Technical Memorandum - State Water Resources Control Board
North Coast Instream Flow Policy Comments

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Memo

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RE: Technical Memorandum - State Water Resources Control Board North Coast Instream Flow Policy Comments

INTRODUCTION

R2 Resource Consultants Inc. made an intrepid effort to develop region-wide scientific underpinnings for policy application given the limited scope and time available (e.g., validation sampling was conducted as recently as 2006, and the Administrative Draft Task 3 Report was completed by August 2007). The State Water Resources Control Board (SWRCB) selected the various elements (e.g., minimum bypass flow [MBF], maximum cumulative diversion [MCD], diversion season [DS]) and combined them into the North Coast Instream Flow Policy (Policy). However, the inherent variation among streams within the Policy application area regarding fluvial geomorphology, hydrology, stream characteristics, relationships between flow and habitat attributes, as well as variation in fish populations and response to specific attributes, confounds meaningful application of the Policy at the region-wide scale.

Site-specific studies are necessary to capture the variability in channel size, hydrology, fish habitat and instream flow needs. Habitat-flow relationships and fluvial geomorphologic processes should be developed for a sufficient number of representative streams, encompassing the full range of watershed or drainage area sizes, to allow for appropriate region-wide scale application.

The following comments provide a review of the SWRCB Policy and many of its fundamental components, and specifically address the limitations associated with region-wide application of the SWRCB Policy, particularly focusing upon the limited amount of site-specific information and inherent variation within and among streams located within the Policy Area.

1.0 THE PROPOSED POLICY WAS NOT EVALUATED

From both a technical and regulatory perspective, the potential impacts of the Policy on fisheries and aquatic resources were not adequately evaluated. In the alternatives analyses conducted for both the Scientific Basis and the Substitute Environmental Document, inconsistencies in the alternative-specific characterization of Policy design elements preclude a full evaluation of the Policy in its entirety.

1.1 AN ALTERNATIVE COMPRISED OF THE PROPOSED POLICY DESIGN ELEMENTS WAS NOT EVALUATED

Five specific Flow Alternative Scenarios were evaluated in Appendix I of the Scientific Basis for passage and spawning habitat in terms of the minimum, mean and maximum number of passage and spawning days per water year during the October 1 through March 31 period. The Flow Alternative Scenarios are presented in Table I-1. However, none of the Flow Alternative Scenarios appear to include the combination of elements (DS3, MBF3, MCD2) included in the proposed Policy in either the Scientific Basis or the Substitute Environmental Document. Hence, the proposed Policy remains unanalyzed, as required for CEQA compliance purposes.

Further, it is not possible to evaluate the proposed Policy by incrementally evaluating each of the design elements because "*...it was not possible to completely partition out the effect of the MCD element on habitat availability from the effects of the MBF and diversion season elements.*" (Scientific Basis pg. 4-13).

A reanalysis of the specific proposed Policy, incorporating each of the Design Elements, needs to be conducted.

1.2 THE PROTECTIVENESS ANALYSIS DOES NOT SUFFICIENTLY DESCRIBE RESULTS AMONG ALTERNATIVES

The Protectiveness Analysis (Appendix I) does not evaluate the results of application of the Policy because: (1) small watersheds were not addressed; (2) there is no description of how the Policy, in its entirety (see Comment 1.1, above), affects passage and spawning opportunities; and (3) there is inadequate discussion of how the change in the two design elements (MBF3 and MBF4) between alternatives would affect passage and spawning opportunities.

It is not clear how the modeling results in Appendix H and I support the conclusions presented in Tables 3 through 6 (pages xxiii through xxviii of the Executive Summary), or elsewhere in the Scientific Basis, that each design element would be regionally protective.

2.0 APPLICATION OF MINIMUM BYPASS FLOW (MBF3) CALCULATIONS TO DRAINAGE AREAS SMALLER THAN 1.19 SQUARE MILES IS NOT TECHNICALLY SUPPORTED

Different biologic responses are suggested for different elements of the Policy. The Scientific Basis (pg. D-21) acknowledges that "*...Physical habitat space, as defined by upstream passage and spawning needs for example, was found to be linked more directly to maintenance of a minimum bypass flow.*" Also, the Scientific Basis (pg. D-21) states that "*... the basis of the Maximum Cumulative Diversion element was linked most directly to the relation of high flows and preserving channel and riparian maintenance flow functions.*" The Scientific Basis (pg. 4-13) further states "*... it was not possible to completely partition out the effect of the MCD element on habitat availability from the effects of the MBF and diversion season elements.*"

The combination of the MBF, MCD and DS elements included in the Results of Validation Site Protectiveness Analysis (Scientific Basis, Appendix I) has not been shown to be applicable to watersheds with relatively small drainage areas, particularly due to concerns regarding the application of MBF requirements to watersheds less than 1.19 square miles.

2.1 THE METHODOLOGY DOES NOT SUPPORT APPLICATION OF MBF3 TO DRAINAGE AREAS LESS THAN 1.19 SQUARE MILES

Two different approaches are used to determine MBF3 based upon drainage area size. For drainage areas less than 295 square miles, the regression equation E.8b is applied to determine MBF3. Equation E.8b also is applied to drainage areas of any size that are above the upper limit of anadromy. By contrast, a constant (0.6) is applied to drainage areas equal to, or greater than 295 square miles below the upper limit of anadromy (Appendix E pg. E-27).

$$Q_{MBF} = 9.4 \times Q_m(DA)^{-0.48} \qquad \textbf{(E.8b)}$$

The smallest drainage area sampled among the Validation Sites was 0.25 square miles (East Fork Russian River Tributary). However, no spawning habitat transects were available in the East Fork Russian River Tributary validation site. The next smallest validation site containing spawning habitat transects in the data base was for a drainage area of 1.19 square miles (Dry Creek Tributary).

The MBF3 regression equation is applied to drainage areas smaller than those sampled, where it is unknown if the linear model of a decreasing relationship between the MBF3 and drainage area applies. The danger of predicting beyond the range of the data used in the regression analysis was clearly stated in Appendix E (pg. E-18) "*...the confidence in regression-based predictions decreases when the relation is used to predict new observations using independent variable data that fall outside the range of the original data set*". However, the Policy applies the MBF3 equation to basins with drainage areas that are considerably smaller than 1.19 mi^2, for which it is uncertain whether the linear regression from which the MBF3 equation was derived is valid. First, the slope and intercept values are only potentially appropriate estimates given the variability present in the sampled data for drainage areas ranging between 1.19 mi^2 and 327 mi^2 (the range of drainage areas sampled). Second, the assumptions of normally distributed error terms and of constant variance for the regression line are only valid within the range of sampled data. Third, the assumption of the linearity of the regression function only applies within the range of sampled data. Outside the range of the original dataset, there is no statistical evidence or other reasoning provided to support the assumption that the linear model is valid.

In fact, considering the 675 headwater drainage basins upstream of the limit of steelhead anadromy reported for the Policy area (Appendix E pgs. E-19, and E-20 Figure E-9), there are 444 (roughly 66%) headwater drainage basins with areas smaller than 1 square mile. Thus, there are at least 444 occasions in which the MBF3 equation will be used to predict MBF3 for areas smaller than 1.19 square miles, for which the regression equation has not been shown to be valid.

2.2 Protectiveness Analysis Does Not Support the Application of MBF3 Requirements to Watersheds Less Than 1.19 Square Miles

The Protectiveness Analysis (Appendix I) used the criterion that a minimum of 5 days are necessary for spawning. The Scientific Basis (pg. G-26) states "*...it was assumed that a minimum of five days are needed for spawning in both large and small streams.*"

Only one validation site was used where the drainage area was less than 1 square mile (East Fork Russian River Tributary = 0.25 square mile). Examination of the Protectiveness Analysis results (Appendix I) shows that under unimpaired conditions, no spawning habitat is available for any of the indicator fish species at this site.

Less than an average of five days of spawning are provided at the validation sites associated with drainage areas of 1.19 square mile (Dry Creek Tributary) and 1.88 square mile (Dunn Creek). Under unimpaired flow conditions, a maximum of 5 days of spawning for any water year included in the analysis occurs at the 1.19 square mile validation site for steelhead and Coho salmon, and no spawning habitat occurs for Chinook salmon. At the 1.88 square mile validation site under unimpaired conditions, the maximum number of spawning days is 6 for steelhead and Coho salmon, and 2 for Chinook salmon for any water year included in the analysis.

Therefore, results of the Protectiveness Analysis indicate that the Policy may not be applicable to streams within the region characterized by drainage areas less than 1.19 square miles, particularly in consideration of consecutive days required for spawning, rather than the total number of days (not necessarily consecutive) as discussed in Section 4.0 of this Technical Memorandum.

3.0 DEVELOPMENT OF THE MBF3 CRITERION CONFOUNDS ITS APPLICABLITY TO THE POLICY AREA

3.1 PRESENTATION OF DATA IN THE SCIENTIFIC BASIS DOES NOT ALLOW COMPARISON OF THE TWO TYPES OF DATA USED TO DEVELOP THE MBF3 REGRESSION

Two types of data (i.e., from validation points, and sites in Swift (1976) steelhead research) used to obtain equation E.8a used in the MBF3 regression analysis (i.e., $\text{Log}_{10}(Q_{MBF}/Q_m) = -0.4837 \times \text{Log}_{10}(DA) + 0.7870$) are used to determine MBF3 for basin drainage areas that are less than 295 square miles, and for drainage areas of any size that are above the upper limit of anadromy. The presentation of these data does not allow for a comparison of the two types of data, or an assessment of the differences in the variation associated with each data set. The data from the validation sites is described in Appendices G and H, providing information about the characteristics of the validation sites such as drainage area sizes, period of flow records used in the calculations of annual average flow (Q_m) and number of transects per sites. No such information is provided for the Swift (1976) steelhead data.

