California Regional Water Quality Control Board
North Coast Region
Bob Anderson, Chairman

Linda S. Adams
Secretary for Environmental Protection

www.waterboards.ca.gov/northcoast
5550 Skylane Boulevard, Suite A, Santa Rosa, California 95403
Phone: (877) 721-9203 (toll free) • Office: (707) 576-2220 • FAX: (707) 523-0135

Arnold Schwarzenegger
Governor

March 17, 2009

Daniel Edward Schindler, Ph.D.
Professor, School of Aquatic and Fishery Sciences
University of Washington
Box 355020
Seattle, WA 98195-2700

Subject: Peer Review of Proposed Revision to Dissolved Oxygen Water Quality Objectives for the California Regional Water Quality Control Board, North Coast Region

Dear Dr. Schindler:

Enclosed please find a copy of the *Peer Review Draft Staff Report for the Revision of Dissolved Oxygen Water Quality Objectives* (2009). As per communications with Dr. Gerald Bowes of the California State Water Resources Control Board, we understand that you have agreed to provide a scientific peer review of this document to aid us in finalizing the report for the purpose of bringing proposed revisions of the dissolved oxygen water quality objectives to the North Coast Regional Water Quality Control Board for their consideration. Thank you in advance for your time and efforts on this project.

Our original request letter to Dr. Bowes for peer reviewers anticipated the availability of the staff report for peer review in January 2009 with a 30 day review period. Release of the peer review draft has been delayed two months. So, it is with apology that we submit later than anticipated the document for your review and hope that you will be able to prepare comments by April 17, 2009. Please contact Alydda Mangelsdorf of my staff if you need to discuss an alternative to this arrangement.

Included as Attachment A is a copy of the original peer review request letter to Dr. Bowes with general questions for your consideration. In addition, we have a few specific questions we would appreciate your thoughts on.

1. The most recent guidance published by the U.S. Environmental Protection Agency (USEPA) on the development of ambient water quality criteria for dissolved oxygen was published in 1986. Staff has followed this guidance in the development of proposed revisions to the life cycle-based DO objectives because the findings of an in-house literature review conducted in 2005 (Carter 2005) corroborates the findings of USEPA (1986). Evidence as provided in Appendix H of the staff report, however, indicates some reason to believe that with respect to DO objectives protective of spawning, the translation of intragravel requirements into water column objectives (e.g., the addition of 3 mg/L DO) may be over-protective. We would appreciate your thoughts on whether current science supports the use of a 3 mg/L correction factor to translate the intragravel DO requirements of salmonid eggs and alevin into ambient water column DO water

quality objectives (e.g., 8 mg/L DO as a 7-day average in the intragravel environment; 11 mg/L DO as a 7-day average in the water column).

2. Staff reviewed scientific literature to determine that background DO conditions could be estimated by calculating the daily minimum DO resulting from 85% saturation at natural receiving water temperatures at a given site. Evidence as provided in Appendix G of the staff report, however, indicates some reason to believe that calculating a daily minimum DO resulting from 90% saturation at natural receiving water temperatures may more closely estimate background DO conditions. We would appreciate your thoughts on whether current science supports the use of 85% saturation as the basis for estimating background DO conditions.
3. Staff has outlined a general procedure for estimating natural receiving water temperatures (Section VI.3.2.2 of the staff report). We would appreciate your thoughts on whether current science indicates that these general procedures are adequate.
4. Staff has outlined a general procedure for determining if natural conditions prevent the attainment of life cycle-based DO objectives (Section VI.3.3.1). We would appreciate your thoughts on whether current science indicates that these general procedures are adequate.

Included as Attachment B is guidance to reviewers from staff on the peer review of documents. Thank you very much for your time and efforts on this project. If you have any questions, please feel free to contact Alydda Mangelsdorf at (707) 576-6735 or AMangelsdorf@waterboards.ca.gov.

