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POTENTIAL REFINEMENTS & ALTERNATIVES TO THE ENVIRONMENTAL PROTECTION AGENCY'S PROPOSED SAN FRANCISCO BAY/DELTA WATER QUALITY STANDARDS

Prepared for

California Urban Water Agencies
Sacramento, California

Compiled by

Mr. Stephen N. Arakawa and Mr. Randall D. Neudeck
Metropolitan Water District of Southern California
P.O. Box 54153, Los Angeles, CA 90054

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NOTICE

This draft report was prepared as a technical document for reference use by the California Urban Water Agencies and others in preparing their comments to the U.S. Environmental Protection Agency on "Water Quality Standards for Surface Waters of the Sacramento River, San Joaquin River, and San Francisco Bay and delta of the State of California, January 6, 1994." This draft technical report is not part of the CUWA formal comment to EPA.

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1. PREFACE

This report was prepared for the California Urban Water Agencies (CUWA) as a part of a CUWA technical review of the Environmental Protection Agency's (EPA) proposed "Water Quality Standards for Surface Waters of the Sacramento River, San Joaquin River, and the San Francisco Bay and Delta of the State of California (40 CFR part 131). CUWA commissioned this report as a part of its overall review and evaluation of this standard.

This report addresses alternatives and refinements to the EPA's proposals with the objective of providing comparative environmental protection to the Bay/Delta Estuary that is more biologically justified and more responsible to consideration of attainability and other designated estuarine uses. These alternatives and refinements were also proposed in an effort to increase the flexibility of water project operations and potentially minimize water supply and economic impacts to existing users. It should be noted, that there are some gaps in the technical analysis of the proposed refinements. In addition, there is overlap among the alternative refinements. This was done intentionally to answer questions that EPA asked in its proposal and to assure that the record includes all matters of concern to us and all viable alternatives and refinements.

2. PROPOSED REFINEMENTS TO EPA'S ESTUARINE HABITAT SALINITY STANDARD

2.1 Summary

Background: In May 1991, the State Water Resources Control Board (SWRCB) approved measures in their Bay/Delta Water Quality Control Plan to provide protection for the Bay/Delta estuarine habitat. This included setting dissolved oxygen and temperature criteria to protect salmon, outflow and salinity criteria to protect striped bass, and salinity criteria to protect specified locations in Suisun Marsh. In September 1991, EPA disapproved in part the provisions of the Control Plan stating that the State has adopted criteria insufficient to protect the designated uses of the estuary.

In the expectation that the State would render federal promulgation unnecessary, EPA continued discussions with the SWRCB and participated in the interim water right hearings held during the summer of 1992. The purpose of these hearings was to establish interim measures to protect the natural resources of the Bay/Delta Estuary. After the close of these hearing, the SWRCB, due to the urging of the Governor, decided to stop work on developing interim standards.

Believing that SWRCB had not adequately addressed its concerns (EPA letter to SWRCB, September 3, 1991), EPA proposed a rule establishing three sets of federal criteria to protect the designated uses of the Estuary. The following refinements evaluate the first of these proposed federal criteria, the estuarine habitat standard. This standard proposes the establishment of a 2 part-per-thousand isohaline at or below three locations (Roe Island, Chipps Island, and the confluence of the Sacramento and San Joaquin Rivers) in the western Delta and Suisun Bay areas for a specific number of days depending on water year type.

Overview of Refinements: While increased emphasis must be placed on developing and implementing timely solutions to the fishery concerns in the Bay/Delta ecosystem, implementation of a scientifically unvalidated and/or inflexible standard could have significant environmental as well as economic disadvantages. Any one of a number of approaches could be implemented as an alternative to the proposed salinity standard which would provide equal or better protection to the biological resources with significantly reduced adverse impacts. Some alternatives will be proposed by CUWA and others in the formal comments to EPA, and strong arguments will be made for their economic and biological superiority. If, however, an estuarine habitat standard in the form of a salinity compliance criterion is judged by EPA to be preferred for whatever reason, then consideration should be given to the proposed refinements described in this report and to the phased implementation of the standard while non-State and federal water projects are brought into the regulatory process for complying with the standard.

EPA should modify the proposed estuarine habitat (salinity) standard to further reflect variations in the natural hydrologic patterns. Not only will these hydrologic patterns play havoc in meeting "fixed" standards, but competition for the same environmental water will occur, possibly causing conflict between environmental objectives. For example, adjustments to account for low February through June runoff periods should be made in order to avoid emptying reservoirs to protect downstream migration of winter-run salmon smolts during dry years. The following is a detailed description of CUWA's proposed refinements to the EPA's proposed estuarine habitat standard.

2.2 Adopt a Suisun Estuary Standard, to be Met at Chipps Island and the Confluence, to Ensure that the Entrapment Zone is Located Over a Majority of Suisun Bay, Grizzly Bay, & Honker Bay

Description of the Refinement: Adopt a Suisun Estuary Protection Standard, to be met at Chipps Island and the Confluence of the Sacramento/San Joaquin Rivers, which will provide adequate and appropriate protection, consistent with EPA's stated goal, for the estuarine habitat of Suisun Bay. This will place the entrapment zone (roughly corresponding to an area exhibiting a salinity range of 2 to 12 ppt) over the greatest majority of Suisun Bay, Grizzly Bay, and Honker Bay and their ecologically important shoals, tidal flats and marshes. Placement of the point of compliance any further downstream of Chipps Island, such as the Roe Island/Port Chicago location proposed by EPA, may result in counterproductive environmental measures and could diminish the potential for protection of estuarine functions of concern to EPA.

Basis for the Refinement: The majority of scientific literature suggests that placement of the entrapment zone within Suisun Bay and keeping low-salinity habitat, on average, below the confluence is beneficial to a wide of range of species. This is accomplished by a Chipps Island and Confluence standard. The Roe Island standard proposed places the leading (upstream) edge of the entrapment zone in western Suisun Bay and much of the 2-ppt to 12-ppt entrapment zone downstream, in the confines of the Carquinez Strait, which lack shoals and shallow water habitat, and may have adverse impacts on key estuarine processes such as residence time of nutrients and eggs and larvae in the shallow water habitats of Suisun Bay. A Chipps Island standard is therefore a more appropriate way to accomplish the stated goal of protecting estuarine habitat.

CUWA performed a number of other analyses which suggest that estuarine processes in Suisun Bay are enhanced by outflows which place the calculated average location of X2 near Chipps Island. Outflows of this magnitude: 1) place the turbidity maxima in Suisun Bay; 2) are sufficient to ensure transport of eggs, larvae, and nutrients into the shallow-water areas of the Suisun Bay complex; 3) place the 2-ppt to 14-ppt brackish water zone in the majority of the estuary; 4) provide for mixing of freshwater and saltwater in the estuary and dispersal of eggs, larvae, and nutrients in the estuary; 5) reduce density-dependent predation and competition (by dispersal); and 6) promote increased phytoplankton and zooplankton production by increasing the residence time of nutrients in the shallow-water estuary. (CUWA Reference: Summary)

This finding is consistent with the scientific literature cited by EPA in the reference to its proposed rule:

1. CUWA analysis of riverine productivity (CUWA Reference 8) indicates that primary productivity increases when the calculated average location of X2 is near river kilometer 72, just downstream of Chipps Island.

2. A review of the literature upon which the SFEP based its conclusions indicates that processes such as mixing of fresh and salt water; transport and distribution of eggs, larvae, and juveniles; transport and distribution of food supplies; and other processes necessary for estuarine function should be located in Suisun, Honker, and Grizzly bays, not in the narrow confines of main channels (Sacramento River, San Joaquin River, and Carquinez Strait). Maintaining this mixing zone in the Suisun Bay complex enhances the opportunity for shallow water euyhaline species to thrive.

3. Given that X2 correlates well with these estuarine processes (SFEP 1993), then X2 is a reasonable indicator of estuarine condition at low and moderate outflows.

However, when outflows are higher, and the average X2 is pushed to the western end of Suisun Bay, analysis of the uncertainty in the X2 versus abundance relationships increased dramatically, and the location of X2 explains less of the variance in the data.

1. The variance in abundance indices for some species increases exponentially as the index increases. This suggests that high indices are less reliable predictors of actual abundance than low indices. (CUWA Reference 6)

2. The variance in calculated abundance indices based on the Fall Midwater Trawl data increases significantly for values of X2 less than 70-75. This suggests that predictions of abundance indices may be reliably made from X2 for average locations of X2 upstream of Chipps Island, but that the predictive value of X2 declines rapidly when X2 is located downstream of Chipps Island. (CUWA Reference 6)

3. Comparing the abundance indices versus X2 for Chipps Island and Roe Island, indicates that the amount of variability in abundance explained by X2 increases with downstream movement of X2 for some indicators (*Crangon franciscorum*, striped bass, starry flounder, and longfin smelt) but decreases for other indicators (*Neomysis mercedes*, particulate organic carbon, striped bass survival, and Sacramento splittail). In this comparison, there was no significant difference in variance for delta smelt. This suggests that X2 becomes a less reliable predictor of overall estuarine habitat conditions at the high outflows needed to place X2 downstream of Roe Island than for the moderate outflows needed to place X2 downstream of Chipps Island. (CUWA Reference 6)

4. Comparing abundance indices of other estuarine species to the location of X2 also indicates that X2 does not universally predict abundance. X2 predicts less than 40% of the variance in abundance for delta smelt (r2 = 0.14), jacksmelt (r2 = 0.17), white sturgeon (r2 = 0.07), threadfin shad (r2 = 0.22), topsmelt (r2 = 0.33), and American shad (r2 = 0.36). For topsmelt and threadfin shad, the relationship between X2 and abundance is negative; that is, downstream movement of X2 is associated with a decline in abundance index. (CUWA Reference 6)

Placement of X2 at Chipps Island will Better Protect Delta Smelt: A statistical analysis of the Fall Midwater Trawl abundance data by CUWA indicated that Delta smelt were widely distributed in the Suisun Bay, the Delta, and the Sacramento River within a given month, suggesting that the response of adults to salinity is not entirely predictable. Data from the 1993 Delta smelt sampling program indicate that in summer and fall of 1993 approximately 50% of the Delta smelt population was found upstream of Suisun Bay and 50% was found in Suisun Bay (CUWA Reference 6). Statistics would therefore show it is premature to consider adjusting the estuarine habitat criteria to meet the poorly-defined habitat requirements of a single species.