The 21 validation data points represent values for transects at 12 sampled streams (e.g., the East Fork Russian River Tributary was not used in the analysis) based on one to two transects per stream. The number of water years analyzed to obtain the Q_m of those 12 streams varied from 2 at the Dry Creek Tributary, to 37 at Lagunitas Creek. However, it cannot be determined whether the 51 data points from the Swift (1976) study represent Q_{MBF} results for individual transects or entire streams, or the number of water years used to determine Q_m.

3.2 EVALUATION OF THE DATASETS INDICATES THAT IT MAY NOT BE APPROPRIATE TO POOL THE SWIFT (1976) DATASET WITH THE VALIDATION SITE DATASET TO CALCULATE THE MINIMUM BYPASS FLOW MBF3

The SWRCB provided the dataset used to calculate the minimum bypass flow (MBF3) contained in the Excel file "Qopt-Qaa.xls". The dataset was examined for the Swift (1976) data and the Validation Site data as separate datasets, to evaluate the appropriateness of combining these datasets into one pooled dataset, which was used as the basis to calculate MBF3. Least-squares linear regression analyses were conducted for each separate dataset.

The least-squares fit to the Swift (1976) data produced the following regression equation:

$$\log_{10}\left(Q_{MBF}/Q_m\right) = 0.6160 - 0.3885 \times \log_{10}\left(DA\right).$$

Both the intercept and the slope estimates were significantly different from zero, and the coefficient of determination (i.e., r^2) was equal to 0.610. The residual sum of squares (*RSS*) was $RSS_S = 1.2405$ with degrees of freedom $df_S = 49$.

The least-squares fit to the Validation Site data produced the following regression equation:

$$\log_{10}\left(Q_{MBF}/Q_m\right) = 1.0472 - 0.7641 \times \log_{10}\left(DA\right).$$

Both the intercept and the slope estimates were significantly different from zero, and the coefficient of determination was equal to 0.665. The residual sum of squares was $RSS_V = 1.1342$ with degrees of freedom $df_V = 19$. **Figure 1** displays both of these regression lines on a scatter plot of the data.

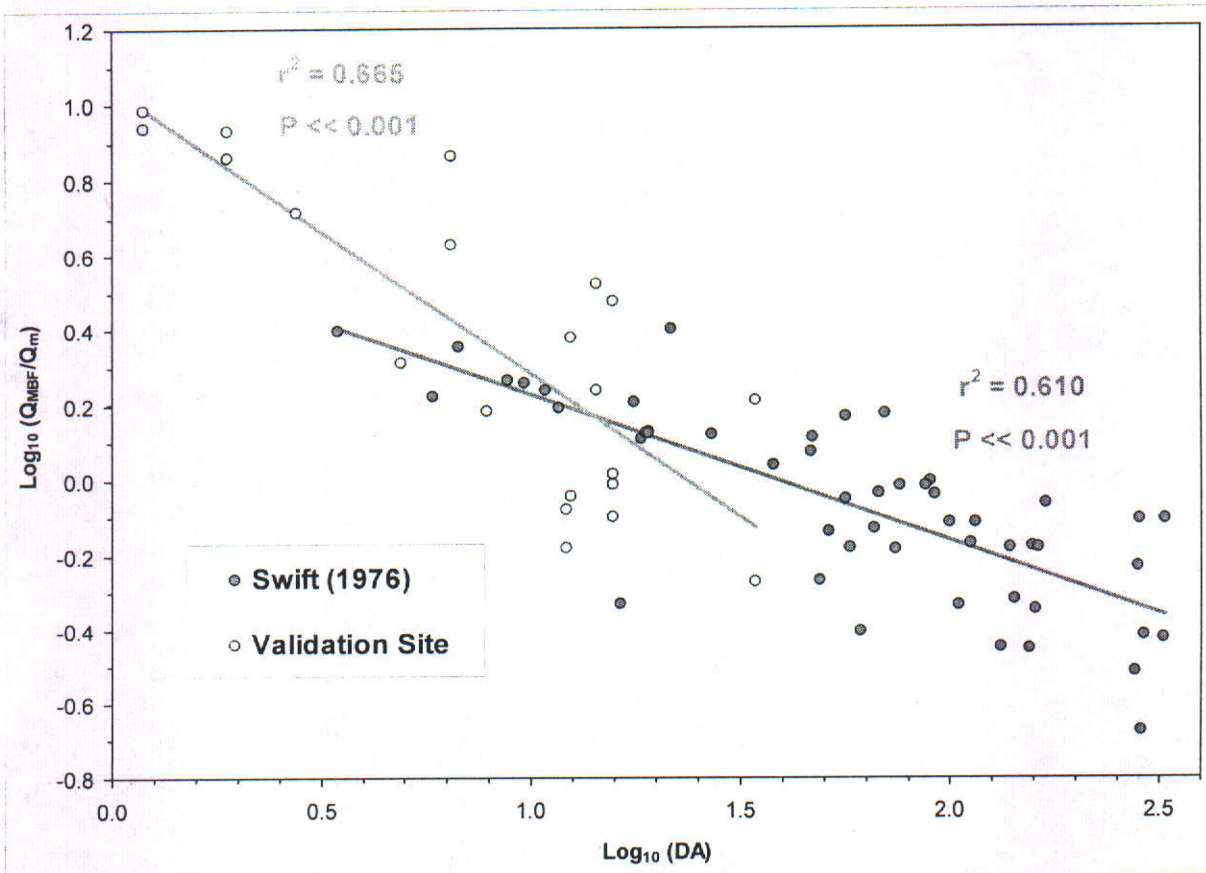

Figure 1. Distribution of the $\log_{10}$ of the ratio between the steelhead spawning discharge and the average annual discharge (i.e., $\log_{10}(Q_{MBF}/Q_m)$ as a function of the $\log_{10}$ of the drainage area (i.e., $\log_{10}(DA)$), and the regression equations fitted to the Swift (1976) data set (blue line) and the Validation Site data set (orange line).

The least-squares fit to both data sets combined produced the regression equation:

$$\log_{10}(Q_{MBF}/Q_m) = 0.7870 - 0.4837 \times \log_{10}(DA),$$

with residual sum of squares $RSS = 2.7962$ and degrees of freedom $df = 70$.

The appropriateness of using the first two equations instead of the third equation to predict mean responses for the combined data set was tested through an F-ratio test. The F-ratio statistic (F^*) for this test was calculated as:

$$F^* = \frac{(RSS - RSS_S - RSS_V)/(df - df_S - df_V)}{RSS/df} = \frac{(2.7962 - 1.2405 - 1.1342)/(70 - 49 - 19)}{2.7962/70} = 6.034.$$

Because the p-value associated with F^* was 0.004, the hypothesis that the mean responses for the combined data set should be predicted by using the third equation that assumes a common regression line, must be rejected. The result of this test indicates that the regression analysis performed in Appendix E of the Scientific Basis is inappropriate because it pooled the significantly different Swift (1976) and Validation Site data sets.

3.3 ADDITIONAL RATIONALE IS NECESSARY FOR MODEL SELECTION

Only one linear model, the one relating Q_{MBF}/Q_m as a response variable, and drainage area (DA) as an explanatory variable, was fitted and presented in all the supporting scatter plot figures in the Scientific Basis. Insufficient explanation is provided for the selection of this particular model, as opposed to other linear models using additional explanatory variables (e.g., elevation, reach gradient, longitude or latitude, bankfull width, geographic location, etc.) or a combination of them. The reason for the selection of Q_m, the estimated mean annual flow for the site gage, to scale Q_{MBF} (i.e., the lowest flow at which maximum steelhead spawning habitat availability occurred at the particular transect/site) is not provided, as opposed to other more robust indicators of annual flow central tendency such as the median. In consideration of the range in the number of water years analyzed (2 – 37), evaluation of the appropriate measure of central tendency should be provided. This consideration is particularly important because Q_m is used as a "scaler" to account for variable drainage area-flow differences.

3.4 JUSTIFICATION IS NECESSARY REGARDING THE USE OF AN EXPLANATORY VARIABLE TO MODIFY THE RESPONSE VARIABLE

In Appendix E of the Scientific Basis, the calculation of MBF3 was derived from the least-squares estimation of the parameters of the following linear regression model:

$$\log_{10}\left(Q_{MBF}/Q_m\right) = \alpha + \beta \times \log_{10}\left(DA\right) + \varepsilon, \quad \textbf{(1)}$$

where: (1) the only explanatory variable is the $\log_{10}$ of the drainage area (i.e., $\log_{10}\left(DA\right)$); (2) the response variable is the $\log_{10}$ of the ratio between the suitable spawning flow for steelhead and the average annual discharge (i.e., $\log_{10}\left(Q_{MBF}/Q_m\right)$); (3) α and β are the intercept and slope of the regression line, two parameters whose values are estimated through the least-squares regression procedure; and (4) ε is the error of the model assumed to be normally distributed.