Sincerely,

Alydda Mangelsdorf for

Holly A. Lundborg
Senior Environmental Scientist

Attachment A: Letter to Dr. Bowes, December 2008
Attachment B: Guidance to Reviewers from Staff

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Linda S. Adams
Secretary for Environmental Protection

Arnold Schwarzenegger
Governor

December 8, 2008

Dr. Gerald Bowes
Department of Water Quality
State Water Resources Control Board
Post Office Box 100
Sacramento, California 95812-0100

Subject: Request for External Peer Reviewers of the Scientific Basis of the Proposed BPA for Dissolved Oxygen Water Quality Objectives

Dear Dr. Bowes:

In accordance with Health and Safety Code section 57004, the North Coast Regional Water Quality Control Board (Regional Water Board) is requesting external scientific peer review of the scientific basis for a proposed amendment to the *Water Quality Control Plan for the North Coast Region* (Basin Plan). The proposed Basin Plan amendment (BPA) will revise the existing water quality objectives (objectives) for dissolved oxygen (DO).

DO objectives were first adopted by the Regional Water Board in 1975 and have remained unchanged since that time. The goal of the proposed BPA is to update the DO objectives to the current scientific understanding and acknowledge the relationships (elevation, salinity, and natural temperature conditions) that affect DO. These revisions to the DO objectives are crucial for the development of a Klamath River Total Maximum Daily Load (TMDL) Action Plan for dissolved oxygen and other related parameters. Staff intends to bring the DO objective before the Regional Water Board prior to the hearing on the proposed Klamath River TMDL. The Klamath TMDL must demonstrate full protection of beneficial uses, for example, through compliance with the DO objective. As such, it is necessary to adopt a revised DO objective prior to the adoption of the Klamath TMDL so as to ensure that the DO analyses conducted in support of the TMDL are based on an accurate and appropriate DO objective.

Purpose of the Request

The purpose of this letter is to request external scientific peer reviewers of the Staff Report, including BPA Action Plan, for the proposed revision of the DO objectives. Peer reviewers are asked to review the scientific basis for the proposed DO objectives, including guidance followed, literature cited, data analyzed, and judgments and assumptions relied upon. This request provides an overview of the amendment and scientific issues in order to facilitate selection of external peer reviewers. The Staff Report is not yet available.

Expected Date of Regional Board Action

The Regional Water Board is expected to formally consider the proposed revisions to the DO objectives during its scheduled meeting in June 2009. This is in advance of the September 2009 meeting in which the Regional Water Board will consider the Action Plan for the Klamath River TMDL so as to meet EPA's court-ordered approval of the TMDL by December 31, 2009.

In order to meet this schedule, we request receipt of the peer reviewer's comments by February 15, 2009.

Expected Date the Documents will be Available for Review
January 15, 2009.

Requested Review Period
We request a thirty (30) day review period in order to finalize the staff report and proposed BPA for a public review of the document prior to the Regional Water Board's consideration of staff's proposal in June 2009. We judge the proposed revision of DO objectives to be relatively straightforward, relying primarily on guidance developed by EPA and other Basin Plans. As such, we do not believe the review will require excessive effort or time. As the proposed revision of the DO objective relates to the proposed Action Plan for the Klamath River TMDL, there may be some overlap in the selection of peer reviewers. As such, peer review comments on the proposed DO revisions can be submitted to Regional Water Board staff after peer review is complete on the proposed Action Plan for the Klamath TMDL.

Suggested Areas of Expertise for Reviewers
The proposed amendment focuses on two general disciplines. We suggest that having at least two reviewers is appropriate for this project.
Reviewers should have expertise in the following fields:

- Water chemistry and limnology: particular emphasis on the physical, chemical, and biological factors influencing DO in the various riverine, reservoir, and estuarine environments of the California north coast.
- Fisheries biology: with a focus on the freshwater habitat (physical and chemical) needs of salmonid species.

Contact Information
Alydda Mangelsdorf (AMangelsdorf@waterboards.ca.gov) at (707) 576-6735 is the staff contact.

Attached please find (1) a plain English summary of the proposed amendment, (2) a list of focused scientific topics for the peer reviewers, and (3) a list of scientists involved in development of the draft document.

Please contact me if you have questions. Thank you for your assistance.