However, from a biological standpoint, placement of theoretical 2-ppt isohaline (X_2 line) at Chipps Island will place the entrapment zone (roughly corresponding to an area exhibiting a salinity range of 2 to 12 ppt) over the greatest majority of Suisun Bay, Grizzly Bay, and Honker Bay and their ecologically important shoals, tidal flats and marshes[1]. Measurements in these shallow shoals, tidal flats and marshes show that phytoplankton growth rates are ten times as productive as deeper channel areas (Cloern et al 1983, Arthur and Ball 1978-80) and many larval and juvenile fish rapidly grow in these high food densities areas (Moyle and Cech 1988). Correspondingly, for a large part of their annual life span, the Delta smelt utilize the freshwater edge of the entrapment zone, where the salinity is approximately 2-ppt (Ganssle 1966, Moyle et al. 1992, Sweetnam and Stevens 1993). In addition, over the years the Delta smelt have been increasingly subject to entrainment by the State and federal pumps, reverse flows of water in the San Joaquin River, and constriction of habitat in the less productive, deep water river channels of the Delta (Moyle et al. 1992).

Nevertheless, because of the string dependence of Delta smelt on the entrapment zone, and because of the critically low populations of these fish observed during the 1985-92 drought, this species has the greatest to benefit from the X2 standard.

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[1] Testimony of Phillip B. Williams, at the 1987 State Water Resources Control Board Phase I Hearings indicated that when the upper limits of the entrapment zone (2-ppt) is placed at Chipps Island (74 km east of the Golden Gate Bridge), the length of the entrapment zone would be about 16 km, extending throughout Honker and Suisun bays to the Carquinez Strait (58 km). However, when flows are released to meet EPA's proposed Roe Island salinity standard (approximately 28,000 cfs), the entrapment zone is shifted downstream into a less desirable geographic location in terms of optimizing estuarine habitat, the Carquinez Strait. This location of the entrapment zone may result in counterproductive environmental measures and could diminish the potential for protection of the Delta smelt's rearing habitat. Furthermore, this location of the entrapment zone is inconsistent with EPA's stated restoration goal (Federal Register, Jan. 6, 1994, pg. 815 & 820).

Placement of X2 at Chipps Island will Better Protect Winter-Run: The implementation of a proposed standard locating X2 at Roe Island could have significant water costs, with the highest average costs occurring during dry and critical years -- years in which the loss of carryover storage could adversely impact winter-run chinook salmon.

The criteria in EPA's proposed estuarine habitat standard does not account for years that have a wet October through January period and a dry February through June period, or a series of critical dry years in a row which could result in low year-end reservoir storage conditions. DWR modeling analysis indicate a number of years when reservoirs ran out of water and various instream and Delta standards were not met (DWR Modeling Runs September 24, 1994). Analysis of the Roe Island requirement by CUWA, using DWR DAYFLOW records, show that during the 1940-75 period of record chosen by EPA's the proposed Roe Island requirement would have been met less than 50% of the time, for all water year types (CUWA Reference: Summary and #6).

Furthermore, attempting to release the water required to place X2 at Roe Island may increase the frequency of overtopping downstream weirs and cause winter-run smolts to be diverted into the Sutter and Yolo Bypass. Other difficulties include: 1) outlet structure limitations; 2) timing of flows problems; 3) instream riparian use diversions; 4) instream recreational safety concerns; 5) winter-run salmon temperature requirements; and 6) permanent crop root damage concerns, due to higher river stage causing localized increased groundwater levels. A preliminary review indicates that it would be operationally difficult for the Central Valley Project and the State Water Project to meet a Roe Island standard through releases from Shasta, Oroville, and Folsom reservoirs (J. Snow, DWR, and P. Fujitani, USBR, X_2 Modeling Workshop, February 1993; J. Cox, Memorandum, March 2, 1994). A summary of these operational constraints include:

1. Shasta Outflow Constraints: The capacity to release controlled outflow through the Shasta and Keswick Reservoir powerplants is limited to 16,000 cubic-feet per second (cfs). This is further reduced by instream diversions, especially during the spring and summer months. The Sacramento flood control system is also set up to divert flows in excess of 23,000 cfs over Tisdale Weir and into the Sutter Bypass.

2. Oroville Outflow Constraints: The capacity to release controlled outflow through the Oroville Reservoir and Hyatt Powerplant is limited to 17,000 cfs. This capacity is further reduced by constraints pre-1914 instream water right diversions of approximately 5,000 cfs and by permanent crop root damage concerns, due to higher river stage causing localized increased groundwater levels.

3. Folsom Outflow Constraints: The capacity to release controlled outflow through Folsom and Nimbus is limited to 8,000 cfs. However, in recent years due to

recreational safety concerns the City and County of Sacramento have pressured the USBR to limit the total release at Nimbus to 6,000 cfs.

4. Total Controlled Outflow Capacity: The total controlled outflow of Shasta, Oroville, and Folsom reservoirs, considering their respective constraints, is approximately 36,000 to 40,000 cfs.

Comparing this total controlled outflow capacity (of 36,000 to 40,000 cfs) to the flow requirement to meet a Roe Island standard (of 28,000 to 40,000 cfs) places the reservoirs at the edge of their operational limitations. Operating in these tight constraint will not insure that standards can be met on a continuous basis.

Furthermore, the water cost of placing X2 at Roe island will jeopardize the ability of the State and federal water projects to meet the temperature requirements of the winter-run chinook salmon set forth in the National Marine Fishery Service's Winter-Run Biological Opinion.

Placement of X2 at Chipps Island Will Provide Substantial Protection to Other Species: The preponderance of data suggests that placement of the entrapment zone within Suisun Bay and keeping low-salinity habitat, on average, below the confluence is beneficial to a wide of range of species.

Results of periodicity/distribution analysis[2] by CUWA indicate that in the early life stages 14 of the 41 (34%) species for which potential impacts were determined, had at least one life stage which would potentially benefit when X2 is extended downstream to Chipps Island. Extending the X2 to Roe Island would result in additional benefits for many of the same species that benefited under the Chipps Island standard. however, several species are more adversely impacted when X2 is at Roe Island than at Chipps Island. In addition, there is a greater potential for additional species to be adversely impacted under the Roe Island standard (CUWA Reference 5, pg. 38-54).

Comparing the abundance indices versus X2 for Chipps Island and Roe Island, indicates that the amount of variability in abundance explained by X2 increases with downstream movement of X2 for some indicators (*Crangon franciscorum,* striped bass, starry flounder, and longfin smelt) but decreases for other indicators (*Neomysis mercedes,* particulate organic carbon, striped bass survival, and Sacramento splittail). In this comparison, there was no significant difference in variance for delta smelt. This suggests that X2 becomes a less reliable predictor of overall estuarine habitat conditions at the high outflows needed to place X2 downstream of Roe Island than for the moderate outflows needed to place X2 downstream of Chipps Island. (CUWA Reference 6)

[2] Periodicity/distribution analysis represent qualitative predictions of changes in linear amount of suitable habitat present within the upper estuary that would be expected with the implementation of the standards at different locations; Chipps Island, Roe Island.

Furthermore, according to statisticians who have taken a preliminary look at some of the CUWA technical team analyses, we have not proven beyond a traditional statistical doubt the existence of a consistent, discrete discontinuity in the uncorrected aggregate annual abundance index data for several estuarine organisms relative to the location of calculated X_2. On the other hand, the data are strongly suggestive of such a discontinuity, and the same statistical tests do not favor a continuous function over a discontinuous one. In strict statistical terms, it is a standoff. When statistics fail to help us with a choice between alternative interpretations, we are forced to appeal to reason and what we know about the biology of the organisms of interest (i.e. biological good sense). In consideration of the dynamics of the system and the physical attributes of the setting, it is difficult to imagine that there would not be a discontinuity in the relationship between the biology and the location of the entrapment zone, with the 2-ppt isohaline approximating its upstream end, over the majority of Suisun Bay, Grizzly Bay, Honker Bay, and their associated shoals, tidal flats, and marshes. This is at the heart of our interpretation of the uncorrected abundance indices versus average calculated location of X_2. In summary, something biologically beneficial takes place when the average calculated location of X_2 is located at or downstream of Chipps Island, but how far downstream is much less important.

Data for several individual species show rather obvious changes in the behavior of the functions in the general vicinity of Chipps Island or immediately downstream. The nature of these changes differs depending on the species being considered. This is to be expected, however, since each individual species differs both qualitatively and quantitatively in its environmental needs and in its response to environmental perturbations, whether positive or negative.

In several cases, the specific behavior of the data, especially when viewed as a temporal continuum, suggests that if calculated average location of X_2 (the independent variable) is affecting abundance indices, it is as a necessary but not a sufficient influencing parameter. That is, the abundance index may or may not respond to a change in calculated average location of X_2 from one year to the next, depending on what some other, perhaps more important, parameter may be doing. This is suggested by, for example, a sudden increase in variance in the abundance index, coupled with an inconsistent and only occasional response in the index to a significant change in the calculated average location of X_2 from one year to the next. Given the extreme patchiness of the data and severe data analysis problems (see accompanying technical reports by Phyllis Fox and R2 Resource Consultants) leading up to the use of abundance indices by EPA as justification of their proposed standard, the appearance of these discontinuities is a powerful argument for the existence of a point of average calculated location of X_2 past which it does little ecological good to move.

The relatively abrupt change in behavior of abundance index data versus average calculated location of X_2 in the general vicinity of Chipps Island or immediately downstream is evident for 8 of the 9 freshwater sensitive species chosen by EPA to justify their proposed standard. The data suggest that, for species distributed primarily in the Suisun Bay, Grizzly Bay, and Honker Bay complex, average calculated location of X_2 need only be located so as to place the downstream-extending and ecologically important entrapment zone over the majority of this area for optimum biological benefit for the greatest number of estuarine species to be realized and for this estuarine function to be fully protected.