The least-squares fit of the model in Equation (1) to the pooled data from Swift (1976) and the Validation Sites produced the following regression equation:

$$\log_{10}\left(Q_{MBF}/Q_m\right) = 0.7870 - 0.4837 \times \log_{10}\left(DA\right), \quad \textbf{(2)}$$

The selection of Q_m to scale Q_{MBF} eliminates the possibility of its use as an explanatory variable for Q_{MBF}, disregarding the fact that the correlation coefficient between Q_{MBF} and Q_m is slightly higher than the one between Q_{MBF} and DA (i.e., r = 0.857 and r = 0.827, respectively). Moreover, the selected model (i.e., Equation (1)) implicitly assumes the following multiple regression linear model:

$$\log_{10}\left(Q_{MBF}\right) = \alpha + 1 \times \log_{10}\left(Q_m\right) + \beta \times \log_{10}\left(DA\right) + \varepsilon, \quad \textbf{(3)}$$

where the slope of $\log_{10}(Q_m)$ is set equal to 1 without associated error. The regression equation resulting from fitting Equation (3) to the data is:

$$\log_{10}\left(Q_{MBF}\right) = 0.7870 + 1 \times \log_{10}\left(Q_m\right) - 0.4837 \times \log_{10}\left(DA\right), \quad \textbf{(4)}$$

with an r^2 equal to 0.870 and a P-value equal to 9.66×10^{-33}. The hypothesis that the slope of $\log_{10}(Q_m)$ is equal to 1 can be tested against the data by fitting a model that includes the least-square estimates of that slope, together with the intercept and the slope of $\log_{10}(DA)$, and then comparing the resulting regression line to that in Equation (4) through an F-ratio test. The regression equation with both estimated slopes was:

$$\log_{10}(Q_{MBF}) = 0.8355 + 0.7420 \times \log_{10}(Q_m) - 0.1609 \times \log_{10}(DA), \qquad \textbf{(5)}$$

with an r^2 equal to 0.885 and a P-value equal to 3.73×10^{-33}. The F-ratio statistic to test if the slope of $\log_{10}(Q_m)$ is equal to 1 is calculated by dividing the ratio of the difference between the residual sum of squares under Equation (4) and the residual sum of squares under Equation (5) (i.e., RSS_4 and RSS_5) to the difference between the degrees of freedom under both equations (i.e., df_4 and df_5) by the mean square error for Equation (5) (i.e., MSE_5):

$$F^* = \frac{(RSS_4 - RSS_5)/(df_4 - df_5)}{MSE_5} = \frac{(2.7962 - 2.4715)/(70 - 69)}{0.0358} = 9.064.$$

Because the inverse of the F probability distribution under an α–level of 5% (i.e., $F_{(0.05;1;69)}$) is equal to 3.980, and F^* is greater than 3.980, the hypothesis that the slope of $\log_{10}(Q_m)$ is equal to 1 must be rejected. Thus, the adoption of a linear model relating $\log_{10}(Q_{MBF}/Q_m)$ as a function of $\log_{10}(DA)$ (i.e., Equation (2)), which was akin to the adoption of Equation (4) for the development of MBF3, probably was not the best model choice if the purpose was to develop a linear regression that explains as much of the variability present in $\log_{10}(Q_{MBF})$ as a function of the available variables $\log_{10}(Q_m)$ and $\log_{10}(DA)$.

In other words, the use of Q_m to redefine the response variable was inappropriate because: (1) Q_m itself actually explains most of the variation in the response variable Q_{MBF}; and (2) the assumption that the regression coefficient (of $\log_{10} Q_m$) equals 1, implicitly assumed in the ratio transformation of the response variable, is not statistically supported.

3.5 Statistics Are Not Provided to Allow Assessment of Goodness-of-Fit of the Regression

In the Scientific Basis, statistics are not presented to allow the evaluation of the goodness-of-fit and statistical significance of the regression (e.g., coefficients of determination, standard errors of estimated slope and intercept, F ratio statistic or level of significance [P value]) for the fitted regression equation that determines MBF3 for basin drainage areas less than 295 square miles, or for basin areas of any size that are above the limits of anadromy. Given the observable large variability present in the data, particularly for drainage areas larger than 10 square miles, the above-mentioned statistics are necessary to evaluate how much of the data variability was addressed by the fitted linear model, and whether a linear relationship with drainage area is statistically meaningful.

3.6 Additional Justification Is Necessary Regarding the Selection of the Enveloping Curve Approach Used to Determine Minimum Bypass Flows

Reasons for the use of an enveloping-curve approach to set minimum bypass flows as part of a regional policy need to be further provided. Three potential enveloping-curve approaches are presented in Appendix D (pg. D-39) of the Scientific Basis: (1) the regression quantile approach used by Terrell *et al.*

(1996) and developed by Koenker and D'Orey (1987); (2) the upper bound of a 95% linear regression predictive interval (Neter *et al.* 1983); and (3) the method that was applied in the calculations of both MBF3 and MBF4 that was described as "*...generating regression-derived curves, then adjusting the intercept estimate upwards by three standard deviations*". Reasons for the preference of method (3) to calculate MBF3 and MBF4 over method (1) or (2) are not found in either Appendix D or E of the Scientific Basis. The selected method (3) appears to ignore the fact that in most regression analyses, the estimated slope and intercept are correlated. The adjustment of only the intercept, but not the slope, is questionable because both slope and intercept estimates were derived from the same data set.

3.7 THE DATASET USED IN THE REGRESSION TO ESTIMATE MBF3 DOES NOT APPEAR TO BE CONSISTENT WITH THE STATED METHODOLOGY

In three of the validation site streams, discrepancies were observed between the number of spawning transects sampled per stream and the number of Q_{MBF} values available per stream. In both Carneros Creek and Pine Gulch Creek, two spawning transects were sampled per stream, but there is only one Q_{MBF} value per stream reported in the data. This appears to be consistent with the stated methodology described in Appendix H (pg. H-1) of the Scientific Basis, which states "*The optimum flow providing maximum spawning habitat availability on a transect occurs at the lowest flow at which the greatest amount of spawning habitat is available...In the analysis of protectiveness, the limiting optimum spawning flow for the site is set equal to the transect requiring the lowest optimum flow. This limiting optimum spawning flow is the flow used to determine the Upper MBF (MBF3) alternative as discussed in Section E.3.2*".

However, in the Dry Creek Tributary, only one spawning transect was sampled, but the data subset provided by the SWRCB contained in the Excel file "Qopt-Qaa.xls" appears to contain two Q_{MBF} values for this stream.

Therefore, the 21 Q_{MBF} values representing the Validation Sites are higher than expected, considering the procedure that was reported to have been used to determine the flow providing maximum spawning habitat availability (i.e., the Q_{MBF} values) described in Appendix H of the Scientific Basis (see above). In other words, no more than 12 Q_{MBF} values (i.e., one Q_{MBF} value selected per Validation Site, using the smallest site-specific Q_{MBF} value when a site had two transects that provided two distinct Q_{MBF} values) should have been used in the regression to calculate MBF3. However, examination of Figure E-8 on pg. E-19 indicates that:

- 21 data points were used in the regression, not 12 as indicated by the methodology
- 9 of the 21 data points used in the regression were higher than those which should have been used, as indicated by the methodology

Moreover, examination of the unimpaired flow data provided by SWRCB for Dunn Creek (Dunn_sp-1_Alt01_Daily Habitat_Alt0 and Dunn_sp-2_Alt01_Daily Habitat_Alt0) and for Carneros Creek (Carneros_sp-1_Alt01_Daily Habitat_Alt0 and Carneros_sp-2_Alt01_Daily Habitat_Alt0) indicates methodologic inconsistencies. For example, as described in Appendix H (pg. H-1) of the Scientific Basis, the "optimum" flow providing maximum spawning habitat availability on a transect occurs at the lowest flow at which the greatest amount of spawning habitat is available. The limiting optimum spawning flow for a site is set equal to the transect requiring the lowest optimum spawning flow. According to this approach, information in Appendix H indicates that maximum spawning habitat availability in Dunn Creek would be provided by spawning transect 1, which is consistent with Appendix I of the Scientific Basis. However, maximum spawning habitat availability in Carneros Creek would be provided by spawning transect 2, which does not appear to be consistent with Appendix I. Thus, because some methodological steps are unclear, additional clarification should be provided in the Scientific Basis.

4.0 THE PROTECTIVENESS ANALYSIS MAY NOT FULLY SUPPORT APPLICATION OF THE POLICY

4.1 SPAWNING OPPORTUNITY EVALUATION IN THE PROTECTIVENESS ANALYSIS DOES NOT SUPPORT APPLICATION OF THE POLICY TO STREAMS IN SMALL DRAINAGE AREAS

The Scientific Basis (Appendix G, pg. G-26) states *"...it was assumed that a minimum of five days are needed for spawning in both large and small streams. Although spawning may occur in as little as one day in smaller flashier streams, the required incubation times may be longer due to cooler temperatures."*

However, review of the Scientific Basis does not seem to incorporate the consideration of consecutive days required for spawning. The information described in the Scientific Basis regarding the number of days in which instream flow conditions could provide a spawning opportunity for steelhead is generally consistent with that which is reported in the literature. Using steelhead as an example, a spawning opportunity is defined to generally range from a period of three to five consecutive days, as indicated by the observations reported below.

- Briggs (1953) reports that breeding fish occupied redds "*...from two to three days to as long as one week*"
- CDFG (1954) reports "*The length of time that elapses between the beginning of courting and nest building activities on the chosen redd and the deposition of the sexual products varies greatly. In the observations of 1933 the deposition of the eggs and milt took place four hours and twenty-five minutes after the fish were placed in the pen and one hour and twenty-five minutes after digging had been started... Although the 1933 fish completed spawning within 12 hours, it is believed that often the process takes a week or more. The length of time probably depends upon the ripeness of the fish, water and atmospheric conditions (especially temperature and height of water), and the extent to which the mating fish are interrupted by intruders (human beings, stream-side mammals, birds, and other fish).*"
- The Scientific Basis states that Trush (1991) observed redds completed within a 30 hour period, and considered 3 days as a conservative estimate of spawning duration in the small streams he surveyed. He noted that steelhead would ascend the channel, spawn, and emigrate back downstream all within the time frame of a single storm hydrograph.
- The Scientific Basis states that Gallagher (2000) estimated average stream residency of steelhead in the Noyo River, including pre- and post-spawning, to be 11 days.
- Hannon *et al.* (2003) reported that average residence time for steelhead on redds in the American River is about three days.

Compared to Chinook and Coho salmon, steelhead spawning generally occurs in smaller stream channels that are located in the upper reaches of a watershed. Using habitat time series data for the validation site streams provided by the SWRCB and the information presented in Appendix I, an analysis was conducted to investigate the number of times that flows in the smaller validation site streams provided aquatic habitat conditions that would constitute a steelhead spawning opportunity, defined for the purposes of this analysis as 3 to 5 consecutive days, consistent with that which is reported in the literature.

Unimpaired daily flow data for Dry Creek, Dunn Creek and Carneros Creek were used to determine the number of times when a spawning opportunity (defined as 3, 4 or 5 consecutive days) occurred during the hydrologic period of record available for each validation site stream, respectively (see **Table 1**). Although flows meeting the spawning criteria established in the Scientific Basis also periodically occurred on 1 or 2 day intervals at some validation sites, these were not counted as spawning opportunities in this analysis, but are presented for comparative purposes only. The following analysis did not include consideration or application of incubation criteria.