Sincerely,

Holly Lundborg, Senior
Planning Unit

Attachments

Attachment 1

Description of Proposed Action

INTRODUCTION

The North Coast Regional Water Quality Control Board (Regional Water Board) is proposing an amendment to the *Water Quality Control Plan for the North Coast Region* (Basin Plan) for the revision of dissolved oxygen (DO) water quality objectives (objectives) herein after referred to as *Proposed DO Amendment*. The staff report for the *Proposed DO Amendment* addresses the following issues:

- The development of DO water quality criteria, as recommended by USEPA.
- The DO requirements of salmonids in each of their life stages.
- The DO requirements of other aquatic species, as appropriate and available.
- Techniques for establishing background DO conditions as the basis for protecting water quality in waterbodies unable under natural conditions to achieve the DO requirements of salmonids on a year around basis.

BACKGROUND

The Regional Water Board directed staff in its 2007 Triennial Review of the Basin Plan to develop a proposal for the revision of the DO objectives. The existing DO objectives were put into effect in 1975 and have remained unchanged since that time. The DO objectives are contained in two places within the Basin Plan: 1) page 3-4.00 under the heading "Dissolved Oxygen" and 2) Table 3-1 on pages 3-6.00 through 3-8.00. The objectives on page 3-4 .00 are based on the life cycle requirements of sensitive aquatic species and are applicable throughout the region. These objectives are referred to here as the *life cycle DO objectives*. The objectives in Table 3-1 are based on background conditions as measured by extensive regional sampling in the 1950s and 1960s and are applicable in individually named waterbodies. These objectives are referred to here as *background DO objectives*. At present, the *background DO objectives* take precedence over the *life cycle DO objectives* for those waterbodies named in Table 3-1 of the Basin Plan.

Revision of the DO objectives is necessary because: 1) the *life cycle DO objectives* are given only as daily minimum requirements and thus allow for multiple, consecutive days of marginal conditions; 2) the *background DO objectives* are daily minimums based on grab sample data which by in large did not capture actual daily minimum conditions; and 3) the listing of threatened and endangered aquatic species in the region and the specter of global warming call for updated and innovative approaches to water quality regulation.

Staff proposes three fundamental changes to the existing DO objectives. First, the framework of the DO objectives should be reversed so that the *life cycle DO objectives* take precedence over the *background DO objectives*. This is to better ensure that threatened and endangered aquatic species receive the immediate protection they require. Second, the *life cycle DO objectives* should be updated to include weekly average limits so as to better prevent the occurrence of multiple days of marginal conditions. Third, in those waterbodies where natural conditions prevent the attainment of *life cycle objectives*, the existing *background DO objectives* should be updated.

Staff proposes that these revisions apply to both warm and cold freshwater habitat within the region, including habitat used for spawning, reproduction, and/or early development. There appears at present no reason to revise the DO objectives designed to protect marine habitat (MAR) and inland saline water habitat (SAL).

Attachment 2

Description of Issues to be Addressed by Peer Reviewers

The statutory mandate for external scientific review (Health and Safety Code Section 57004) states that it is the reviewer's responsibility to determine whether the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices.

We request that the reviewer make this determination for each of the following issues that constitute the scientific portion of the proposed regulatory action. An explanatory statement is provided for each issue. A full Staff Report will be available January 15, 2009.

1. Suitability of proposed *life cycle DO requirements* to protect the cold and warm water fisheries of the North Coast Region from acute and chronic ill effects.

The proposed revised *life cycle DO requirements* are primarily based on USEPA 1986 Ambient Water Quality Criteria for Dissolved Oxygen (EPA 440/5-86-003). Staff also reviewed more recent scientific literature on the life cycle requirements of salmonids, among other species, to confirm the continued validity of USEPA's 1986 document.

USEPA (1986) recommends daily minimum limits to protect against acute effects on "embryo and larval stages," as one category and "other life stages," as a second category of salmonid and nonsalmonid life cycle requirements. USEPA (1986) also recommends 7-day or 30-day average limits to protect against chronic effects on "embryo and larval stages," as one category and "other life stages," as a second category of salmonid and nonsalmonid life cycle requirements. Staff proposes that the Basin Plan be revised to add 7-day average limits for 1) spawning, incubating and early life stages of salmonids, 2) other life stages of salmonids, and 3) spawning, incubating and early life stages of nonsalmonids. The values proposed are those indicated by USEPA (1986) to result in no production impairment. These are in addition to the existing daily minimum limits already contained in the Basin Plan and determined by staff to be appropriate for continued use.