Potential Biological Effects of Refinement: Protection of estuarine species, comparable to EPA's proposed standard, could be provided by meeting a proposed standard at Chipps Island. Also, more protection would be provided to some species by reducing reservoir drawdown (in trying to meet the Roe Island criteria) and preventing the entrapment zone from being shifted too far downstream into Carquinez Strait. In addition, the Suisun Estuary standard would maintain the variability in hydrology which supports biological diversity in the estuary, while maintaining flows adequate to provide transport of eggs, larvae, and nutrients through the Delta and into the Estuary.

Potential Water Requirements: Analysis of the Suisun Estuary standard indicate that average annual water costs would be reduced from approximately 700,000 acre-feet to approximately 300,000 to 500,000 acre-feet. Water costs in dry and critical years would remain in the 1,000,000 acre-foot range.

Analysis of the Roe Island requirement, using DWR DAYFLOW records, show that during the 1940-75 period of record chosen by EPA's the proposed Roe Island requirement would have been met less than 50% of the time, for all water year types.

2.3 Allow Compliance with the Standard to be Measured Three Ways - Daily Average Salinity; Minimum Flow; & 14-Day or 29-Day Average Salinity

Description of the Refinement: Compliance with meeting the requirement of a 2-ppt salinity location in the estuarine habitat standard should be based on the following three measurements: 1) average daily salinity; 2) 14-day or 29-day average salinity; and 3) if a minimum outflow is met (i.e. if the net Delta outflow index is greater than the steady-state outflow calculated to be necessary to maintain the X_2 location at the appropriate monitoring station).

Basis for the Refinement: Controlling the position of X_2 (2-ppt salinity location) on a daily basis in the western portion of Suisun Bay through the use of reservoir freshwater outflows from the Sacramento River presents significant biological, compliance, and sometimes insurmountable operational problems. Factors such as wind, barometric pressure, daily tides, monthly tidal cycles, monitoring artifacts, and operational constraints will affect the ability to reliably comply with the presently proposed salinity standards. For example, according to the San Francisco Estuary Project (SFEP) report entitled, "Managing Freshwater Discharges into the

San Francisco Bay", the amount of flow needed to maintain X_2 at Roe Island (at km 65) is about 28,000 cfs. However, when the position of the X_2 line is drawn upstream by 1 km in one day due to some uncontrollable factor, the amount of water necessary to bring the X_2 line back down to Roe Island within 1 day is considerably higher in the 100,000 cfs range (DWR modeling analysis & CUWA Reference 8).

As previously discussed in Section 2.2, there are numerous operational difficulties in meeting the proposed Roe Island criteria through releases from Shasta, Oroville, and Folsom reservoirs (J. Snow, DWR, and P. Fujitani, X_2 Modeling Workshop, February 1993). These difficulties include: 1) outlet structure limitations; 2) timing of flows problems; 3) instream riparian use diversions; 4) instream recreational safety concerns; 5) winter-run salmon temperature requirements; and 6) permanent crop root damage concerns, due to higher river stage causing localized increased groundwater levels.

The relationship for developing a flow standard can be easily accomplished since the proposed salinity standard relies heavily, if not exclusively, on correlations between abundance indices for selected freshwater sensitive estuarine species and the average location of the theoretical "imaginary" 2-ppt isohaline (X_2) calculated from dayflow information. Thus, the very basis for the EPA position is calculated river outflow (dayflow); the average location of X_2, which is what has been correlated with abundance indices, is itself, in the last analysis, river flow. Actual salinity or conductivity measurements were not used in the generation of any of the correlations used by EPA to support their proposed standard. If flow is the independent variable used as the basis for the correlations, flow would logically be the basis for any standard which purports to address the "dependent" correlates of interest (i.e. abundance indices). To do otherwise is to even further remove the compliance criterion from the objective of designated biological estuarine uses.

From a biological standpoint, neither flow nor the acknowledged surrogate for flow X_2, is the parameter thought to influence those estuarine organisms of interest. The influential parameter is a mixing and distributional process occurring within a large zone, the entrapment zone. As pointed out above, the average location of X_2 (calculated from flow) is a surrogate for the theoretical or "imaginary" 2-ppt isohaline, which roughly corresponds to the upstream edge of this zone, which is generally acknowledged to be significantly in excess of 15 km long. Since this zone is an area of turbulent mixing of two very different water masses, and is characterized by highly variable salinities (with no uniform gradient) between roughly 2 and 12 ppt, it cannot be defined, characterized, located or especially measured by a single salinity. Since the surrogate for salinity used to generate correlations with annual abundance indices, X_2, used by EPA in support of their proposed standard is calculated from flow in the first place, it makes sense to use precisely the same process to generate the standard and measure compliance: a flow calculated to result in an average location of X_2 at a certain compliance point or area.

One of the recommendations of the San Francisco Estuary Project workshop was to allow for "variability" in the position of X_2 to prevent constancy of position (SFEP Report 1993, pg. A-10). The environmental (habitat) variability recommended by these workshop documents, and that variability which makes biological sense, is relatively short-term variability. Such variability revolves around natural daily and/or monthly tidal cycles or seasonal variations and attendant current, salinity and entrapment zone fluctuations. This is the type of "habitat variability" that estuarine organisms are evolved to deal with. EPA has stretched the time horizon of "environmental variability" to span several years, which extends beyond at least one and usually several life cycles of the organisms EPA has chosen to use to justify their proposed standard. This is *far* beyond the time scale of habitat variability to which these organisms could be expected to routinely adjust, in the sense that the cited documents intended. The appropriate kind of habitat variability can be achieved by allowing a range of salinities (i.e. 2-14 ppt) in the most biologically meaningful area (Suisun Bay, Grizzly Bay, and Honker Bay). If the imaginary 2-ppt isohaline is to be used as a justification for a standard, it should be used to justify the calculation of X_2 from flow and the management of flow to manipulate, to the extent practicable, the "calculated average location" of X_2 at or near the upstream end of the Suisun Bay, Grizzly Bay, and Honker Bay complex. This will result in juxtaposing the most biologically beneficial range of salinities with the most biologically beneficial area.

Potential Biological Effects of Refinement: Since the biological basis for proposing the standard was developed from calculated X_2 (based on net Delta outflow) and species abundance relationships by the San Francisco Estuary Project workgroup, the biological needs of the fishery resources would be better met by a flow-based standard than by a surrogate salinity-based standard. Obviously, flow more directly addresses the basis for the correlations. In fact, Delta outflow may have a more direct effect on some estuarine species through larval transport from the Sacramento and San Joaquin rivers to the Suisun Bay, Grizzly Bay, and Honker Bay complex.

Potential Water Requirements: In modeling the water supply impacts of EPA's proposed X_2 salinity standard, a number of uncertainties related to operationally complying with such a standard would require operators to build-in a safety factor (or buffer zone) in order to assure compliance (J. Snow, DWR, and P. Fujitani, X_2 Modeling Workshop, February 1993). These uncertainties included: daily fluctuations in spring- and neap-tidal effects; location of sensors to measure water quality; variance in EPA's equation relating outflow to bottom salinity; and the amount of days it takes reservoir releases to effect salinities at that location. In order to reliably comply with the salinity standards proposed for Roe Island, enough freshwater would have to be provided to meet the objective 4.6 kilometers downstream of Roe Island (DWR Modeling analysis).

The conversion of the salinity standard to a flow standard which is more reliably controlled, would eliminate the need for this built-in safety factor, thus allowing for more reliable estimates of water supply impacts. Based on DWR's modeling results, dated September 22, 1993, the difference in water supply impacts by converting to a flow standard would be approximately 600,000 acre-feet per year in an average year and 1,400,000 acre-feet per year during very dry years.

2.4 Allow Standards to be Modified as Habitat Improvements are Made

Description of the Refinement: Many other factors which contribute to the decline in fisheries abundance and habitat degradation eventually will have to be controlled to meet EPA's goals. Addressing these factors will lead to improvements to habitat and to positive biological response, and thereby produce a healthier environment. Therefore, the proposed estuarine habitat standard which concentrates on water project operations should be modified, as appropriate, once equivalent fisheries habitat or other environmental improvements are provided in the Delta. Examples of some improvements to be considered include:

1. Creating habitat in the Delta by converting islands to habitat for estuarine species and wetlands/riparian areas;

2. Developing conservation easements with purchased water to promote recovery of aquatic/estuarine and riparian/wetland habitat in the Delta and upstream areas;

3. Creating aquatic and riparian/wetland habitat in upstream areas to help restore natural river dynamics. This includes restoring portions of the natural meandering stream corridor and secondary channels through levee-setback programs;

4. Curtailing diversions throughout the watershed during pulse flows to reduce fish entrainment impacts;

5. Removing, consolidating, and screening diversions in the Delta and upstream areas, and/or rehabilitating screens;

6. Modifying fishing regulations (barbless hooks, slot limits, season changes, etc.) to reduce direct take and permit populations to recover;

7. Establishing a nutrient-enhancement program to enhance the primary productivity of Honker, Grizzly, and Suisun bays, without affecting water quality for human consumption;

8. Providing additional funding to implement the Upper Sacramento River Recovery Plan on a priority basis;

9. Providing funding for implementation of genetic conservation hatchery practices, including capital improvements, for the protection and recovery of wild fish stocks;

10. Providing funding to support additional acoustic barrier demonstration projects;

11. Providing funding to implement measures to protect, restore, and enhance natural production of salmon and steelhead trout in tributary streams of the Sacramento and San Joaquin rivers; and

12. Others

Basis for the Refinement: This concept would promote a healthy regulatory process in which biologists and ecologists would be encouraged to develop and restore historical areas of estuarine habitat. The restoration process would also maximize the efficient use of reservoir outflows for the various competing uses. The existing Delta configuration, with channelization and diked islands, contains less habitat area than may be ideal or that existed historically. Increases in spawning and rearing areas with the appropriate salinity could be provided with conversion of selected Delta islands to estuarine/aquatic habitat.