As shown in Table 1, unimpaired hydrologic conditions in a Dry Creek tributary (drainage area equal to 1.19 square miles) do not provide 5 consecutive days needed for spawning. Unimpaired hydrologic conditions in the Dry Creek tributary also do not provide steelhead spawning opportunities of 3 or 4 consecutive days. Although a total of five 1-day or 2-day events were observed in the data, these events did not occur on consecutive days during the spawning period.

The evaluation of unimpaired hydrologic conditions and the potential for steelhead spawning opportunities in Dunn Creek (drainage area equals 1.88 square miles) yielded similar results as those for the Dry Creek tributary. Two validation sites (sp-1 and sp-2) were used in Dunn Creek (see comment above in Section 3.7). For one of these validation sites (Site sp-1), unimpaired hydrologic conditions do not provide 5 consecutive days needed for spawning, but do provide one consecutive 3-day and one consecutive 4-day spawning opportunities. For the other validation site (Site sp-2), unimpaired hydrologic conditions provide one consecutive 5-day, one consecutive 4-day, and two consecutive 3-day spawning opportunities.

Two validation sites (sp-1 and sp-2) were used in Carneros Creek (drainage area equals 2.75 square miles). For one of these validation sites (Site sp-1), unimpaired hydrologic conditions do not provide any 3, 4 or 5 consecutive day spawning opportunities. For the other validation site (Site sp-2), unimpaired hydrologic conditions provide one consecutive 5-day, two consecutive 4-day, and one consecutive 3-day spawning opportunities. Comparing the results of the habitat time series data to the results in the Scientific Basis, it appears that the results from Site sp-1 were used to characterize spawning opportunities in Carneros Creek, as presented in Appendix I of the Scientific Basis (Figure I-4). If Site sp-1 was the appropriate site used to characterize spawning opportunities in Carneros Creek (as presented in Appendix I of the Scientific Basis), then the results indicate that there were no 3, 4 or 5 consecutive day spawning opportunities at Site sp-1 under unimpaired conditions for this site representing a stream with a drainage area of 2.75 square miles.

Fish Bulletin 179, Contributions to the Biology of Central Valley Salmonids (State of California *et al.* 2001), reports that in California, peak steelhead spawning occurs from December through April in small streams and tributaries with cool, well-oxygenated water. The length of time it takes for eggs to hatch depends mostly on water temperature. Steelhead eggs hatch in about 30 days at 51°F (Leitritz and Lewis 1980). Fry usually emerge from the gravel four to six weeks after hatching, but factors such as redd depth, gravel size, siltation, and temperature can speed or retard this time (Shapovalov and Taft 1954).

If steelhead did spawn during the 1-day or 2-day events that were identified in the data, it is uncertain whether stream conditions during subsequent days or weeks provided adequate flows to support steelhead embryo incubation. For example, at spawning Site sp-1 in Carneros Creek, the habitat time series data identified a 2-day spawning opportunity on December 1-2, 2001, when flows were 73.4 cfs and 36 cfs, respectively. Over the next 11 days, flows in Carneros Creek steadily decreased to 2 cfs (December 13, 2001). However, in the habitat time series data and in Appendix I, results of the incubation analysis are not presented.

Based on the results from the three validation site streams analyzed, streams located in drainage areas of between 1.88 square miles to 2.75 square miles (Dunn and Carneros creeks) appear to provide no, or very limited steelhead spawning opportunities. Additionally, review of the time series data indicates that flows in Carneros Creek exhibit sharp declines during the weeks following peak storm events that also correspond to individual spawning days counted in Appendix I of the Scientific Basis. While juvenile fish and newly-emerged fry may be able to move into more suitable habitats if flows begin to decline rapidly, incubating embryos cannot do so and, thus, are subject to increased stress and possible mortality. In addition to considering the consecutiveness of spawning days, the Scientific Basis should provide a more robust presentation of results regarding the potential effects of flow variability on embryo incubation in these smaller streams.

Table 1. Steelhead Spawning Opportunity Assessment (Unimpaired Flow) Using Habitat Time Series Data Supporting the Scientific Basis for the North Coast Instream Flow Policy

North Coast Instream Flow Policy - Steelhead Spawning Opportunity Assessment (Unimpaired Flow)								
Stream	Watershed Drainage Area (mi^2)	Available Data: Period of Record	Number of Spawning Opportunties (Consecutive Days)					Date(s) of Spawning Opportunities
			1 day	2 days	3 days	4 days	5 days	
Dry Creek								
Transect Dry_sp-1_Alt01_Daily Habitat_Alt0	1.19	10/1/1967 through 9/30/1969	3	—	—	—	—	1/30/1968; 2/2/1968; 2/8/1969
			—	2	—	—	—	1/25-26/1969; 2/5-6/1969
			—	—	—	—	—	
			—	—	—	—	—	
			—	—	—	—	—	
Dunn Creek								
Transect Dunn_sp-1_Alt01_Daily Habitat_Alt0	1.88	10/1/1961 through 9/30/1964	1	—	—	—	—	1/19/1964
			—	3	—	—	—	1/19-20/1962; 12/2-3/1962; 3/30-31/1963
			—	—	1	—	—	1/22-24/1964
			—	—	—	1	—	2/13-16/1962
			—	—	—	—	—	
Transect Dunn_sp-2_Alt01_Daily Habitat_Alt0		10/1/1961 through 9/30/1964	2	—	—	—	—	3/6/1962; 1/19/1964
			—	2	—	—	—	2/10-11/1962; 12/2-3/1962
			—	—	2	—	—	1/19-21/1962; 3/29-31/1963
			—	—	—	1	—	1/22-25/1964
			—	—	—	—	1	2/13-17/1962
Carneros Creek								
Transect Cameros_sp-1_Alt01_Daily Habitat_Alt0	2.75	10/01/2001 through 9/30/2005	21	—	—	—	—	12/14/2001; 12/20/2001; 12/22/2001; 12/28/2001; 12/31/2001; 1/5/2002; 12/13/2002; 12/15/2002; 12/28/2002; 12/31/2002; 2/16/2003; 12/29/2003; 1/2/2004; 2/2/2004; 2/16/2004; 2/18/2004; 2/25/2004; 1/7/2005; 1/11/2005; 2/28/2005; 3/22/2005
			—	3	—	—	—	12/1-2/2001; 12/19-20/2002; 12/30-31/2004
			—	—	—	—	—	
			—	—	—	—	—	
			—	—	—	—	—	
Transect Cameros_sp-2_Alt01_Daily Habitat_Alt0		10/01/2001 through 9/30/2005	22	—	—	—	—	12/5/2001; 12/14/2001; 12/17/2001; 1/1/2002; 1/3/2002; 12/13/2002; 12/15/2002; 12/17/2002; 12/28/2002; 12/31/2002; 1/10/2003; 2/16/2003; 12/29/2003; 1/3/2004; 2/2/2004; 2/25/2004; 1/11/2005; 1/28/2005; 2/18/2005; 2/28/2005; 3/4/2005; 3/22/2005
			—	6	—	—	—	12/2-3/2001; 1/5-6/2002; 2/19-20/2002; 12/20-21/2002; 1/3-4/2005; 1/7-8/2005
			—	—	1	—	—	12/28-30/2001
			—	—	—	2	—	12/20-23/2001; 2/16-19/2004
			—	—	—	—	1	12/28/2004-1/1/2005

In conclusion, unimpaired stream flow in watersheds with drainage areas less than 1.88 square miles appears to provide potential spawning opportunities for steelhead on only a limited and infrequent basis. In other streams (e.g., Carneros Creek, drainage area 2.75 square miles), no spawning opportunities that include several consecutive days were provided at one transect, and limited opportunities were provided at the other transect and, thus, illustrates the need for further consideration of drainage area size to application of the proposed Policy.

5.0 THE "LEVEL OF PROTECTION" RESULTING FROM POLICY APPLICATION MAY NOT BE APPROPRIATE FOR ALL STREAMS IN THE POLICY AREA

Each step of the methodology, from the establishment of biological criteria to the development of the minimum bypass flows and the maximum cumulative diversion elements, employed a "risk-averse" approach. In combination, the Policy results in a very high, but not comprehensively defined level of protection, the application of which may be overly restrictive for many streams within the Policy area.

Application of a maximum level of protection to each individual Policy element (e.g., biological criteria, field measurements, analytical assumptions, Protectiveness Analysis) results in a compounding of effects, which, while restricting opportunities for diversion of water, may not increase the actual protection of the instream resource. It is acknowledged that some level of resource protection is necessary to maintain aquatic resource conditions and prevent the degradation of public trust resources in the Policy area. However, it is uncertain whether this compounding of protectiveness is necessary to protect fisheries resources in the Policy area.

The Scientific Basis undertook a well-intentioned attempt to apply a maximum level of protection. Because little was known about most of the streams within the Policy area, the Policy development process relied upon an exceedingly "conservative" approach by applying the most restrictive conditions as possible to each Policy element. However, the Policy and the Scientific Basis do not present evidence to suggest that resource impairment within the Policy area (or within a subset of the Policy area, as characterized by the validation site streams) is of a magnitude that warrants a Policy approach designed to compound protectiveness. The "maximum protectiveness" approach selected does not present a balanced assessment of: (1) existing conditions and resource needs within the Policy area; and (2) the baseline level of protection required to sufficiently protect existing resources.