Reviewers are asked to assess the degree to which the revised *life cycle DO requirements*, as proposed, are based on sound science and are likely to ensure adequate DO conditions in North Coast waterbodies to provide the life cycle requirements of salmonid and nonsalmonid aquatic organisms. Further, reviewers are asked to assess the degree to which current science agrees that the proposed *life cycle DO requirements* will be likely to result in no production impairment of the North Coast salmonid and nonsalmonid fisheries.

2. Assessment of existing *background DO requirements* as outdated and requiring update.

The objectives in Table 3-1 of the Basin Plan are based on background conditions as measured by extensive regional sampling in the 1950s and 1960s and are applicable in individually named waterbodies. These objectives are referred to as *background DO objectives* and take precedence over the *life cycle DO objectives* in those waters listed in Table 3-1 of the Basin Plan. For waterbodies from the Stemple Creek north up to but not including the Klamath River, the *background DO objectives* assigned in Table 3-1 of the Basin Plan is 7.0 mg/L as a daily minimum, except in Humboldt and Bodega bays which are assigned a *background DO objective*

of 6.0 mg/L as a daily minimum. For waterbodies from the Klamath River up to the Oregon border, the *background DO objectives* range from 5.0 mg/L as a daily minimum to 9.0 mg/L as a daily minimum.

The data used to establish background conditions were collected by a range of partners including federal, state and local agencies. The Department of Water Resources published the data in annual bulletins beginning with data from 1951. Generally, the data are monthly grab samples that were collected during day light hours and analyzed in the field using a modified Winkler method. They represent the range of DO conditions found in North Coast streams during the day when photosynthesis is active and contributing oxygen to the water column. Further, they represent the DO conditions found during a very active period in North Coast land use history. These data unlikely include the true daily minimum at any of the given sites, which more typically occur in the pre-dawn hours. Yet, they are established as daily minimums requirements.

Prior to the advent of 24-hour data loggers, DO compliance data was reasonably compared to the Table 3-1 objectives to determine compliance since they too were collected during day light hours. However, DO data is now frequently collected in North Coast streams using 24-hour data loggers which capture DO conditions both day and night. These datasets include the pre-dawn DO concentrations, frequently including the lowest DO conditions of the day. The comparison of pre-dawn DO data to day-time DO objectives is in essence a comparison of apples to oranges and does not provide an accurate understanding of the degree to which a given site is truly impaired due to DO depletion.