Potential Biological Effects of Refinement: Since the mitigation projects would not receive approval unless they demonstrated an equivalent or net environmental benefit, this refinement would allow implementation of a much more comprehensive set of solutions to the many problems which pose threats to estuarine functions and biota which rely on these functions.

Potential Water Requirements: Due to the varying range of modifications that could be made and their associated implementation schedule, potential water requirements have not been fully analyzed. However, preliminary review indicates that as more restoration measures are completed and habitat conditions are improved, reservoir outflows could be more efficiently utilized and a much broader and more effective management of the estuary and its principal rivers will be possible.

2.5 Develop a Comprehensive Biological Response Monitoring Program That Fully Investigates All Factors Influencing Estuarine Health (e.g. Outflow, Point-Source Pollution, Exotic Species, B.O.D. Loading)

Description of the Refinement: Develop a comprehensive monitoring program, with the assistance of State and federal resource agencies, the scientific community, and biostatisticians to monitor biological response to changes in salinity location to determine whether the standards and the measures used to implement them are having the intended results. In addition, the monitoring program should fully investigate the myriad of other factors influencing estuarine organisms in this system (e.g. nutrient loading, exotic species, pesticides, commercial overfishing, poaching control, point-source pollution discharge, agricultural return flows, entrainment, etc). These agencies would evaluate the existing monitoring programs and include the following revisions, similar to those described in the SWRCB's Draft Water Rights Decision 1630.

1. A baseline monitoring program with new locations and updated equipment for measurement of physical and chemical parameters;

2. An updated, comprehensive summary of all relevant biological surveys that describe trends in the Estuary's resources and recommendations for which biological surveys should be incorporated into a required monitoring program;

3. A program that will provide sufficient information to manage the Estuary on a real-time basis to the extent practicable. This program should include descriptions of locations, equipment, and the coordination that is needed among agencies;

4. A coordinated data management system that allows ready access to physical, chemical, and biological monitoring data through electronic media by the participants in the Interagency Ecological Studies Program (IESP), other agencies, and the public;

5. An intensive effort to reanalyze all relevant historical biological sampling data to eliminate analytical errors and fully account for sampling artifacts and deficiencies and to calibrate and revise sampling programs to avoid such problems in the future; and

6. Creations of a centralized, standardized interactive physical and biological database, such as a Geographic Information System (GIS) database or comparable system, to include the USGS two-dimensional hydraulic model (upgraded to incorporate a three-dimensional model when ready) with historical capability, so that historical site-specific tide, current and salinity information can be generated for each biological sampling effort.

<u>Basis for the Refinement</u>: The purpose of the proposed monitoring program is to determine the effectiveness of the standards and provide a basis for adjustments in the standards as appropriate. The monitoring program should investigate those factors to which estuarine biota respond and the kinds and degree of interactions of these factors in determining the makeup of the estuarine biological community. Furthermore, there is a need for additional research into the relationship between the abundance and distribution of aquatic and wetland marsh species in the Bay/Delta and a full range of potential causative factors. As the SFEP Report notes, EPA is basing its regulatory process on correlations and indicators, and no attempt has been made to establish causal relationships between X2 and abundance and distribution (SFEP 1993).

Such biological monitoring should be coordinated with other ongoing data collection programs such as the San Francisco Estuary Project's monitoring program, the IESP monitoring program, State and federal resource agency monitoring programs, and in conjunction with the Bay/Delta multi-species ecosystem approach proposed in Section 6.1 of this report.

This proposed monitoring program and its associated data management system should allow for appropriate modifications to the proposed standards during the triennial reviews or during shorter review periods. This information would allow environmental scientists to recommend refinements to standards to optimally protect important estuarine functions and all biological resources, and to determine much more accurately and precisely the impacts on competing uses. In addition, it would allow regulatory agencies to demonstrate that their regulatory programs do not prevent the modification of standards when physical improvements are made to other aspects of the Bay/Delta ecosystem to reduce impacts or when scientific analysis indicates changes are appropriate.

Potential Biological Effects of Refinement: The environmental benefit of a comprehensive monitoring program is that it will provide data to support modification of the standards: 1) when changes in physical configurations alter the ecosystem in a manner which would require re-evaluation of the standards; and 2) to reflect changes in understanding of other causative factors including responses of the system to non-flow influences.

Potential Water Requirements: In the near-term, there would be no change in potential water requirements, since this monitoring program does not impact reservoir releases or outflow requirements. In the long-term, this monitoring program would reflect a much more intelligent and well informed approach to water management than is possible with our present state of knowledge.

2.6 Use a Sliding Scale to Determine Achievement of Criteria

Description of the Refinement: In response to the EPA's proposed step function criteria to determine the requirements of EPA's proposed estuarine habitat standard, the California Department of Water Resources (DWR), the State Water Resources Control Board (SWRCB), CUWA, and Dr. William Walker each independently developed a smooth function sliding scale. Although these scales are calculated slightly differently, they all take into consideration water use in the watershed and diversions from the watershed at the level that occurred around the mid-1960s to mid-1970s to reflect conditions of EPA's target period.

DWR's scale, which would determine the number of days the 2-ppt isohaline would be at or downstream of each of the proposed locations, was based on: 1) consideration of the full record (1922-92) of historical hydrologic conditions including the drought years; 2) water use in the watershed and diversions from the watershed at the level that occurred in 1975; 3) a regression equation (and method of least-squares) utilizing all data points to account for the variability of X_2 location; and 4) a forecast of the current unimpaired runoff and antecedent reservoir and runoff conditions, similar to the Sacramento River Index forecast, to determine the transition from one year-type designation to another.

SWRCB's scale was based on: 1) EPA's recommended level of protection for the San Francisco Bay/Delta similar to that which existed during the late 1960s and early 1970s -- SWRCB analyzed the 1964-1976 period; 2) a regression equation (and method of least-squares) utilizing all data points to account for the variability of X_2 location; and 3) the February through June Sacramento River Index.

CUWA's scale was based on: 1) EPA's recommended level of protection for the San Francisco Bay/Delta similar to that which existed during the late 1960s and early 1970s -- CUWA analyzed the 1968-1975 period; 2) a regression equation (and method of least-squares) utilizing all data points to account for the variability of X_2 location; and 3) the February through June Sacramento River Index.

Dr. Walker's scale was based on: 1) consideration of the full record (1922-92) of historical hydrologic conditions including the drought years; 2) water use in the watershed and diversions from the watershed at the level that occurred in 1975; 3) a regression equation (and method of least-squares) utilizing all data points to account for the variability of X_2 location; and 4) a forecast of the current unimpaired runoff and antecedent reservoir and runoff conditions, similar to the Sacramento River Index forecast, to determine the transition from one year-type designation to another.

The methodology for developing an accurate sliding scale function and an appropriate February through June runoff forecast should be developed cooperatively by EPA, DWR, SWRCB, CUWA, the Interagency Ecological Studies Program (IESP), appropriate State and federal resource agencies, and other interested parties. It is recommended that this forecast methodology be based on 90% exceedance values of an appropriate Sacramento River Index and updated on a monthly basis from February through June.

<u>Basis for the Refinement</u>: Use of a smooth function sliding scale, instead of the step function as presently proposed, would be more representative of the naturally occurring continuous hydrologic cycle. Although EPA states in the Federal Register that is inclined to use the smooth function criteria as an alternative to the step function criteria, other refinements should also be considered.

1. In the development of a hydrologic baseline for habitat improvement, EPA's goal was to restore habitat conditions that existed in the late 1960's and early 1970's (USFWS 1992, WRINT-FWS-10). According to EPA, this period generally reflected the conditions that occurred in the Estuary before fish habitat and populations began to experience the most recent significant declines (Federal Register, Jan. 6, 1993, pg. 820). However, in order to provide an adequate representation of the different water year types, EPA proposed the hydrologic period from 1940 through 1975. EPA stated that the hydrologic conditions were fairly consistent during this time and it served as a better indicator for all water year types of the habitat conditions existing in the recommended target years of the late 1960's to early 1970's (Federal

Register, Jan. 6, 1994, pg. 820). However, by selecting this 36-year period, EPA has severely limited the reflection of natural hydrology.

The selection of the 1940-1975 hydrologic baseline period is significantly different from the anti-degradation goals (mid-1960s to mid-1970s) EPA appears to be trying to mimic. Results of hydrologic modeling analysis by DWR indicate that this 36-year period is wetter than the average and would require a significantly greater number of days of compliance, and correspondingly more outflow than should be required (DWR analysis, Jan. 6, 1994). Out of the 36-year period, 55% of the years are classified in the wet to above-normal period, while during the long-term period from 1922-1992, only 42% of the years are classified wet and above-normal. This results in higher outflows of approximately 1.4 million acre-feet during the 1940-1975 period than during the target 1960's to 1970's period. Using the longer period of hydrologic record, 1922-1992, which includes three major droughts, the average outflow would still be 0.5 million acre-feet greater than during the target period. In short, the period of record used by EPA to determine the number of X_2 days of compliance is a significantly wetter period than the target anti-degradation period.

In addition, the period chosen by EPA does not include any critical years and EPA's method for extrapolation of critically dry year criteria is not statistically "credible". EPA should consider some other appropriate hydrologic period. One such hydrologic baseline, that would meet both EPA target period and State and federal anti-degradation goals is the 1975 level of demand simulated over the 1922-1992 hydrologic period.

2. The method of developing the smooth function sliding scale that is proposed by EPA in the Federal Register as an alternative to the step function should be revised. EPA in its initial development of the proposed X_2 standard, used the 1940-1975 hydrology to determine the average the number of days that X_2 occurred at or downstream of the proposed compliance locations. EPA then took the historical "average" number of days for each year type and set the average as the "minimum" value to be satisfied. They then drew a smooth curve through the four averaged data points to calculate the minimum number of days of compliance during a wet, above-normal, below-normal, and dry-year. To develop critical-dry-year criteria, EPA extended that line outside the data points to determine the number of days of compliance. (see Federal Register, January 6, 1994; pg. 835-837). This resulted in a requirement to meet flows at Chipps Island during critical years for 90 days. However, the long-term (1930-1992) average, if the number of days X_2 is positioned between Chipps Island and Port Chicago in critical years, is only about 40 days (DWR letter Nov. 15, 1993).