5.1 POLICY ACKNOWLEDGES SCIENTIFIC UNCERTAINTY, BUT ATTEMPTS TO ELIMINATE UNCERTAINTY REGARDING THE LEVEL OF PROTECTION

5.1.1 The SWRCB policy and supporting appendices repeatedly acknowledge uncertainty and the appropriate level of protection

The Scientific Basis (pg. 4-12) states that "*A consistent, quantitative, biologically meaningful basis could not be identified for selecting a specific threshold, in terms of a number difference or percent reduction that distinguished between protective and non-protective flow conditions.*"

The Scientific Basis (pg. D-1) states "*...there are presently no metrics available that clearly and unequivocally define protectiveness in terms of specific instream flow levels applied at a regional level.*"

5.1.2 Bypass flows lower than those prescribed by MBF3 may be protective

The Scientific Basis (pg. 6-6) states "*Because a regionally protective Policy inherently results in over-protecting some streams (e.g., see Figure D-5 in Appendix D), application of the MBF3 alternative criterion would likely result in many cases where additional study could indicate that lower bypass flows might still be protective.*"

5.1.3 Long-term viability does not necessarily require optimal habitat conditions, which serve as the basis for the Policy elements

The Scientific Basis (pg. D-1) states that "*Given an unimpaired hydrograph for a given stream, the Policy essentially seeks to establish limits on the amount of flow that can be diverted, with the limits presumably set at levels that will not impact the long-term viability of existing anadromous salmonids (i.e., the limits are set to be protective of the resources).*"

The Scientific Basis (pg. D-6) states that "*With respect to habitat quantity, assuming all other population regulating factors are non-limiting, there is likely some minimum amount of habitat below which a stream cannot support a viable anadromous salmonid population.*"

5.1.4 Maximum cumulative diversion threshold is established based on the assumption that greater rate of diversion is less protective than a smaller rate

The Scientific Basis pg. (D-28) states that "*Unfortunately, the results indicate that changes in channel values are approximately linear with changes in bankfull flow over the likely range of diversion rates that would be permitted under the Policy. As a result, there is no readily discernable asymptotic limit suggested for identifying a protective maximum cumulative diversion threshold. ...The clearest conclusion that can be inferred is that a greater rate of diversion is less protective than a smaller rate, but we cannot identify a clear threshold between protective and non-protective conditions.*"

The Scientific Basis (pg. D-29) states that "*Hence, specification of a regionally protective maximum cumulative diversion rate should involve an element of conservativeness, where a level is proposed that is considered by professional judgment to have a low risk of reducing channel size significantly over the long term, and of resulting in reductions in surface grain size distribution over the short term.*"

5.1.5 The maximum cumulative diversion rate used a worst-case scenario

The Scientific Basis (pg. 3-7) states that "*Evaluation of the MCD element requires a worst-case scenario in which it is assumed that all appropriated water is diverted, rather than an estimate of actual current use.*"

5.2 BIOLOGICAL CRITERIA, DATA SETS AND FIELD METHODOLOGIES ALL EMPLOYED "RISK-AVERSE" APPROACHES

As described above, the establishment of biological criteria and other Policy-related elements used in the development of the minimum bypass flows and the maximum cumulative diversion elements employed a "risk-averse" approach. This approach may result in a high level of protection, but it is based on hydrologic standards, the "protectiveness" of which was not comprehensively assessed as a whole, and which could be considered overly restrictive for many streams within the regional area. To illustrate this point, the following examples are provided:

5.2.1 Passage Depth Criteria

The Scientific Basis (pg. G-15) states that "*Passage depth criteria included more ideal conditions of suitability of passage which included all possible sizes of individual fish and sufficient clearance underneath the fish so that contact with the stream bed and abrasion are minimized. However, in applying passage depth criteria, it must be recognized that the occurrence of critical depth at riffle crests can limit the depths available for passage under unimpaired flow conditions, where fish are naturally forced to pass through sections shallower than desired based on conservative design criteria.*"

5.2.2 Spawning Depth and Velocity Criteria

The Scientific Basis (pg. G-20) states that "*The selective minimum depth criteria were 0.2 feet greater than minimum reported values, and hence can be considered conservatively protective with respect to providing suitable depths for spawning.*"

The Scientific Basis (pg. G-20) states that "*For velocity, the criteria proposed by Thompson (1972) typically exceeded the range of values reported by other investigators for favorable or proper conditions. The Thompson (1972) criteria should therefore be conservatively protective of spawning habitats and were selected for analysis.*"

5.2.3 Passage Transect Placement

The Scientific Basis (pg. G-5) states that "*Passage transects placed at locations in each validation site that would require more flow than elsewhere in a reach to meet passage depth criteria: transects were typically placed over wide, shallow riffles or in a few cases where a limiting depth occurred in the hydraulic sense.*"

5.2.4 Spawning Transect Placement

The Scientific Basis (pg. G-6) states that "*Spawning transects were located upstream of riffle crests in pool or run tails. ... spawning transects placed near riffle crests were generally located downstream of deeper cross-sections that provided spawning habitat.*"

5.2.5 Spawning Habitat Assumptions

MBF3 uses "*flow at which maximum spawning habitat availability occurred for steelhead*" as the flow needed in the streams to be protective.

However, it is not clear why maximum spawning flows are necessary to be protective. An alternative minimum bypass flow (MBF4) may indeed be protective. The Scientific Basis (pg. 3-3) states "*In particular, the MBF3 and MBF4 alternatives summarized in Table 3-1 were both developed to account for variation in instream flow needs for different channel sizes, but respectively approximated the maximum/minimum amounts of water that might be left instream without substantially over-/under-protecting anadromous salmonids.*"

6.0 FURTHER CONSIDERATION SHOULD BE GIVEN TO THE APPLICABILITY OF THE POLICY TO UPPER WATERSHEDS (ABOVE POINT OF ANADROMY)

The Policy allows that the upper extent of anadromy be used to determine the drainage area that will be identified in the calculation of an applicant's required minimum bypass flow at the point of diversion. Data and the Protectiveness Analysis in the Scientific Basis do not support the application of anadromy to the upper extent of most watersheds within the Policy area.

In several sections of the Policy, the text indicates that the upstream extent of anadromy must be determined and applied to several implementation components of the Policy. Key examples include, but are not limited to: (1) the calculation of minimum bypass flows; and (2) SWRCB-determined points of interest (POI) for site-specific evaluation by the applicant, which are summarized below.

- Policy (pg. 12) states "*The upper limit of anadromy is defined as the upstream end of the range of anadromous fish that currently are, or have been historically, present year-round or seasonally, whichever extends the farthest upstream. The upper limit of anadromy may be located on a perennial, intermittent, or ephemeral stream.*
- Policy (pg. 4) states "*The regional criteria for the minimum bypass flow in watersheds less than or equal to 295 square miles in area is a function of the mean annual unimpaired stream flow and the watershed drainage area, either at the point of diversion, or at the upper limit of anadromy.*"
- Policy (pg. 4) states "*The drainage area at the stream's upper limit of anadromy can be used to calculate the minimum bypass flow that is needed for points on the stream above the limit of anadromy and still be protective of fishery resources.*"
- Policy (pg. 14) states "*After review and approval of the Water Supply Report and the upper limit of anadromy determination, the State Water Board shall select POIs for an analysis of the proposed project's effects on instream flows. A POI is a location on a stream channel where the applicant shall analyze the effects of the proposed project, in combination with other water diversions, on fishery resources.*"
- As related to applications to appropriate water, the Policy (pg. 15) states "*A POI location at which the proposed project's demand is less than one percent of the remaining unappropriated supply will be considered a location at which the proposed project could not adversely affect instream flows.*"
- Policy (pg. A1-10) states "*…the upper limit of anadromy needs to be determined because the watershed drainage area at the upper limit of anadromy is needed to calculate the minimum bypass flow. Additionally, the upper limit of anadromy location will aid the State Water Board in its selection of points of interest for the evaluation of the effects on fishery resources.*"

Where the upper limit of anadromy is uncertain, the SWRCB will presume that the point of diversion is within the range of anadromous fish. This presumption, in addition to other Policy issues (e.g., stream classification, importance of recruitment of upstream resources) should be considered in more detail because the majority of streams in the Policy area are located in small watersheds and in drainage areas located upstream of the point of anadromy. The Policy (pg. 12) states "*In some cases, the historic upper limit of anadromy is not known with certainty. In those cases, if the stream reach from which the applicant proposes to divert water appears to support fish under unimpaired conditions, the SWRCB will presume that the POD is located within the range of anadromous fish. <u>This presumption might result in higher calculated minimum bypass flows than would be needed if the POD is actually upstream of the upper limit of anadromy</u>.*" [emphasis added]

The Scientific Basis (Appendix E, pg. E-20) further states "*…proportionally more water is needed to meet the protectiveness level as drainage size decreases, there would be no need to apply a regression equation derived for anadromous spawning habitat to non-anadromous habitat in even smaller drainage basins. Doing so would require even more water to be kept instream than is needed to maintain* *downstream spawning habitats. This suggests that the MBF in non-anadromous habitat should be limited to the flow that meets the MBF requirement for a stream at its' upstream point of anadromy."*

The Scientific Basis (pg. 1-8) states that there are two important implementation issues for the Policy, which relate to: (1) which streams the Policy should be applied to in order to be protective of anadromous salmonids; and (2) whether different stream types (or classes) require different levels of protection. The Policy relies upon a stream classification system developed by the California Department of Forestry (CDF). However, Appendix D of the Scientific Basis (pg. D-34) states that "*...because the CDF classes were developed with forestry impacts in mind, particularly with respect to sedimentation and riparian management, they might not lend themselves strictly to assessing protectiveness of instream flow standards."*

The Policy's directive to implement a "one-size-fits-all" approach is not consistent with sections of the Scientific Basis that acknowledge the inherent variability in watershed and stream-specific conditions that can influence the recruitment of upstream resources (e.g., food, instream woody material, and energy). Appendix D of the Scientific Basis (pg. D-37) states that "*One-size-fits-all approach cannot result in protecting anadromous salmonids in all streams equally ...two main sources of variability influencing the definition of protectiveness, where variability in flow needs at the site scale is compounded by variability across sites."* Further, Appendix D (pg. D-37) states "*...Because of inherent variability, not all streams of a given size, slope, elevation, aspect, drainage density, drainage area, precipitation, and other measures of similarity may be able to support the same level of diversion without impacting salmonids."*

Key issues that should be reconsidered in greater detail in the Policy include: (1) the CDF classes developed to address forestry impacts may not be directly applicable for assessing protectiveness of instream flow standards; and (2) if a "one-size-fits-all" approach will not result in an equal level of anadromous salmonid protection, then applying a higher standard that uses the most stringent conditions to maximize protection (e.g., including ephemeral streams) is unlikely to result in a greater amount of improvement.