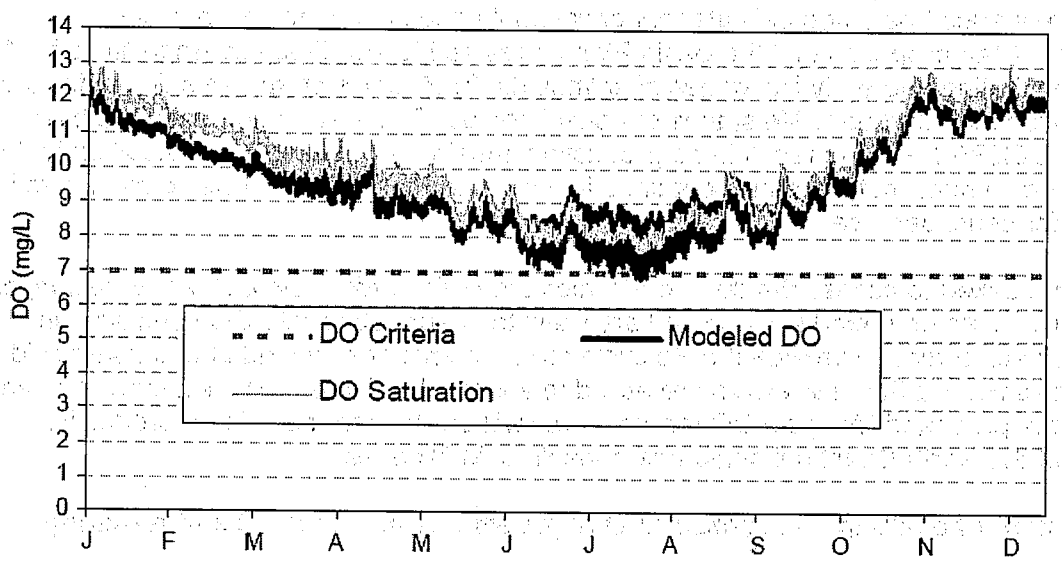

Figure 1. Upstream of Iron Gate Reservoir on the Klamath River. Comparison of DO under natural conditions and 100% DO saturation based on natural temperatures to the existing Table 3-1 *background DO objective.*

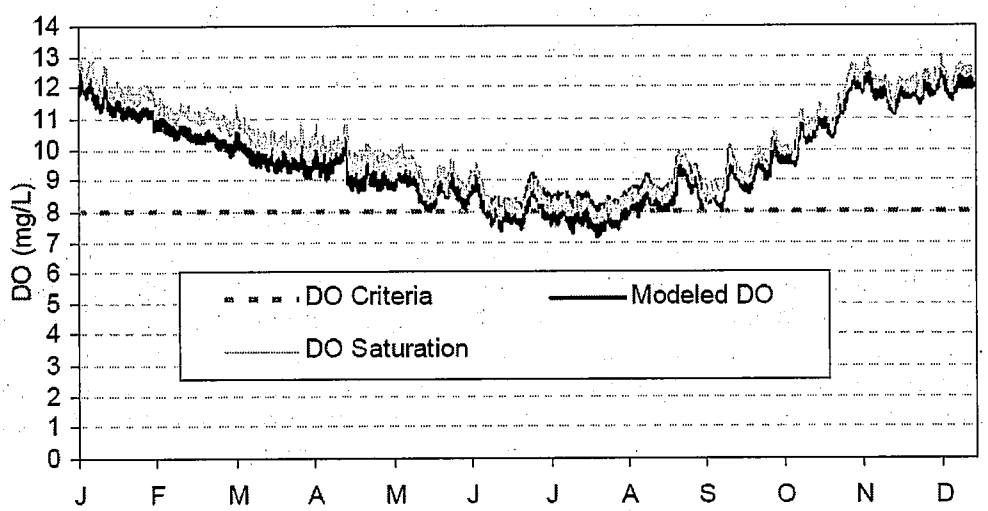

Figure 2. Downstream of Iron Gate Reservoir. Comparison of DO under natural conditions and 100% DO saturation based on natural temperatures to the existing Table 3-1 *background DO objective.*

As an example, the Klamath River is listed on the 303(d) list as impaired due to violations of the ambient DO water quality standard and a TMDL is currently being developed. In this case, violations of the ambient water quality standard for DO are only one indication of DO impairment. Water quality modeling is being conducted using data from the Klamath River to determine how much pollutant loading must be reduced to achieve ambient water quality objectives. For DO, the model indicates that even with the elimination of *all* pollutant sources – under a natural condition—water quality will still not consistently meet the Table 3-1 objectives. Separate modeling indicates that even if fully saturated (100% DO saturation), DO at natural temperature conditions would not consistently meet the Table 3-1 *background DO requirements.* These model outcomes have given further indication that the Table 3-1 *background DO objectives* inaccurately represent achievable daily minima.

Existing DO data throughout the Region is scant and does not lend itself to a region wide reassessment of background DO conditions. Further, funds for region wide modeling are not available. As such, staff are unable to simply revise the Table 3-1 DO objectives to better comport with true daily minimum background conditions. Further, the threatened and endangered status of several species of salmonids in North Coast streams suggests that where possible, water quality standards should be tailored to meet the life cycle requirements of these organisms. Thus, staff proposes that the order of priority be reversed so that the *life cycle DO objectives* take precedence over the *background DO objectives.* Such a reversal means that the *lifecycle DO objectives* will apply in most waterbodies. Only in waterbodies where "natural conditions" prevent the attainment of *life cycle DO requirements* does staff propose that the *background DO objectives* be updated.

