterion.

Charles Delos May 18, 2007

(See attached file: LognormProportionLTMean.xls)

Reproduction of Appendix A in "The Lognormal Distribution" by Aitchison & Brown, 1957

Note: Proportion < Mean = Pr (X < mean) = Pr (Z < sigma/2)

Sigma	Proportion < Mean	Proportion > Mean
0	0.5000	0.5000
0.05	0.5100	0.4900
0.10	0.5199	0.4801
0.15	0.5299	0.4701
0.20	0.5398	0.4602
0.25	0.5497	0.4503
0.30	0.5596	0.4404
0.35	0.5695	0.4305
0.40	0.5793	0.4207
0.45	0.5890	0.4110
0.50	0.5987	0.4013
0.55	0.6083	0.3917
0.60	0.6179	0.3821
0.65	0.6274	0.3726
0.70	0.6368	0.3632
0.75	0.6462	0.3538
0.80	0.6554	0.3446
0.85	0.6646	0.3354
0.90	0.6736	0.3264
0.95	0.6826	0.3174
1.0	0.6915	0.3085
1.1	0.7088	0.2912
1.2	0.7257	0.2743
1.3	0.7422	0.2578
1.4	0.7580	0.2420
1.5	0.7734	0.2266

1.6	0.7881	0.2119
1.7	0.8023	0.1977
1.8	0.8159	0.1841
1.9	0.8289	0.1711
2.0	0.8413	0.1587
2.1	0.8531	0.1469
2.2	0.8643	0.1357
2.3	0.8749	0.1251
2.4	0.8849	0.1151
2.5	0.8944	0.1056
2.6	0.9032	0.0968
2.7	0.9115	0.0885
2.8	0.9192	0.0808
2.9	0.9265	0.0735
3.0	0.9332	0.0668
3.1	0.9394	0.0606
3.2	0.9452	0.0548
3.3	0.9505	0.0495
3.4	0.9554	0.0446
3.5	0.9599	0.0401
3.6	0.9641	0.0359
3.7	0.9678	0.0322
3.8	0.9713	0.0287
3.9	0.9744	0.0256
4.0	0.9772	0.0228