DWR also performed an analysis of the actual number of days the 2-ppt isohaline was at or downstream of the three locations during the target period, 1964-1976 and during the full period of record, 1922-92. Their analysis indicates that the EPA standard overstates the required days of compliance for all three sites in all water-year types using either the target period or the full period of record.

3. In addition, using the "average" number of days as the basis for a "minimum" standard results in a standard that would require far more outflow than would have actually occurred during the period of record. It is equivalent to making the average grade in a class the minimum grade, effectively "raising the curve." For further clarification of this point, see Section 2 of this report entitled "Calculation of the Number of Days of Compliance." We believe a more statistically accurate method should be used in calculating the minimum number of days of compliance in each year type classification. This could include the use of a regression line and all the data points; it appears that EPA's present method is to draw a smooth polynomial curve through the average of four data points.

4. To determine the transition from one year type designation to another, EPA should use a statistically valid forecast of the current unimpaired runoff and antecedent reservoir and runoff conditions, similar to the Sacramento River Index forecast. It is recommended that this forecast methodology be based on the 90% exceedance values and updated on a monthly basis from February through June. This forecast should be developed in coordination with DWR, IESP, and other appropriate State and federal resource agencies.

Potential Biological Effects of Refinement: From a biological standpoint, a sliding scale approach would more closely mirror the natural monthly variations in flow conditions to which many of the estuarine species of interest have adapted. In addition, although EPA states in the Federal Register that it is inclined to use the smooth function criteria as an alternative to the step function criteria, the refinements to the sliding scale proposed by CUWA would further reduce the potential for biological impacts. These include: reducing the potential for low end-of-year reservoir outflows on migrating Sacramento River salmon and reducing the potential corresponding harm of dewatering newly spawned eggs.

Potential Water Requirements: Analyses to determine the potential water savings of this refinement have not been completed. However, it is anticipated that this refinement would result in a significant savings, particularly in dry and critical years, once these types of natural hydrology conditions are incorporated into the sliding scale function.

2.7 Protect Salmon by Safeguarding Against Empty Reservoirs

Description of the Refinement: Allow for a phased relaxation of the standards when carryover storage in Shasta and Oroville Reservoir reaches levels that could significantly affect temperature for downstream migration of winter-run salmon populations, and well as salmon smolt survival and striped bass spawning. A phased relaxation schedule should be developed cooperatively with the Interagency Ecological Studies Workgroup, the Native Fish Recovery Team, DWR, USBR, and other appropriate State and federal resource agencies.

Basis for the Refinement: The criteria in EPA's proposed estuarine habitat standard is based on replicating the occurrence of desired habitat conditions in Suisun Bay prior to 1976 by maintaining the imaginary 2-ppt salinity line downstream of the three proposed locations for a specific number of days depending on year type (wet, above-normal, below-normal, dry, and critical). However, the development of this criteria does not account for years that have a wet October through January period and a dry February through June period. In addition, it does not account for a series of critical-dry years in a row which could result in low year-end reservoir storage conditions.

DWR completed modeling simulation runs, on September 24, 1993, to evaluate the water supply impacts of EPA's proposed estuarine habitat standard. DWR's analysis indicated a number of years when reservoirs would run out of water and various instream and Delta standards were not met. Unless EPA includes a phased relaxation of its proposed standards for conditions of this nature, not only will compliance with this and other standards be impossible, but the loss of a carryover storage for late summer and fall outflow through the Delta could result in significant upstream salinity intrusion.

Potential Biological Effects of Refinement: Temperature requirements in the upper Sacramento River are critical for the protection of the winter-run salmon population. Low reservoir storage can result in increased water temperatures. Elevated water temperatures threaten downstream fish spawning and incubation. This refinement is an effort to reduce the potential impacts of low reservoir carryover storage.

Potential Water Requirements: Analyses to determine the potential water requirements of this refinement have not been completed. However, since this refinement is concerned only about the trading of water between competing environmental uses, there should be no effective water savings.

2.8 Measure Salinity One Meter from the Surface to Accurately Reflect Conditions Where Estuarine Organisms Are Found

Description of the Refinement: Achieving compliance with this estuarine habitat standard through salinity should be measured one meter below the water surface. Therefore, a 2.0 ppt bottom salinity standard (1.76 ppt surface salinity) will be met when surface electrical conductivity (EC) is 3.4 mS/cm (using the Accerboni and Mosetti conversion equations). This will provide a more ecologically significant and accurate measurement of estuarine health, and reflect conditions where estuarine organisms are found.

Basis for the Refinement: EPA's proposal recommends that the 2-ppt salinity standard be measured one meter off the channel bottom at each of the three proposed locations. The basis for this recommended location is that near-bottom salinity is a more stable indicator than surface salinity (SFEP Report 1993). However, a summary of scientific evidence recommends that surface salinity is a more ecologically significant and accurate measure of estuarine health.

1. Past studies conducted by the U.S. Geological Survey (USGS) and DWR indicate that mixing and turbulence provide neither a uniform nor easily measurable correlation between surface salinity and bottom salinity. In DWR Bulletin 31, *Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay*, DWR noted that the salinity measurements at different depths over a tidal cycle often cross; that is, the salinity at the bottom is sometimes higher and sometimes lower than salinity at the surface. This indicates that there is significant mixing, caused by the tides, freshwater outflow, currents, wind, barometric pressure, uneven bathymetry, and channel geometry. This finding is consistent with the discussions of the entrapment zone in the SFEP workshop reports, and with USGS comments that the relationship between salinity and circulation in the estuary has not been documented (J.R. Burau, USGS, pers. comm.). This is the kind of variability in habitat parameters, including salinity, to which estuarine organisms are adapted.

2. Measuring or calculating salinities near the bottom in deep water is not scientifically justified and would not provide ecologically meaningful information in judging the "health of the estuary." Fall midwater trawl studies conducted by the California Department of Fish and Game (CDFG), from which much of the data used by EPA in support of their proposed salinity standard are taken, included measurements of "surface" salinities at the time and place of sampling. Although these salinity measurements were never used in the correlations with annual abundance indices cited by EPA (average location of X_2 calculated from dayflow was used instead), these data were used by CDFG in correlations presented in the Delta Smelt Biological Assessment. This was primarily because surface salinities more accurately reflect conditions where Delta smelt and many other freshwater sensitive estuarine organisms are found -- surface layers and shallow water areas over shoals. In this regard, it is important to note that the USGS has determined that salinities measured near the bottom in deep water areas especially channels, are not nearly as reflective of salinities (and natural variabilities in salinities) in ecologically important tidal flats and shoal areas as are surface salinities.

3. Measurements of phytoplankton growth rates show that shallow areas are ten times as productive as deeper channel areas (Cloern et al 1983). In addition, phytoplankton densities are higher when the entrapment zone, which is the area where salinities are highly variable and range between roughly 2 and 12 ppt, is within the relatively shallow bays rather than when it is further upstream or downstream in deeper channels (Arthur and Ball 1980). Furthermore, many young fish require high food densities in order to obtain sufficient food for growth (Moyle and Cech 1988). These scientific findings show that measurements of salinity properties in the shallow bay areas, that range in depths between 1 and 3 meters, would be a more significant indicator of estuarine health and preferred habitat than measurements in deeper areas;

4. It is not clear at what cross-sectional location EPA wants to measure the bottom salinity. Due to the varying depths of the main channel and the shallow bays, this could have significant impacts on the ecological significance of the data, the calculated position of the 2-ppt isohaline, and on the costs of operating and maintaining the monitoring equipment. If one wishes

to assure biological success, one should be concerned with parameters where aquatic species are located.

Potential Biological Effects of Refinement: If compliance with a standard is tied to monitoring bottom salinities in the neighborhood of 2-ppt in deeper areas in Suisun Bay (i.e. in channel areas near Roe Island), the resulting salinity range in the great majority of the Suisun Bay complex, including Grizzly Bay and Honker Bay and associated tidal flats and shoal area, will not correspond to that which is optimal for biological activity. This is clearly shown by the USGS modeling effort. The consequence will be that the entrapment zone will be pushed into Carquinez Strait, which has virtually no productive shoals and tidal flats, and overall potential biological benefits will be lost.

Potential Water Requirements: Due to the complexity of the mixing zone (entrapment zone) caused by tidal strength, freshwater outflows, currents, wind, barometric pressure, uneven bathymetry, and channel geometry, modeling simulations to determine the potential water requirement of this refinement have not been completed and would be difficult to produce without extensive 3-D hydrodynamic and salinity studies. Those modeling efforts which have been completed (e.g. USGS two-dimensional model and preliminary three-dimensional modeling efforts) strongly suggest that the water requirements would be extremely high. This is primarily because of the saltwater intrusion into deeper channel areas that occurs on most flood-tide conditions.

2.9 Utilize the Recessional Portion of the Peak Spring Tidal Series to Maximize Freshwater Benefit

Description of the Refinement: Utilize timed pulse flows and the recessional portion of the peak spring tidal series over a period of several days to improve the effectiveness of influencing the location of the interface of salt and freshwater masses (the entrapment/mixing zone).

Basis for the Refinement: According to USGS research and modeling, sustained pulse outflows could be timed with the recessional portion of the peak spring tidal series over a period of several days to greatly improve the effectiveness of influencing the location of the interface of salt and freshwater masses (the entrapment/mixing zone). This phenomenon results from the progressively shorter upstream excursion of the fresh/salt interface and the additive incremental effect of increased river flows with each successive high tide, like compound interest, on the net movement of the interface in a downstream direction. During other parts of the tidal series, operational changes in freshwater outflow are overwhelmed by tidal flux and are essentially ineffective in influencing the location of the entrapment zone or any of its surrogates (e.g. X_2).

Real-time monitoring could be used to determine when pulses should be released to reflect the specific needs of target species within the Estuary. When combined with restrictions on urban and agricultural diversion, pulses would result in lower direct take of target species within the watershed.