As described in Appendices D and G, the Scientific Basis applied results from 13 validation streams to a total of 3,402 streams in the Policy area. For these 3,402 streams, the Scientific Basis considered variation at a gross scale by addressing: (1) stream classification; (2) drainage area; and (3) geographic location. Appendix H (pg. H-1) of the Scientific Basis states "*...In the analysis of protectiveness, the limiting upstream passage flow for the site is set equal to the transect requiring the highest initial passage flow."* Fish passage ability varies by stream-specific conditions (e.g., channel depth, channel morphology), and a uniform application of one standard to over about 3,400 streams based on only 13 validation streams does not appear to be an adequate level of analysis to fully take into consideration different stream classes or streams with multiple reaches that contain varying degrees of habitat complexity. It also is likely that other parameters introduce additional variability, which does not appear to have been considered or addressed in the Policy, including: (1) watershed location (e.g., elevation); (2) surrounding land use; (3) type of, and extent of both upland and riparian vegetative cover; (4) geology; and (5) other site-specific instream processes such as productivity, nutrient spiraling, water temperature and channel morphology (See comments in Section 8).

7.0 CONSIDERATION SHOULD BE GIVEN TO EXEMPTING UPSTREAM REACHES FROM POLICY REQUIREMENTS

The overall contribution and quality of aquatic habitat associated with headwater or low order (1^{st} and 2^{nd}) ephemeral and intermittent streams in the upstream reaches of the Policy area is uncertain, compared to the total amount of suitable habitat used by anadromous salmonids in the Policy area. Additionally, many of these ephemeral and intermittent upper watershed streams are unregulated (i.e., not diverted). Thus, due to the flashy and unpredictable nature of the hydrologic regimes in these upper reaches, it is likely that fish utilizing these reaches today would be subject to a similar degree of risk of exposure to unstable and potentially stressful habitat conditions, relative to what has occurred historically.

The Policy's attempt to apply a maximum level of protection to headwater or 1^{st} and 2^{nd} order ephemeral and intermittent streams may not be appropriate for these streams which may not have historically supported anadromous salmonids. If natural disturbance and site-specific conditions occurring under unimpaired flows preclude achievement of the desired level of habitat benefit to be provided by the Policy, an overly rigorous level of protection would be unwarranted. For example:

- Harvey *et al.* (1994) report that in steep mountain channels (>2%), natural spawning areas for salmonids are rare because stream beds are armored with cobbles and boulders too large to be moved by spawning fish during redd building.
- For fish species in the Humbolt Bay Watershed, CDFG and California Coastal Conservancy (2005) report that:
  - Fall-run Chinook salmon utilize the mainstems of larger river systems, with some utilization of smaller tributaries. Typically 1% to 2% gradient.
  - Coho salmon utilize all accessible reaches of streams, especially side channels, typically 1% to 3% gradient.
  - Steelhead typically utilize tributary channels less than 8% (usually 3 to 5%) gradient.

As the examples above illustrate, stream gradients associated with anadromous salmonid habitat utilization reported in the literature are generally less than what is identified in the Policy as the upper limit of anadromy. Therefore, the application of a gradient criterion that is higher than the range of stream gradients frequently reported for anadromous salmonids would be overly protective because fish would not likely have been present historically in these upstream reaches.

The Policy identifies a criterion of 12% slope over 100 meters as a means for an applicant to demonstrate that the upper limit of anadromy is at a different location that what was presumed by the SWRCB.

In a technical memorandum dated July 9, 2007, R2 Resource Consultants made an initial recommendation based on general experience that "*…on a regional basis, steelhead passage would likely be precluded by reaches 500 feet or longer over a longitudinal slope continuously greater than or equal to 8%.*" This determination was refined to suggest that "*a slope of approximately 12%, as discernable over 100 m using digital elevation models (DEMs), would likely limit upstream passage of steelhead in the Policy area, and therefore by default, coho and Chinook salmon which generally are found lower in Policy area watersheds. This corresponds to the limiting value used to define intrinsic habitat potential for steelhead in the Policy area by NMFS (Agrawal et al. 2005).*"

Reference documentation, DEMs and other GIS data files used to reach the determination that a 12% slope over 100 meters is an appropriate criterion are not specifically provided as part of the Scientific Basis. The technical memorandum suggests that this information is available and if so, could therefore be used for further analytical application. In fact, a collection of GIS datasets for California, including DEMs, appears to be available from a number of potential sources including, the California Spatial Information Library (http://gis.ca.gov/index.epl), the California State University Northridge (http://geogdata.csun.edu/ca_dems.htm), the National Digital Elevation Program (http://www.ndep.gov/links.html) and the United States Geological Survey (http://www.usgs.gov/ngpo/index.html). Because it appears that GIS data is publicly available, this data should be applied to the geographic areas to be affected by the Policy. Prior to Policy implementation and to the extent feasible with available information, these GIS datasets could be used to conduct an analysis that produces a standardized demarcation of those Policy area streams or upstream reaches that would be either exempt from, or subject to the Policy.

Through this approach, GIS-based analyses, including application of the Policy exemption criterion to Policy area streams, could be used to determine which ephemeral and intermittent upper watershed reaches meet the exemption criterion. Using available GIS data (e.g., DEMs), a GIS-based analysis could be conducted to query those stream reaches within the Policy area that have a slope of 12% or more over the requisite 100 meters. Delineation of those upstream reaches where gradients exceed 12% would provide a more accurate representation of those reaches that would and would not be affected by the Policy.

As a tool to assist applicants interpretation and compliance with the implementation requirements that will be established by the Final Policy, the results of such a GIS-based analysis should be included as part of the Scientific Basis that will be used to support the Final Policy to be approved by the SWRCB. Further, establishment of the upper extent of anadromy by the SWRCB, to the extent feasible using the Policy criterion and available GIS applications, would: (1) avoid the duplication of effort by multiple applicants if they choose to independently submit information to the SWRCB that indicates a stream reach meets this criterion and a different location of anadromy is more appropriate; and (2) eliminate the potential for dispute if there are inconsistencies among individual applicant submittals to the SWRCB.

Additionally, neither the Policy nor the Scientific Basis define the specific conditions that would constitute an impassable natural barrier. The burden of proof (i.e., survey) lies with the applicant, but the specific criteria that SWRCB staff will use to make their determination is not identified. Thus, with no established standard or definitive guidance criteria, it is unclear what criteria would be applied, and how this information would compare to the previously established criterion of a 12% gradient (see above) and possibly, to other applicable features (e.g., suitable pool depths) that are defined for other evaluation purposes elsewhere in the Scientific Basis.

Test evaluations could be conducted to: (1) ensure that the Policy would be applied on a consistent basis throughout the regional area; and (2) identify those portions of the Policy area that likely could be excluded from Policy compliance requirements based on stream channel gradient or other known natural barriers limiting the point of anadromy.

8.0 CONTRIBUTION OF TRIBUTARIES ABOVE THE UPPER LIMIT OF ANADROMY TO THE RECRUITMENT OF INSTREAM MATERIALS REQUIRES ADDITIONAL JUSTIFICATION

The Policy indicates that if a project is above the point of anadromy, then recruitment of upstream resources (e.g., food, gravel, instream woody material, energy) is important. However, insufficient supporting information has been provided to either discuss the current status of upstream resources, to assess the extent to which upstream resources contribute to downstream effects in the Policy area, or to support the SWRCB determination that the Policy should apply above the limit of anadromy.

Additionally, the Policy and its supporting documentation provide insufficient supporting evidence to indicate that productivity, nutrient availability and other aquatic parameters are limiting, either in key watersheds within the Policy area, or in upstream or downstream reaches of specific streams. Therefore, the determination that all streams above the limit of anadromy need to be protected to the maximum extent possible is not supported.

8.1 ADDITIONAL JUSTIFICATION IS NECESSARY TO ADDRESS MINOR CHANGES IN THE MAGNITUDE OF "SPILL" OCCURRENCES

Because most tributary streams are located upstream of the point of anadromy, the Scientific Basis should include greater focus and additional discussion of the potential effects of "spill and fill" associated with upstream reservoir operations on downstream fisheries resources.

High flow events could create temporary upstream passage opportunities if spill occurs, thereby allowing adult fish to move into ephemeral streams during adult immigration and holding, and spawning. Mortalities (adults, embryos, juveniles) may occur if fish use these temporary habitats and are not able to volitionally or non-volitionally exit these areas prior to when instream conditions become unsuitable (e.g., ephemeral stream dries up, increase in summer water temperatures, limited food availability), generally during low flow periods. Although the literature reports that ephemeral streams may be used by some species (juvenile Coho salmon, steelhead adults and fry) during certain lifestages, the overall contribution and quality of these 1st and 2nd order ephemeral and intermittent stream habitats to the total amount of suitable habitat (e.g., intermittent and perennial streams) used by the majority of a population is not discussed in the Scientific Basis. Additionally, many of these ephemeral and intermittent upper watershed streams are unregulated (i.e., not diverted). Thus, due to the "flashy" nature of the hydrologic regimes in these upper reaches, it is likely that fish utilizing these reaches today would be subject to a similar degree of risk of exposure to unstable and potentially stressful habitat conditions, relative to what has occurred historically.

Reservoir filling could temporarily result in reduced downstream flow volumes and velocities when the upstream reservoir is filling. Diverting from upstream tributaries during the October 1 – March 31 diversion season could result in the following:

- Diversions during high flow periods may reduce the peak flows (see discussion below on the analysis of flat-lining flows with regard to the potential for changing the timing of peak flows downstream and effects on downstream resources)
- The reservoir filling period may extend slightly longer if upstream diversions are occurring concurrently; however, diversions and filling occur during the winter when there are generally higher flows in the channel and cooler water temperatures

Based on hydrologic flow regimes that occur during the winter months, coupled with cooler ambient air temperatures (particularly at higher elevations), it is unlikely that potential flow and water temperature changes occurring during the winter diversion season would result in direct impacts to fish downstream. Also, rather than constraining early season filling opportunities, it may be more biologically beneficial to allow upstream reservoirs to fill early in the diversion season, which could provide spill later in the season during periods when habitat could be more consistently sustained. More thorough analysis of the potential effects of "spill and fill" associated with upstream reservoir operations is needed to conclude that the practice is detrimental to instream resources during the October 1 – March 31 diversion season.

