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To: Karen Niiya
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Re: Peer Review – Draft Policy for Maintaining Instream Flows in Northern California Coastal Streams

The assigned review tasks were the following:

1. Provide comments on specific issues within my technical specialty (irrigation)
2. Provide suggestions regarding unresolved scientific issues, and discuss whether the proposed rule appears to be based on sound scientific knowledge, methods, and practices, despite the scarcity of data that was available on some topics.

The reports and proposed Policy reflect a substantial effort by staff and consultants to come to grips with a very challenging problem. It is clear that the writers recognize that uncertainties exist, and that negative impacts will occur if some Policy aspects are implemented.

The nature of a "scientific peer review" is that reviewers focus on omissions and weaknesses of a report as opposed to providing ample congratulations. It is hoped that the comments below will serve to strengthen the quality of any Policy that is implemented.

Irrigation-related Review

The comments below pertain to the 5-page supplement entitled "Water Availability Analysis Assumptions for Estimating Partial Face Value of Senior Diverters".

This memo contains some excellent considerations of the problem for frost protection, but there are also some statements and omissions that raise questions. Examples:

1. The statement that "Frost protection occurs by spraying water over the plants to keep the air temperature around the crops from dropping below freezing" is incorrect. The air temperature will drop below freezing. Frost protection from this type of sprinkling occurs because water is continually applied to leaf/plant/bud surfaces, and there is a continuous phase change from liquid to solid. The latent heat of fusion of water (about 80 cal/gm) is hopefully enough to keep the plant tissues near 32 deg. F. The air temperature will drop lower. Protection attributed to controlling the air temperature is fairly insignificant with this method of irrigation for frost protection.
2. The supplement states that "…recorded daily low temperature was 33 deg Fahrenheit or less…" and "hourly temperature data were not readily available". Sprinklers must be turned on well before the air temperature drops to 32 deg. F, because when they are turned on, the air temperature drops to the wet bulb temperature, which can be quite low if the air is relatively dry. Therefore, the only way to properly estimate the hours of operation is to know hourly data. Ten hours may be inadequate.
3. There are certainly huge variations in temperature and relative humidity throughout the region. Therefore, making tight policy (8 days, 10 hours) based on limited data does not appear wise.
4. The example of Permit 21006, with values of 21 cfs and 120 acre-feet, gives no insight into the challenge. To make this knowledge transferable, one would need to know the details of the temperature, how those compare to other areas, the size of the field, and the design flow rate (GPM/acre). Given the lack of specifics, one does not know if this is a case where the grower uses Pulsator® sprinklers on

vines rather than conventional overvine rotator or impact sprinklers, which have been more widely tested and are recognized as more reliable, but require higher flow rates per acre.

In spite of the concerns raised above, it appears that the single statement of "Additionally, if better information is available for a particular project, it should be used" addresses the concerns. It is strongly recommended that the issue of frost protection be treated with a high degree of flexibility by the board for these reasons:

1. A single event of frost damage during a year can destroy a crop. This obviously has huge financial implications.
2. Freeze events are unpredictable.
3. There are huge variations in weather conditions throughout the region, and very little excellent hourly data of relative humidity and air temperature (the two values needed for analysis) on an hourly basis.
4. Farmers have inherent limitations regarding the hours of water application during frost protection because of problems with runoff, waterlogging, and high energy bills. Therefore, there is little-to-no need for regulatory concern about farmers abusing their right to pump for frost protection.

General Review

The wording in the Policy Summary is good in that it indicates a desire to construct a flexible Policy, using statements such as:

a. *The proposed Policy contains guidelines…*
b. *The Policy does not establish specific instream flows requirements.*
c. *The Policy is intended to provide guidance…*
d. *…the Policy allows for flexibility in compliance. Site-specific studies may be conducted…*

The **first major criticism** of the Policy was that in reading it, I was unable to grasp exactly what the simple impacts of implementing the Policy would be on **existing**

diverters. There was ample detail regarding the number of diversions, formulas and assumptions, discussion of fish, locations of diversions, etc. There was a fairly detailed discussion about possible impacts on those who want future diversion rights. However, basic questions that were unanswered include:

a. How many diverters will be directly impacted?
b. To what degree will those diverters be impacted?
    i. Time of year
    ii. Flow rate
    iii. Acre-feet of annual diversions
c. Where are those diverters located?

As a small detail, it would have helped to see a map showing the physical upstream limits of the proposed Policy on each stream.

The **second major criticism** of the Policy regards how the scientific uncertainty was translated into Policy, and how that Policy might then be used to formulate specific actions. Most of the following comments pertain to this point.

1. There exist large degrees of uncertainty in the various assumptions and in the envisioned impacts of recommended actions. Therefore, I recommend that the Policy include the following program steps:
    a. Defining of priorities and relative benefits for taking specific actions. For example,
        i. What percentage of the problem is due to blockages of fish migration caused by physical barriers? If this is the major problem, the priority would be to begin near the ocean and then work upstream to eliminate physical barriers.
        ii. What percentage of the problem is due to reduced flows? If this is the major problem, the priority may be to begin at the upstream reaches with reductions in diversions.
    b. Verification of the actions, as they are accomplished in order of priority.

c. Documentation of the consequences of the actions. In other words, after the first priorities are completed, how well are the quantifiable objectives met?
d. Re-evaluation of the types of actions that have been recommended, and their documented consequences/impacts.
e. Development of modified recommendations, including how/when the next layer of priorities should be implemented.