This refinement would also involve changing the beginning and end of the regulatory period somewhat each year to correspond to changes in the calendar timing of the lunar tidal cycle. Under this proposed refinement, the regulatory period would begin on the day of the first peak high tide of the spring tide series associated with a new moon after January 15th each year, and last through five lunar cycles. Since the peak spring tide associated with a new moon occurs 11 days earlier each year, the beginning of the regulatory period would vary between mid-January and mid-February, but would average about the first of February. This corresponds with the general thrust of the EPA proposal, but is much more closely aligned with natural estuarine processes. This refinement has the added advantage of consistently encompassing the maximum number of periods during which operational adjustments could be effective -- six. Any other approach would usually encompass five such periods, with six only rarely occurring when a lunar tidal maximum happened to fall on the first of February.

Note, after further review of documentation on lunar tidal cycles, the actual length of the cycle is 29.54 days, or approximately 29-days, not 28-days (Hutchinson and Sklar, Estuaries, December 1993).

As indicated above, maximizing the effectiveness of outflow adjustments to achieve desired conditions, and maximizing the number of effective occasions within any one regulatory period, will maximize the probability of salutary biological effects. This is especially true with respect to transport and distribution of larval and juvenile forms to the productive shoal, tidal flat, and marsh areas in Suisun, Grizzly, and Honker bays.

Potential Biological Effects of Refinement: Providing timed pulse flows allow larvae and young-of-year to be transported out to their rearing habitat in Honker, Grizzly, and Suisun bays. When combined with restrictions on urban and agricultural diversions, pulses would result in lower direct take of target species within the watershed.

Potential Water Requirements: Although analyses to determine the potential water requirements of this refinement have not been completed, utilization of the natural tidal cycle is anticipated to have significant water savings.

2.10 If a Roe Island Standard is Promulgated, Trigger with a Natural Storm Event

Description of the Refinement: If EPA promulgates a Roe Island salinity standard, a natural storm event should be utilized to trigger a calculated salinity standard at Roe Island.

Basis for the Refinement: A natural hydrologic trigger to activate the Roe Island salinity standard is important because it would take advantage of natural antecedent condition, as opposed to requiring the CVP, SWP, and other operators to attempt to create such a condition through controlled releases.

The following is a list of specific questions regarding this topic asked by EPA in their "Request for Comment" section in the Federal Register (Jan. 6, 1993, pg. 840). These include:

1. Would a trigger at some upstream site, such as Middle Ground, retain the desired link to storm events while ensuring a more frequent triggering of the standard?

2. Should the criteria be triggered only by storm events actually occurring in the February through June period?

3. Should the trigger be stated as a single day when mean salinities are less than 2-ppt, or by a longer averaging period (14 days, 28 days, etc.)?

4. Should the need to consider a trigger be eliminated by setting a criteria at a location further upstream? Both USFWS and USBR have suggested developing a criteria at Middle Ground (68 km). At this location, the criteria would be triggered in all but critical years and would thereby provide an increased level of protection overall.

The CUWA technical workgroup has reviewed these questions and provides the following answers:

1. The recommended Suisun Estuarine Standard would be triggered at Chipps Island and the Confluence of the Sacramento and San Joaquin rivers. If Roe Island criteria are established, a trigger at an location farther upstream such as Middle Ground Island would still require outflows in excess of those controllable by water users to move the 2-ppt isohaline downstream from Middle Ground Island to Roe Island.

2. A triggering event in January is also an inappropriate method because there is a potential that a short-term episode of high flow could trigger the standard. A January trigger would be feasible only if the triggering were based on a 14-day or 29-day averaging period.

3. Compliance with meeting the requirement of a 2-ppt salinity location in the estuarine habitat standard should be based on the following three measurements: 1) average daily salinity; 2) 14-day or 29-day average salinity; and 3) if a minimum outflow is met (i.e. if the net Delta outflow index is greater than the steady-state outflow calculated to be necessary to maintain the X_2 location at the appropriate monitoring station).

4. Moving the location of the Roe Island criteria to Middle Ground (kilometer 68) would not, as EPA suggests, have an adverse impact on San Pablo Bay. The outflows necessary to push the 2-ppt isohaline into San Pablo Bay are in excess of those controllable by the various water projects and diverters. As Kimmerer (SFEP Report 1993) notes, the relationship between outflow and the location of X_2 is not linear, and outflows of over 43,000 cfs are needed to sustain X_2 at kilometer 60. Much larger outflows are necessary to push freshwater into San Pablo Bay and to place and sustain low-salinity habitat in this location.

Potential Biological Effects of Refinement: This triggering refinement would allow initiation of a standard intended to protect biological resources in a manner that reflects the type of protection provided by nature. It would also protect against adversely affecting other species, such winter-run salmon, by preventing large reservoir drawdowns which could potentially result in high water temperatures in other periods of the year.

Potential Water Requirements: Although analyses to determine the potential water requirements of this refinement have not been completed, utilization of storm triggers could provide significant water savings.

2.11 If a Roe Island Standard is Promulgated, Permit Compliance Gaps in the Standard to Eliminate Anomalous Meteorological Events

Description of the Refinement: If EPA promulgates a Roe Island salinity standard, then EPA should allow for gaps in complying with the moving average to eliminate uncontrollable days of extreme and anomalous meteorological events. With this refinement, days on which extreme meteorological conditions interfere with achieving the 2-ppt criteria at Roe Island would only be counted as days of meeting the criteria upstream at Chipps Island. This approach could be applied only until all days that are required at the upstream site are met.

Basis for the Refinement: The criteria for measuring compliance with a moving (rolling) average should allow for discontinuities in the averaging period. Extreme events, such as short-term salinity intrusions due to high wind combined with extreme tides and other factors, may trigger compliance problems by skewing the moving average. This would result in a requirement to release large amounts of water when, in fact, such releases would not be needed to maintain the position of the 2-ppt isohaline without these anomalies. In fact, reservoir releases would have little effect on these extreme events, and would be better reserved to meet fishery needs when these anomalies are not present.

Furthermore, adding large reservoir releases to already large natural outflows could result in outflows which would have adverse impacts on brackish water species, which require higher levels of salinity (CUWA Reference 5&6). It is important to note that adopting a standard based on flow calculated to result in an average location of X_2 at a compliance point or area, as recommended elsewhere in this document, would eliminate any need to allow for compliance gaps in the standard.

Potential Biological Effects of Refinement: Since the refinement does not change the total number of days of meeting the standard at the proposed sites, there should be no significant detrimental biological effect. Extreme and anomalous events, such as tides and strong westerlies, are natural processes which produce natural variation in estuarine conditions to which estuarine species are presumably adapted. Estuarine conditions such as higher salinity and turbidity which are produced by these events are largely independent of outflow conditions, according to USGS researchers.

Potential Water Requirements: Based on DWR's X_2 modeling analysis, inclusion of this refinement in the proposed estuarine habitat salinity standard would reduce the need for a buffer zone of 4.6 kilometers to meet the proposed standard at Roe Island on a continuous basis. Therefore, according to DWR the water supply savings of this refinement could be substantial.

3. PROPOSED REFINEMENTS TO EPA'S STRIPED BASS SPAWNING SALINITY STANDARD

3.1 Summary

Background: In May 1991, the State Water Resources Control Board (SWRCB) approved salinity objectives to protect the upstream migration and spawning of adult striped bass. These objectives included establishing a 1.5 mmhos/cm electrical conductivity (EC) at Antioch, and a 0.44 mmhos/cm EC at Prisoners Point in April and May. In addition, the SWRCB proposed several alternative standards to protect spawning conditions upstream of Prisoners Point, on the San Joaquin River. In September 1991, EPA disapproved this criteria stating that they were not adequate to protect spawning striped bass in a reach farther upstream between Prisoners Point and Vernalis on the San Joaquin River.

The SWRCB addressed EPA's recommendations to maintain spawning conditions in the reach between Prisoners Point and Vernalis in its draft Decision 1630. The SWRCB concluded that:

> "Maintaining the additional spawning reach between Prisoners Point and Vernalis would require a substantial amount of water in dry and critical years. Under the current regulatory scheme, this water would have to come from New Melones Reservoir, which already is heavily committed to supplying water from salinity protection and pulse flows in the southern Delta." (SWRCB D-1630, April 1993)

Rejecting SWRCB's reasoning for not approving salinity objectives that would protect the upstream migration and spawning of adult striped bass between Prisoners Point and Vernalis, EPA proposed a striped bass spawning standard for the San Joaquin River. The proposed salinity standard is based on the following criteria:

> "The 14-day running average of the mean daily EC shall not be more than 0.44 mmhos/cm EC for the period April 1 to May 31 in wet, above-normal, an below-normal years at the following stations: Jersey Point, San Andreas Landing, Prisoners Point, Buckley Cove, Rough and Ready Island, Brandt Bridge, Mossdale, and Vernalis. In dry and critical water years, the criteria are required only in the reach between Jersey Point and Prisoners Point, as measured at Jersey Point, San Andreas Landing, and Prisoners Point." (Federal Register, Jan. 6, 1994, pg. 827)

To support its proposed spawning standard, EPA refers to studies that indicate the location and time of spawning appear to be controlled by temperature and salinity. EPA cites research by the California Department of Fish and Game asserting that "striped bass spawn successfully only in freshwater with electrical conductivities less than 0.44 millimhos per centimeter electroconductivity (mmhos/cm EC), and prefer to spawn in waters with conductivities below 0.33 mmhos/cm. Conductivities greater than 0.55 mmhos/cm appear to block the upstream migration of adult spawners." (Federal Register, Jan. 6, 1994, pg. 826). EPA also cites literature by Farley, Turner, and Radtke, that high salinity can block migration of striped bass up the San Joaquin River, thereby reducing spawning, which could also reduce survival of bass eggs.