8.2 Mobilization and Downstream Movement of Instream Materials Associated with Habitat Availability, Stream Productivity and Energy Transport are not Appropriately Evaluated to Support Policy Inclusion of Areas Upstream of the Point of Anadromy

The cascade of energy downstream is a key component of the river continuum concept, and is briefly discussed in Appendix D of the Scientific Basis (pg. D-35), which states "*...longitudinal gradient of physical conditions in streams that determines community structure and functions as the ecosystem progresses from headwaters to a large river. As the hydrologic processes, food resources, nutrient dynamics, and riparian vegetation change with increasing stream size, the composition of the vertebrate and macroinvertebrate communities, and functional feeding groups in particular, will change in response. The productivity of the ecosystem in downstream channels can depend intrinsically on delivery of nutrients, and organic and inorganic matter from upstream (Cummins 1979; Vannote et al. 1980).*"

Although the preceding text recognizes that multiple factors contribute to, and influence instream nutrient availability and energy transport as part of the river continuum, these considerations are addressed in a limited, conceptual manner in the Scientific Basis, and are addressed to an even lesser extent with respect to the application of available data. Because of the large proportion of headwater and low order ephemeral and intermittent streams that would be subject to Policy compliance, extending the Policy into areas above the upper limit of anadromy should be more fully evaluated. Additional investigation and rationale is warranted to better support the need for such an all-encompassing level of protection that would extend past the limit of anadromy.

Potential topics that should be explored in greater detail, and subsequently discussed as part of the Policy rationale, are discussed below.

8.2.1 Relationship of Gravel Mobilization to the River Continuum

The Scientific Basis (Appendix D, pg. D-36) states "*...gravels originating in even the fourth type (d) of streams can ultimately supply spawning habitat used by anadromous salmonids downstream. Consequently, streams of type (a), (b), and (c) would all need to be protected at a minimum in terms of providing sufficient water and bedload to anadromous habitat in streams of type (a).*"

Even though type (d) streams can be a source of gravel input to a system, this does not necessarily mean that these stream types are needed to supply gravel. The sentence from the Scientific Basis that is quoted above does not call for type (d) streams to provide bedload to type (a) streams (i.e., anadromous fish habitat).

The Scientific Basis should address the potential for site-specific gravel mobilization, and should include the following additional considerations:

- Dependence on specific site (slope, velocity)
- Magnitude and duration of peak flow changes, which could vary by type of stream class. For example:
    - Class III streams: Flashy, high gradient, narrow channel; peak flows are intense, of short duration and unpredictable
    - Class I streams: Lower gradient, wider channel, broader floodplain, greater channel complexity and habitat types; peak flows are of longer duration, and have a more regular pattern

8.2.2 Stream Productivity and the River Continuum: Importance of the Downstream Movement of Resources (Instream Woody Debris, Sediment, Energy) into Stream Reaches Located Below the Point of Anadromy

Instream productivity is influenced by a multitude of factors, many of which are poorly understood or highly variable depending on stream-specific conditions. In addition, stream inputs (e.g., woody material, organic matter) can be heavily influenced by upland and riparian vegetation as well as surrounding land uses. Because of the complexity of such ecological interactions, it is uncertain whether assigning a protectiveness level by limiting one habitat parameter (i.e., flow) during a time of the year when natural productivity is relatively low will make a substantial contribution to overall instream productivity and habitat availability on a long-term basis. To illustrate this point, several key components that have an ability to influence stream productivity are discussed below. To substantiate the need for the Policy to extend above the upper limit of anadromy, these types of considerations, as they apply to streams or stream types located in the Policy area, should be addressed as part of the Protectiveness Analysis that is presented in the Scientific Basis.

Seasonal Considerations and Mobilization of Nutrients and Food Sources Through Flood Pulses

- Seasonal flood pulses are natural processes that are a characteristic of stream function
- Flood disturbance in small streams can control the distribution of primary producers
- Flooding appears to allow juvenile salmonids access to a wider range of food resources, and winter floods may be important for food supply and sustaining growth and condition (Pert 1987).
- Streams undergo succession on seasonal timescales
  - Invertebrates in temperate streams can have slow-seasonal, fast-seasonal and nonseasonal life cycles (depends on light regime, leaf litter/nutrient inputs – often specific to individual stream conditions)
  - Drifting is somewhat controlled by water temperature – different species react differently by season

Influence of "Drift" on the River Continuum: Contribution of Macroinvertebrate Communities as a Food Resource for Fisheries Resources

Influence/extent of "drift" and downstream movement of dissolved and particulate organic matter (leaf litter) and macroinvertebrates can be variable and/or limiting in systems with either natural or man-made barriers. Examples of the types of effects that should be evaluated in the Scientific Basis include:

- Potential disruption of the spatial and temporal downstream spiraling of nutrients (particularly important in small streams)
- Formation of pools by barriers (e.g., small dams) and the potential that they can create nutrient "sinks" (e.g., removal of silica from the water & uptake by diatoms that then settle to the bottom of pools)
- The potential that low-head dams act as heat traps and shift community composition, particularly during the diversion season
- Whether retention of nutrients behind dams occurs, and whether the availability of nutrients and composition of plant and microbial communities is expected to change
- Whether the potential exists, or the extent of the concern regarding sediment trapping by dams and the accumulation of toxic materials that are adsorbed physically on sediment particles, or absorbed actively by the biota attached to the sediment

Fish Feeding Patterns and Potential Criteria for Determining Instream Food Production

Pert (1987) suggests that substrate composition probably affects salmonid production during the juvenile rearing lifestage by primarily regulating the production of invertebrates, a valuable food source. Reiser and Bjornn (1979) reported that the highest production of invertebrates is in habitats with gravel and rubble-sized materials, and that invertebrate production decreases proportionately as the size of the substrate particles decreases. In all cases, the composition of the stream substrate was a function of water velocity, with the size of the material increasing with water velocity. Reiser and Bjornn (1979) developed criteria for optimum food production in streams: water velocity: 0.5 to 1.1 m/s; depth: 0.5 to 0.9 m; substrate composition: largely coarse gravel from 3.2 to 7.6 cm in diameter; and rubble from 7.7 to 30.4 cm in diameter. Reiser and Bjornn (1979) also stated that most recommended stream flows for salmonid rearing habitat have been based on food production, cover, and microhabitat needs of the fish, rather than the direct relationships between fish production and stream flow.

Thus, based on the Reiser and Bjornn (1979) criteria above, it is uncertain whether many of the headwater and low order ephemeral and intermittent streams in the upstream reaches of the Policy area would meet the physical habitat specifications identified above. However, to explore these potential implications further because site-specific macroinvertebrate data may not be available for some of the validation site streams, the hydrologic data from the validation site streams could be compared to the productivity criteria (water velocity, depth, substrate composition) suggested above to better determine the potential productivity of Policy area streams, particularly within the smaller watersheds. Application in this manner may provide a better indication of the productivity capabilities and potential downstream contributions of headwater and low order ephemeral and intermittent streams under unimpaired conditions. For example, the Scientific Basis should include an evaluation or, at a minimum, a thorough discussion of the potential for diversions during the October 1 through March 31 diversion season to affect anadromous salmonid food availability and feeding patterns. Such an evaluation or discussion could include the following considerations:

- California coastal streams provide a warmer over-wintering environment and are not subject to freezing over as are many northwest streams (Pert 1987). In warm temperatures, fish-food needs are high and the availability of food is crucial (Cederholm and Martin 1983). The slightly higher stream temperatures in coastal California streams have the potential to make food availability during the winter vital to over-wintering survival (Pert 1987).
- Juvenile salmonids use winter and summer food resources differently. During summer months or under conditions of high densities juvenile steelhead and Coho salmon are able to coexist in streams by partitioning food and space resources. Juvenile Coho salmon prefer pool habitat with available cover from undercut banks and submerged roots (Nickelson and Reisenbichler 1977). They feed primarily on drifting invertebrates (Mundie 1969). Juvenile steelhead, on the other hand, inhabit riffles (Shapovalov and Taft 1954) and feed primarily on benthos (Allee 1974) supplemented by drift. How food resources are partitioned between these two species during winter conditions is not clear (Pert 1987).
- Winter food sources are highly variable. During winter, immature aquatic insects are in greatest abundance (Maciolek and Needham 1952). However, juvenile salmonids may switch to food which temporarily becomes available. Unpredictable food sources, such as salmonid eggs or invertebrates temporarily available in flooded vegetation, may provide critical energy allowing fish to maintain body size (Pert 1987).
- Current literature indicates habitat complexity frequently determines fish abundance and survival, while food availability influences fish condition and growth. In a study conducted on Pudding Creek, a low gradient, coastal stream in northern California, Pert (1987) reports that food availability, as measured by drift samples, was low throughout the study with the exception of a peak on the first major storm event. Juvenile Coho and steelhead in Pudding Creek grew and maintained biomass during winter conditions, which were milder than those in more northern coastal climates. Food supplies were lower than those measured in other winter studies yet quantities appeared adequate for the low densities of fish present. Winter floods were identified as potentially having an important role in overwintering fish survival. Flooding allowed juvenile salmonids access to a wider range of food resources and fish had fuller stomachs during high flow conditions than at other times. However, Pert (1987) also reports that this can only occur if riparian zones have been maintained, which protect the

integrity of the stream as well as facilitate the addition and recruitment of large woody debris into the stream channel.