2. I highlight the importance of establishing priorities in part because of wording in background documents. In one background document (Task 3 Report, *Administrative Draft*, North Coast Instream Flow Policy: Scientific Basis and Development of Alternatives Protecting Anadromous Salmonids) the following statement is made:

> "*Lifting Policy limitations above structural barriers would not be protective of the anadromous salmonid resource if the possibility exists that historically accessible habitat will be re-opened by correction of passage barriers*."

The statement implies that the parallel impacts will occur in a natural passage system, although the physical reality is that a stream is comprised of serial limitations. In other words, an activity to clear a passageway in the upstream areas of a watershed will have no impact until passage impediments are first removed further downstream. The final Policy proposal indicates the existence of numerous natural in-stream barriers – would it be sufficient to remove simply the natural in-stream barriers?

But perhaps more importantly, mandating policy based on a vague "possibility" should be questioned. If all downstream passageways are cleared, and fish begin to appear at the upper end of those clearings, then clearly the possibility of salmonid expansion into the upstream areas exists. But until the downstream passageways are first cleared, one can certainly state that "the possibility does not exist that historically accessible habitat will be re-opened by correction of passage barriers".

3. The importance of developing priorities (and imposed costs) with systematic progression and evaluation is further highlighted by other statements found in the

"Scientific Basis" document. The challenge, of course, is to translate the protection conditions into reasonable recommendations for implementation.

a. The report acknowledges scientific uncertainty, such as on page 2-7 ("Suitable criteria for both channel and riparian maintenance flows are less well defined…") and on page 2-6 ("There are no specific criteria for defining a suitable flow regime to stimulate and/or facilitate downstream passage on a regional basis.") However, the proposed Policy appears to attempt to obtain zero uncertainty regarding negative impacts on fish.

b. The "Minimum Bypass Flows (MBF)" for MBF3 appear to assume a linear (zero intercept) relationship between area and unimpaired mean annual flow. In other words, if the drainage area (DA) doubles, the unimpaired mean annual flow doubles. However, some hydrologic basins may have 2-5 times more unimpaired mean annual flow per acre than others. This then raises the point – why is the acceptable flow in one basin 2-5 times the acceptable flow in another basin with the same area?

c. The MBF for MBF4 is one tenth (10%) of the value for MBF3. How can science-based recommendations, intended to achieve the same objectives, be different by a factor of 10 times? Granted, these are upper and lower limits, but the magnitude of difference indicates uncertainty. Furthermore, the explanation of uncertainty is not clear. Therefore, the selection of the highest, most extreme value appears indefensible. No sensitivity analysis is provided. There is no basis for comparison. For example, for a large drainage area would a $Q_{MBF} = 0.2\ Q_M$ provide 99.9% of the benefit? 99%? 98%? 50% (100% of the benefit in 50% of the cases)? Without such a sensitivity analysis, the conclusion that $Q_{MBF} = 0.6\ Q_M$ can only be regarded as arbitrary rather than science-based. On page 3-3, it is stated that the MBF4 provides the minimum amount of water that might be left instream without substantially under-protecting anadromous salmonids. Why, then, was MBF4 not selected when it is sufficient (perhaps imperfect, but "sufficient")?

d. The formulas for "Minimum Bypass Flows (MBF)" appear to assume that at each node (bifurcation point) in a stream system, the Q_M (unimpaired mean annual flow) is known. The reviewer questions this assumption, because this would require a huge system of historical hydrological stations (stream gauging/recording stations) that are accurately calibrated – and such a system does not exist. The procedure for defining the Q_M at each node must be scientifically defensible and clearly defined.

4. Any Policy cannot eliminate risk. A goal to minimize risk, taking logical and sequential steps, is much more reasonable.

Some brief comments are made below regarding the documentation that will be required for a new diversion permit.

1. The Substitute Environmental Document has substantial submittal requirements for a new diversion permit. Table 3-1 provides cost estimates for permitting a diversion, but those costs do not appear to be in line with the description of the requirements. For example, if a private consulting engineer was offered $14,400 to properly fulfill all of the listed requirements, it is improbable to this reviewer that the engineer would accept the job with the understanding that a quality product would be delivered.

   The true cost of a permit will likely eliminate any ordinary citizen from submitting an application – only municipalities and large companies could afford to provide such documentation. Perhaps this will not be an issue if the permit will only affect off-stream users, rather than riparian users.

2. On pages 8-12 of the Substitute Environmental Document, it appears that the permit requester will be responsible for accumulating many documents that should be available from the Regional Water Quality Control Board. Therefore, it is recommended that the RWQCB maintain excellent current GIS databases and provide pertinent documents, for a fee, to any person/entity that wishes to apply for a permit.