Overview of Refinements: While the proposed striped bass spawning standard is cognizant of dry and critical year flow conditions (i.e. the proposed rules does not require the spawning criteria for the upper reach of the San Joaquin during dry and critical years), meeting the criteria during wetter years has the potential for significant water supply impacts. Whether proposing an "all year" rule or not for the upper reach, EPA has not adequately addressed the causes of salinity degradation in the southern Delta, and has instead set an objective which, because of limits to enforcement authority over dischargers in the area, may lead to demands for dilution flows rather than through source correction. SWRCB stated in draft Decision 1630 that:

> "Salinity between Vernalis and Prisoners Point is influenced primarily by discharges of salty agricultural return flows, not by intruding ocean salinity. Thus, water supplied to dilute the salinity in this reach would primarily be used to dilute pollutants. If the State Water Board is to assure the maximum beneficial use of the State's water supplies, it should not require releases of water supply for the purpose of diluting pollutants except when those water quality standards cannot be achieved solely by controlling waster discharges. To protect spawning habitat during the spawning period, *the appropriate way to regulate salinity caused by agricultural discharges in this reach is by regulating the discharges.*" (emphasis added)(SWRCB Decision 1630, April 1993, pgs. 44-45)

In the April 1993 Draft Decision 1630, SWRCB staff evaluated its proposal concerning maintenance of the EPA-recommended salinity level of 0.44 mmhos/cm EC between Vernalis and Jersey Point. SWRCB found that:

> "This decision (draft Decision 1630) will protect striped bass spawning at the EPA recommended salinity level of 0.44 mmhos/cm EC in the reach from Vernalis to Jersey Point during a substantial part of the spawning period in wet, above-normal, and below-normal water years. During some parts of the spawning period this salinity will not be met in the entire reach. In dry years Vernalis salinity will probably be on average slightly higher, at 0.46 during the pulse flow, and somewhat higher yet during the rest of the spawning period. The dry year regime likely will not significantly impair spawning success. In critically dry years, 0.44 mmhos/cm EC is not expected to be met between Prisoners Point and Vernalis. While the entire spawning reach will not be protected during the entire spawning period each year, this decision will substantially improve spawning habitat over the levels that could occur under D-1485. This decision will provide water quality in the reach between Vernalis and Jersey Point which is comparable to or better than the levels which existed in or before 1975, the base date for

the antidegradation policy under the Clean Water Act." (SWRCB D-1630, April 1993, pg. 105)

SWRCB staff has specifically commented on the proposed EPA criteria for striped bass spawning (SWRCB D-1630, April 1993). Interpretation of their analysis and findings leads to a conclusion that EPA's proposed criteria for the striped bass would be establishing a water quality condition in the San Joaquin River which greatly exceeds the condition that existed during the period 1964 to 1976, which is stated to be EPA's assumption for antidegradation regulation. (CUWA Reference 12)

EPA's proposal of 0.44 mmhos/cm EC will be difficult, if not impossible, to meet with the Delta Cross Channel closed as required by the winter-run chinook salmon Biological Opinion. Without higher quality Sacramento River water conveyed through the Delta Cross Channel, the San Joaquin River between Jersey Point and Prisoner's Point would have higher concentrations of agricultural return flows and therefore higher EC.

A review of 1993 operations of the San Joaquin River and its tributaries by CUWA indicate that the proposed spawning criteria would be difficult, if not impossible, to meet even in a year classified as wet. During April and May 1993, over 100,000 acre-feet of supplemental flows were released down the San Joaquin to meet SWRCB water quality requirements and salmon smolt pulse flow requirements in the winter-run Biological Opinion. If EPA's salinity criteria of 0.44 EC was required during 1993, it would have only been met for a few days during this period. The amount of "additional supplemental" water needed to comply with EPA's proposed criteria at Vernalis during 1993 was estimated to exceed 150,000 acre-feet. (CUWA Reference 12)

The U.S. Bureau of Reclamation believes that it would be of little use to expand striped bass spawning habitat in the San Joaquin River. Evidence indicates that under present conditions striped bass are not spawning habitat limited (letter USBR to SWRCB August 22, 1990). An examination of the 0.44 EC data on the San Joaquin River using the same sources cited by the California Department of Fish and Game (WQCP DFG Exhibit 25) concluded that "there is no evidence that striped bass spawning is limited at the present time (Hanson HTE-73)." Until more efficient screens are constructed to isolate export pumping from the southern Delta channels, increased spawning habitat past the confluence of the San Joaquin and Old/Middle rivers could cause increased entrainment in the pumps and is unlikely to benefit striped bass numbers.

Turner and Farley in 1971 also examined the hatching rate of striped bass eggs placed in varying degrees of salinity. For electrical conductivities (EC) less than 3.0 mmhos/cm the hatching rate was 95% (Turner & Farley 1971; Morgan 1981; Hanson 1990). The 3.0 mmhos/cm EC is considerably higher than the 0.44 mmhos/cm proposed by EPA. Thus it is reasonable to conclude that striped bass eggs can also tolerate a wider variety of salinities.

The use of real-time monitoring can help determine when the majority of striped bass have completed spawning and therefore allow use of reservoir release savings for other purposes.

In addition, implementation of a standard will increase predation on several endangered species. This is inconsistent with the requirements of the federal Endangered Species Act. An introduced species, striped bass are predators of two threatened or endangered species -- winter-run chinook salmon and delta smelt. Actions to increase their population are not justified because such actions may adversely impact these species. The goals sought by EPA to provide a desirable habitat for the striped bass in the San Joaquin River through source pollution control will improve that habitat. Furthermore, providing water for striped bass spawning could reduce the water available for delta smelt and winter-run chinook salmon.

The following is a detailed description of CUWA's proposed refinements to EPA proposed striped bass spawning standard.

3.2 Focus on Water Quality Discharges in the San Joaquin River in Lieu of a Striped Bass Spawning Standard

Description of the Refinement: The proposed rule should address the concerns of causes of salinity degradation in the southern Delta by promulgating a standard which improves water quality discharges in the San Joaquin River. Although dilution of highly saline discharges is effective in wet years, it has little to no effect and corresponding biological benefit in dry runoff years. This refinement would also allow more prudent use of SWP and CVP reservoir releases.

Basis for the Refinement: SWRCB stated in draft Decision 1630 that "salinity between Vernalis and Prisoners Point is influenced primarily by discharges of salty agricultural return flows, not by intruding ocean salinity." It is, therefore, more appropriate to solving the root problem through point-source pollution control programs rather than trying to dilute it through increased outflow. (See Summary 3.1 for additional reasons for the basis of this refinement.)

Potential Biological Effects of Refinement: Although dilution of highly saline discharges may be technically feasible in wet years, it has little or no effect and corresponding biological benefit in dry runoff years.

Potential Water Requirements: This refinement would allow more prudent use of reservoir releases.

3.3 If a Striped Bass Spawning Standard is Implemented, Allow Relaxation of the Standard During Dry & Critical Years

Description of the Refinement: EPA's proposal would require 0.44 mmhos/cm EC on the San Joaquin River between Jersey Point and Prisoner's Point in all years. This requirement should be modified to allow for a relaxation of the standard to 0.55 mmhos/cm EC during dry and critical years. In addition, the standard should be in place for the duration of the critical spawning period and discontinued once monitoring has determined that the majority of the spawning has occurred.

Basis for the Refinement: The basis for this recommendation are discussed in the striped bass summary, Section 3.1.

Potential Biological Effects of Refinement: The refinement would allow higher EC conditions in the spawning areas of the San Joaquin River, but would not be high enough to limit spawning habitat area and spawning activity for existing populations of adult striped bass.

Potential Water Requirements: This refinement would allow more prudent use of reservoir releases in water short years for all species, particularly native species in the Bay/Delta including winter-run salmon.

3.4 If a Striped Bass Spawning Standard is Implemented, Allow Standards to be Modified as Habitat Improvements are Made

Description of the Refinement: Allow proposed 0.44 mmhos/cm EC for striped bass spawning to be modified to 0.55 mmhos/cm EC once the Delta is modified to provide better habitat area.

Basis for the Refinement: Striped bass which are spawning will move to locations where salinity and other habitat conditions are desirable. The existing Delta configuration, with channelization and diked islands contains less desirable habitat area than may be ideal. Improvements in spawning area at the required range of spawning salinity can be provided with conversion of selected Delta islands to fisheries habitat.

Striped bass are a fish which fertilize the eggs outside of the bodies, so a congregation of bass is most beneficial to spawning. The more bass that will congregate in an area, then the better genetic diversity will occur due to more fish participating in the reproductive process (Chadwick 1991). This explains why in years of lesser salinities throughout the reaches of the estuary there is not an expansion into upstream areas (Turner 1976).

Potential Biological Effects of Refinement: Preliminary analyses indicate no effect on striped bass, since the spawning adults would have an equivalent spawning area in the desired salinity range. Other species could be provided greater protection such as winter-run in the Sacramento River if reservoir releases are conserved for temperature.

Potential Water Requirements: The water cost of the striped bass spawning objective can be reduced as habitat conditions are improved to allow more area with required salinity regimes.

4. PROPOSED REFINEMENTS TO EPA'S SALMON SMOLT SURVIVAL INDEX

4.1 Summary

Background: In May 1991, the State Water Resources Control Board (SWRCB) approved temperature criteria in their Bay/Delta Water Quality Control Plan designed to protect salmon on both the Sacramento and San Joaquin rivers. This temperature criteria was in addition to the minimum flow criteria set forth in the 1978 Delta Plan. The SWRCB new criteria included: 1) a maximum temperature of 68°F at Freeport and Vernalis from April 1 through June 30 and September 1 through November 30 to protect fall-run salmon; and 2) a maximum temperature of 66°F at Freeport from January through March to protect winter-run salmon. In September 1991, EPA disapproved this criteria and recommended that the SWRCB adopt a 65°F criterion, or an alternative that was scientifically defensible.

Asserting that SWRCB's temperature criteria are inadequate, EPA is proposing salmon smolt survival criteria for both the Sacramento and San Joaquin rivers. For the Sacramento River, the proposed survival criteria are based on a USFWS mathematical model that predicts migration success of the fall-run population, and relies on the relationship between smolt survival and three factors: temperature, diversion out of the mainstem Sacramento River, and State and federal water project export rates (Federal Register, Jan. 6, 1994, pg. 823). For the San Joaquin River, the proposed survival criteria are based on a mathematical model that is based on flow at Vernalis, State and federal water project export rates, and diversion into the head of Old River (Federal Register, Jan. 6, 1994, pg. 823).