Reviewers are asked to assess the scientific defensiveness of eliminating Table 3-1 *background DO requirements* as outdated given today's typical DO monitoring capabilities. Reviewers are further asked to assess the scientific defensiveness of applying *lifecycle DO requirements* in all waterbodies except those where "natural conditions" prevent their attainment.

3. Estimation of *background DO requirements* by calculating the minimum concentration of DO (mg/L) that would exist at 85% saturation using site atmospheric pressure, salinity, and an estimate of natural background temperatures.

There are at least a couple of waterbodies in the North Coast Region in which "natural conditions" likely prevent the attainment of *life cycle DO requirements*, namely: the Klamath River and the Laguna de Santa Rosa. TMDLs for DO impairment are currently being conducted for both of these waterbodies; but, as of this writing are not yet complete. To ensure that appropriate DO objectives are applied in each waterbody of the Region, staff proposes that for waterbodies in which "natural conditions" prevent the attainment of *life cycle DO requirements*, the *background DO requirements* be updated. This, we propose, be accomplished by calculating the seasonal DO concentrations necessary to ensure at least 85% saturation based on natural temperatures. For this exercise, natural temperatures must be estimated. The Staff Report describes the means by which this is intended to be accomplished.

Several literature sources (Hauer and Hill 1996, Allen 1995) and conversations with Dr. Moyle at UC Davis indicate that healthy riverine systems generally maintain DO saturation greater than about 80%. Indeed, many of the State's regions include a percent saturation requirement in their Basin Plans. These Basin Plan requirements range from 80-95%. Staff proposes 85% saturation as an appropriate criterion because it allows for diurnal fluctuation such as will naturally occur yet restricts it to the range typically found in healthy rivers, including a margin of safety. Staff also proposes that the 85% saturation criteria be applied as a daily minimum to protect against extreme, damaging sags in DO.

Reviewers are asked to critique:

- ✓ The use of natural temperatures as the basis for estimating background DO conditions, as well as the methods/techniques recommended for this purpose.
- ✓ The use of percent saturation to define the DO conditions of a healthy river.
- ✓ The use of 85% saturation as the criteria appropriate for bracketing the DO fluctuation generally found in unpolluted rivers.
- ✓ The application of the 85% saturation criteria as a daily minimum.

4. Definition of "natural conditions."

The *lifecycle DO requirements* are intended to apply throughout the region except where they can not be met under "natural conditions." The term "natural conditions" here refers to those conditions as they are in the absence of human interference. Natural factors at play may include: fire, disease, climate, geology, hydrology, vegetation, and others. They do not include the effects of: water diversions, agricultural return flows, increased solar radiation due to modifications of the riparian zone, the widening of a stream channel due to logging-induced sedimentation, as examples. Reviewers are asked to consider whether the definition of "natural conditions," as described in the Staff Report, adequately covers the factors of prime importance to the protection of water quality and beneficial uses and is based on sound ecological principles.

Other Issues

Reviewers are not limited to addressing only the specific issues presented above. Additionally, we invite you to contemplate the following "Big Picture" questions.

(a) In reading the technical reports and proposed implementation language, are there any additional scientific issues that should be part of the scientific portion of the proposed rule that are not described above? If so, comment with respect to the statute language given above.

(b) Taken as a whole, is the scientific portion of the proposed rule based upon sound scientific knowledge, methods, and practices?

Reviewers should also note that some proposed actions may rely significantly on professional judgment where available scientific data are not as extensive as desired to support the statute requirements for absolute scientific rigor. In these situations, the proposed course of action is favored over no action.

Attachment 3

List of Participants

Regional Water Board staff prepared the documents using regulatory guidance, available scientific literature, and the examples of other regulatory programs. There have been no outside paid consultants contributing to the development of the proposed Basin Plan amendment. However, Dr. Peter Moyle from UC Davis has offered, *gratis*, some opinions and guidance which are cited in the staff report. In addition, the following people have offered comments under the CEQA Scoping process on behalf of their clients:

Dr. Dave Smith, Merritt Smith Consulting
Dr. Mike Deas, Watercourse Engineering, Inc.