8.2.3 Considerations Regarding the Potential Effects of Small Dams in Upstream Reaches

Most studies on the types of disturbance effects that influence the river continuum focus on the effects from large dams. Overall, the ecological consequences of small low-head dams (≤5 m) are less well understood. Production of aquatic invertebrates that juvenile salmonids eat depends on the amount of organic material available in streams. Bilby and Likens (1980) showed the importance of debris dams in small streams for the accumulation of coarse particulate organic matter. Nearly 75% of the organic matter deposited in first-order streams was associated with the dams, versus 58% in second-order streams and 20% in third-order streams. However, little is known about cumulative effects of small, low-head dams on the zonational distribution of macroinvertebrates along the stream gradient.

Given the findings of Bilby and Likens (1980), Policy elements or enforcement actions potentially requiring removal of un-permitted or out-of-compliance onstream dams may have negative implications on instream productivity in upper reaches that could outweigh the potential benefits. To illustrate, if allocthanous organic inputs to a stream are limiting due to historical disturbance or surrounding land uses under unimpaired flow conditions, the application of an overly restrictive protectiveness criteria extending up into headwater areas may do little to improve instream productivity in the upstream areas. Removal of an onstream dam in this type of stream could further reduce productivity by eliminating the retention capability of the reach, thereby limiting the ability of the stream to maintain the limited amount of organic matter that does accumulate with the dam in place.

Small low-head dams are numerous in Europe, and macroinvertebrate investigations have been conducted not only on the effects of these dams, but on the effects of multiple impoundments along the longitudinal profile of the regulated headwater streams. Some findings from these studies indicate:

- Small dams often do not substantially alter the natural discharge regime or chemical conditions, but can influence local flow velocity patterns, sediment composition and energy budgets.
- Local disruption to the stream continuum – There is little to no indication that barrier effects created by dams are of large ecological significance to benthic invertebrates.
- Changes in macroinvertebrate communities can occur in reaches immediately downstream of dams (e.g., longitudinal shift of a few 100 m for most factors), but the effects of small dams were found to not be far-reaching downstream.
- Differences in invertebrate assemblages among sites are primarily not the result of a barrier effect, nor of an altered flow regime, but due more to canopy cover that influences algal growth.

Results from studies conducted on lowhead dams in the United States indicate that effects on macroinvertebrate communities immediately upstream and downstream of impoundments are: (1) similar in different areas of North America (e.g., Helfrich *et al.* 1999; Porto *et al.* 1999; Beasley and Hightower 2000), and also are similar to the findings of European studies (Von Jens Arle 2005); and (2) resemble those for large dams, although to a lesser extent (e.g., Martinez *et al.* 1994; Camargo and Voelz 1998; Wildhaber *et al.* 2000).

8.2.4 Summary of Issues Regarding the Mobilization and Downstream Movement of Instream Materials and Related Effects on Habitat Availability, Stream Productivity and Energy Transport

The Scientific Basis (Appendix D, pg. D-35) states "*Reduction in productivity in the most upstream channelized reaches of the drainage network can therefore ultimately influence productivity in the most downstream reaches if enough of the upstream reaches are affected.*" However, the Scientific Basis provides insufficient data to support a determination that productivity in Policy area streams is limiting to such an extent that "enough of the upstream reaches" are affected.

The statement in the Scientific Basis (pg. 1-6) that "*the Policy should apply above existing barriers in stream reaches potentially supporting anadromous salmonids or that influence flow and habitat in downstream reaches*" requires additional consideration. At a minimum, a literature review should be conducted as part of the Policy refinement process to obtain a better understanding of how, and the extent to which small low-head dams (or similar in-channel structures or impoundments) may affect productivity, community structure and aquatic habitat conditions in the types of stream classes included in the Policy area. An example of one known resource to include in this review is a recently published report titled, "A Fresh Perspective for Managing Water in California: Insights from Applying the European Water Framework Directive to the Russian River" (Grantham *et al.* 2008), which was issued in March 2008 and is available at: http://repositories.cdlib.org/wrc/contributions/208/. In this report, there is a discussion on macroinvertebrate bioassessments that the California Department of Fish and Game conducted in the lower Russian River Basin. On page 46 of that report, the text states that sampling was conducted on 21 tributary streams and one reach on the mainstem Russian River over three seasons between 1995 and 1997. Sampled streams were selected based on their importance as salmonid habitat, and represented the highest quality habitat in the drainage.

As another example, the North Coast Regional Water Quality Control Board in cooperation with the California Department of Forestry funded an instream habitat assessment in 1993, as described in the report titled, Testing Indices of Cold Water Fish Habitat: Final Report for Development of Techniques for Measuring Beneficial Use Protection and Inclusion into the North Coast Region's Basin Plan by Amendment of the "Guidelines for Implementing and Enforcement of Discharge Prohibitions Relating to Logging, Construction and Associated Activities. It is reported that this study measured a range of habitat variables (e.g., wood volume and cover, pools per reach, pool length/depth/volume, riffle armor stability index) in 60 streams within the North Coast Planning Basin of California, which included Del Norte, Humboldt, Mendocino and Sonoma counties. The report stated that "*the objective of the study was to test several indices of cold water fish habitat to determine their relevance to upslope disturbance and determine the range of associated values. If this could be accomplished, the variables and methods developed might eventually be used in a broader regulatory framework.*" The report also stated "*…Variables selected for inclusion in this study were identified following consultations with over 30 scientists from management agencies, research, academia and industry in 5 Western States.*" Thus, it appears that additional habitat-related information may be available for many streams in the Policy area. However, from the information presented in the Scientific Basis, it is unclear whether this type of available information was consulted or utilized in the development of the Protectiveness Analysis.

Although these examples are limited to only a portion of the Policy area, they illustrate that information is currently available that could be used to provide a better general indication of aquatic habitat conditions and regional stream productivity within the Policy area. Consequently, this information, if it were applied to future Policy refinement and implementation processes, could be important for determining not only which stream reaches above the point of anadromy are, or are not limited in productivity as a result of existing diversions and other influencing factors, but also which watersheds and stream reaches are most in need of protection in general. Such an approach also could be used to help focus Policy application, and prioritize the use of already limited resources towards providing greater levels of protection to areas that are most limited in productivity. This exercise would help to determine whether or not it is both appropriate and necessary for the maximum level of protection to be universally applied to all streams within the Policy area, particularly those located upstream of the point of anadromy.

9.0 BIOLOGICALLY MEANINGFUL CRITERIA SHOULD BE DEVELOPED AND INCORPORATED INTO THE POLICY

Biologically-based criteria are not directly incorporated into the elements of the Policy. Rather, diversion limitations on flow (MBF3, MCD2) serve as the criteria, based upon numerous steps in the Scientific Basis used in an attempt to equate these flow metrics to biologic response. Uncertainties remain regarding actual biologic response associated with the methodologies employed. A more straight-forward approach would be to establish biologic criteria in the Policy for watershed specific evaluation as to whether appropriate levels of protectiveness were being provided. Biologic criteria could directly incorporate elements such as number of days of passage, number of days of spawning, etc.

Biologically-based criteria could be established that consider a suite of various lifestage considerations. For example, it is not necessarily germane that a site- or watershed-specific location provides passage, if it does not provide adequate habitat conditions for subsequent lifestages (e.g., spawning, incubation, rearing, outmigration), particularly under unimpaired conditions. Such situations may be appropriately considered to be exempt from Policy requirements.

Additional consideration should be given to evaluation of differences in flows due to various diversion rates, and resultant level of protectiveness. The Scientific Basis (pg. 4-12) states that "*A consistent, quantitative, biologically meaningful basis could not be identified for selecting a specific threshold, in terms of a number difference or a percent reduction, that distinguished between protective and non-protective flow conditions.*" A relative percentage change in flows does not necessarily mean that resultant flows are not protective. Rather, changes in flows that remain well above specific threshold criteria should be considered protective if the minimum thresholds (particularly those based on "risk-averse" methodologies) are achieved.

Additional consideration should be given to the frequency and magnitude of specific flow considerations being realized, and the resultant level of protection. For example, the Policy includes a maximum cumulative diversion (MCD2) that is based upon percentage reduction of a specified flow recurrence interval ($Q_{1.5}$). During wetter years, a specific flow recurrence interval could be realized in an individual watershed on numerous occasions. As previously mentioned, rather than constraining early season filling opportunities, it may be more biologically beneficial to allow upstream reservoirs to fill early in the diversion season, which could provide spill later in the season during periods when habitat could be more consistently sustained.

10.0 BALANCING OF SWRCB AUTHORITIES AND THE PROTECTION OF MULTIPLE BENEFICIAL USES IS NOT CLEARLY DESCRIBED

Clarification is required regarding the extent of the SWRCB's authorities, specifically with regard to the balancing of it's requirement to protect existing beneficial uses and it's authority to oversee species recovery and restoration actions. The Scientific Basis (pg. 1-6) states that:

- *"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. This has proven to be an effective, high-return method for restoring anadromous salmonid populations elsewhere (e.g., Roni et al. 2002)."*
- *"...current trends in fisheries management within the Policy area are to identify and correct passage barriers caused by human actions...Once barrier problems are corrected, it is likely that efforts will be undertaken to subsequently improve habitat conditions above the former barrier location (e.g., DFG 1996; Flosi et al. 1998; DFG 2002; Roni et al. 2002; DFG 2004)."*
- *"Policy should also apply above existing barriers to stream reaches potentially supporting anadromous salmonids, or that influence flow and habitat in such downstream reaches, in anticipation of restored runs in the future."*

From the statements cited above, it is not clear what the intent of the Policy is, and whether the full extent of beneficial uses identified in the California Water Code have been taken into consideration. Specifically, clarification should be provided as to the SWRCB's authority for protecting existing beneficial uses, which include not only the preservation and enhancement of fish and wildlife, but also domestic and agricultural supplies, among others. It is suggested that further clarification be provided to address how the Policy balances and/or prioritizes the level of protection assigned to multiple beneficial uses (e.g., fisheries and agricultural supply), as well as the extent to which the SWRCB has authority to oversee and mandate habitat restoration and species recovery efforts throughout the Policy area, particularly in areas located upstream of the point of anadromy.

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