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January 7, 2009

Supplement to Cal/EPA External Scientific Peer Review Guidelines – "Exhibit F" in Cal/EPA Interagency Agreement with University of California Gerald W. Bowes, Ph.D.

Guidance to Staff:

1. Revisions. If you have revised any part of the initial request, please stamp "Revised" on each page where a change has been made, and the date of the change. Clearly describe the revision in the cover letter to reviewers, which transmits the material to be reviewed. The approved reviewers have seen your original request letter and attachments during the solicitation process, and must be made aware of changes.

2. Documents requiring review. All important scientific underpinnings of a proposed science-based rule must be submitted for external peer review. The underpinnings would include all publications (including conference proceedings), reports, and raw data upon which the proposal is based. If there is a question about the value of a particular document, or parts of a document, I should be contacted.

3. Documents not requiring review. The Cal/EPA External Peer Review Guidelines note that there are circumstances where external peer review of supporting scientific documents is not required. An example would be "A particular work product that has been peer reviewed with a known record by a recognized expert or expert body." I would treat this allowance with caution. If you have any doubt about the quality of such external review, or of the reviewers' independence and objectivity, that work product – which could be a component of the proposal - should be provided to the reviewers.

4. Implementation review. Publications which have a solid peer review record, such as a US EPA Criteria document, do not always include an implementation strategy. The Cal/EPA Guidelines require that the implementation of the scientific components of a proposal, or other initiative, must be submitted for external review.

5. Identity of external reviewers. External reviewers should not be informed about the identity of other external reviewers. Our goal has always been to solicit truly independent comments from each reviewer. Allowing the reviewers to know the identity of others sets up the potential for discussions between them that could devalue the independence of the reviews.

6. Panel Formation. Formation of reviewer panels is not appropriate. Panels can take on the appearance of scientific advisory committees and the external reviewers identified through the Cal/EPA process are not to be used as scientific advisors.

7. Conference calls with reviewers. Conference calls with one or more reviewers can be interpreted as seeking collaborative scientific input instead of critical review. Conference calls with reviewers are not allowed.

Guidance to Reviewers from Staff:

1. Discussion of review.

   Reviewers are not allowed to discuss the proposal with individuals who participated in development of the proposal. These individuals are listed in Attachment 3 of the review request.

   Discussions between staff and reviewers are not permitted. Reviewers may request clarification of certain aspects of the review process or the documents sent to them.

   Clarification questions and responses must be in writing. Clarification questions about reviewers' comments by staff and others affiliated with the organization requesting the review, and the responses to them, also must be in writing. These communications will become part of the administrative record.

   The organization requesting independent review should be careful that organization-reviewer communications do not become collaboration, or are perceived by others to have become so. The reviewers are not technical advisors. As such, they would be considered participants in the development of the proposal, and would not be considered by the University of California as external reviewers for future revisions of this or related proposals. The statute requiring external review of science-based rules proposed by Cal/EPA organizations prohibits participants serving as peer reviewers..

2. Disclosure of reviewer Identity and release of review comments.

   Confidentiality begins at the point a potential candidate is contacted by the University of California. Candidates who agree to complete the conflict of interest disclosure form should keep this matter confidential, and should not inform others about their possible role as reviewer.

   Reviewer identity may be kept confidential until review comments are received by the organization that requested the review. After the comments are received, reviewer identity and comments must be made available to anyone requesting them.

   Reviewers are under no obligation to disclose their identity to anyone enquiring. It is recommended reviewers keep their role confidential until after their reviews have been submitted.

3. Requests to reviewers by third parties to discuss comments.

   After they have submitted their reviews, reviewers may be approached by third parties representing special interests, the press, or by colleagues. Reviewers are under no obligation to discuss their comments with them, and we recommend that they do not.

   All outside parties are provided an opportunity to address a proposed regulatory action during the public comment period and at the Cal/EPA organization meeting where the proposal is considered for adoption. Discussions outside these provided avenues for comment could seriously impede the orderly process for vetting the proposal under consideration.

4. Reviewer contact information.

The reviewer's name and professional affiliation should accompany each review. Home address and other personal contact information are considered confidential and should not be part of the comment submittal.