To implement this criteria, EPA recommends the approach suggested by the Five Agency Chinook Salmon Committee. For the Sacramento River these implementation measures include:

1. Closure of the Delta Cross Channel from April through June;
2. Closure of Georgiana Slough from April 15 to June 15; and
3. Minimum Sacramento River flow at Rio Vista of 4,000 cfs from April through June.

For the San Joaquin River these implementation measure include:

1. A range of flows from 2,000 to 10,000 cfs at Vernalis from April 15 to May 15;
2. Requiring minimum flows of 1,000 cfs at Jersey Point from, April to June, except from April 15 to May 15, when higher flows from 1,000 to 3,000 cfs would be required; and
3. Placing a full barrier at the head of Old River from April through May.

Overview of Refinements: The Salmon Smolt Survival Index proposed by EPA was developed by the U.S. Fish and Wildlife Service (USFWS), which has often noted that there are limits to its application. Analysis by CUWA indicate that the foundation of the equation and its supporting theories appear questionable and highlight concerns that this is not a reasonable index for the kind of regulation proposed by EPA. This is consistent with comments by the U.S. Fish and Wildlife Service who developed the indices and have often noted that there are limits to its application. Analysis by CUWA indicates:

1) A number of statistical errors in the mortality equations that invalidate their uses as probabilities, in effect rendering the output results meaningless;

2) The estimates of survival used by the USFWS are highly variable and have not been sufficiently validated to be used in developing smolt survival criteria;

3) Estimates of survival for an individual tag group exceeds 100% for some tag groups using the existing methods of analysis. The correction factor applied to these estimates to scale the data down under 100% statistically invalidates the regression equations and corresponding output results;

4) There are a number of other sources of potential mathematical error in the index equation for the Sacramento River. For example, adjusting the sampling width of the trawl used to collect data on the smolt abundance, as discussed by USFWS in their testimony to the SWRCB (USFWS Exhibit 31) and placing 95% confidence intervals on the predicted smolt survival indices changes the resulting prediction by approximately 100% -- in effect, rendering the proposed standards output values meaningless; and

5) There are numerous mathematical compliance scenarios that can be calculated from the proposed standard, based on reasonable operational assumptions, that do not help the salmon smolts from a biological sense. For example, if you assume exports are zero and attempt to reduce mortality to zero on the Sacramento River using the equations in the proposed standard, you get very different results;

Furthermore, not only should these standards be reconsidered as to their practicality, but also for their attainability. Analysis of the proposed standards, given reasonable operational and flow conditions in the spring, indicate that the standards will be violated in most years and may not be met under no export conditions. Increasing exports above zero only increase the number of violations according to the calculated Sacramento River Salmon Index (CUWA Reference 3). In short, it is beyond the capability of the upstream operators to control the index result, due in part to the fact that temperature at Freeport is a dominant factor in calculation of the index, and water temperature at this location is controlled by ambient air temperature, not factors under human control.

Temperature model studies of the Sacramento River conducted by the U.S. Bureau of Reclamation indicate that to reduce temperatures to 68° Fahrenheit in the Sacramento River during May and June would require significantly large releases from storage reservoirs and may, in some circumstances, be impossible to meet. For example, to achieve a one degree Fahrenheit reduction in temperature in the Sacramento River at Freeport during May and June could require releases from Shasta Reservoir of more than 400,000 acre-feet. A three degree Fahrenheit reduction in temperature could require outflows in excess of one million acre-feet during the same period (WQCP USBR Exhibit 127). Clearly, it is highly questionable whether controlled reservoir releases can lower Sacramento river temperatures to meet the either: 1) the Freeport temperature factor in the Sacramento River Salmon Index equation; or 2) the EPA's September 1991 recommendation that the SWRCB adopt a lower temperature criteria of 65°F. Studies of the capability of reservoir outflows to manage temperatures on the San Joaquin River is no greater and perhaps less than that on the Sacramento River.

The same deficiencies exist in the practical application of the proposed San Joaquin River Salmon Index. Neither index adequately represents the biological response of salmon to river and delta operations.

4.2 Develop a Chinook Salmon Habitat Management Plan in Lieu of a Salmon Smolt Survival Index

<u>Description of the Refinement</u>: The proposed rule should allow for the development of a habitat management plan in lieu of a salmon smolt survival index to achieve the EPA's desired goals of protecting the survival of salmon smolts on the Sacramento and San Joaquin Rivers. This management plan should be developed by the appropriate federal and State agencies and implemented under their separate authorities. Consideration should also be given to developing a management plan in combination with the ongoing Central Valley Project Improvement Act Anadromous Fish Restoration Plan being implemented by the U.S. Fish and Wildlife Service.

<u>Basis for the Refinement</u>: See Summary 4.1 to review the basis that this chinook salmon habitat management plan was proposed in place of the salmon smolt survival index.

<u>Potential Biological Effects of Refinement</u>: The proposed chinook salmon habitat management plan, in coordination with the USFWS's Central Valley Project Improvement Act's Anadromous Fish Restoration Plan, will provide a comprehensive restoration plan to ensure an understanding of the factors which are causally related to salmon smolt survival.

<u>Potential Water Requirements</u>: In the long-term, a habitat management effort will resolve environmental issues in a permanent and proactive manner while minimizing water costs and maintaining operational flexibility for the State in the management of its water resources.

4.3 If a Salmon Smolt Survival Index is Promulgated, Allow Standards to be Modified as Habitat Improvements are Made & As Additional Research is Completed

Description of the Refinement: If a salmon smolt survival index is promulgated, allow standards to be modified as habitat improvements are made and as additional research is completed.

Basis for the Refinement: Salmon smolts will move to locations where habitat and feeding conditions are desirable. Modifications to improve salmon habitat on the Sacramento and San Joaquin rivers can be accomplished at a reduced impact to water users. Furthermore, as additional research is completed on the factors that are causally related to salmon smolt survival and as updated statistical analyzes are completed, it is imperative that this new research be considered for modification of the standard.

Potential Biological Effects of Refinement: Preliminary analyses indicate no effect on salmon smolts, since the spawning adults and smolts would have an equivalent spawning and rearing area in the desired habitat range. Other species, such as winter-run, could be provided greater protection if reservoir releases are conserved for cold-water temperature releases.

Potential Water Requirements: The water cost associated with implementation of the salmon smolt survival index standard can be reduced as habitat conditions are improved to allow more area with required habitat regimes.

5. PROPOSALS FOR IMPLEMENTATION STRATEGIES WHICH MINIMIZE ECONOMIC IMPACTS

5.1 Summary

Decisions about implementation can dramatically reduce the cost of standards to protect the San Francisco Bay/Delta Estuary. In fact, EPA sponsored studies conducted by researchers at the University of California show that appropriate implementation methods can reduce the cost by two-thirds. Among the benefits are: 1) relying more on market forces to accomplish Bay/Delta environmental objectives; 2) spreading obligations out over all responsible parties, thereby reducing burdens on State and federal project users; and 3) incorporating mechanisms to develop a phased compliance schedule for standards. These objectives can be accomplished by the following:

5.2 Adopt a Narrative Estuarine Habitat Standard Through SWRCB That Allows for a Range of Desired Estuarine Habitat for the X_2 Standard

Description of the Refinement: The following is suggested language for a narrative standard:

> Bay/Delta Estuarine Habitat Standard. The following water quality standard applicable to water specified in the Water Quality Control Plan for Salinity for the San Francisco/Sacramento-San Joaquin Delta Estuary (Bay/Delta), adopted by the California State Water Resources Control Board in State Board Resolution No. 91-34 on May 1, 1991, which is available from the Water Resources Control Board, State of California, P.O. Box 100, Sacramento, CA, 95812
>
> (a) Water Quality Criteria. The quality of water in the Bay/Delta shall be maintained consistent with that level necessary to protect estuarine habitat, fish migration, cold freshwater habitat, and other existing beneficial uses.
>
> (b) Measurement of Compliance. Compliance with the water quality criteria in paragraph (a) may be demonstrated by any one or more of the following methods:
>
> (i) attainment of at least 2-ppt salinity (measured as either average daily salinity or 14-day moving average salinity one meter below the surface) during the months of February through June for at lest the number of days at each location determined by the following equations.
>
> [Chipps Island / Confluence Salinity Equations]

The Chipps Island measurements shall be taken at the Mallard Slough Monitoring site, Station D-10 (RKI RSAC-075) made at the salinity measuring station maintained by the California Department of Water Resources. The Confluence measurements shall be taken at the Collinsville Continuous Monitoring Station C-2 (RKI RSAC-081) maintained by the California Department of Water Resources.

(ii) calculation of sufficient outflow from the Sacramento and San Joaquin rivers to result in the placement at each station identified in the equations in paragraph (b)(i) of the freshwater/saltwater interface, as defined by the location of the 2-ppt isohaline, for at least the number of days listed during the months of February through June.

(iii) such other methods as may be adopted by the State of California, pursuant to any plan developed in accordance with paragraph (c) or any plan otherwise designed to assure compliance with the water quality criteria contained in paragraph (a).

(c) Implementation. Implementation of the water quality criteria contained in paragraph (a) may be achieved through development by the State of California of a water quality protection plan consistent with Sections 208 and 319 of the [Federal Clean Water] Act. in developing any such plan, the State of California shall consider:

(i) State and Federal regulatory authorities and programs necessary to achieve compliance with the plan.

(ii) the use of supplemental numeric criteria consistent with the water quality criteria contained in paragraph (a)(i), including, where appropriate, supplemental numeric criteria for salinity and flow.

(iii) allowance for temporary increases in salinity levels to the extent that control measures to offset the increases are included in the plan.

(iv) the identification of best management practices for the protection of salmon smolt survival.

(v) the development of a comprehensive multi-species monitoring program to ensure that adopted standards do not produce net adverse impacts on the overall Bay/Delta ecosystem.

(vi) the identification of specific monitoring locations and methods, including biological monitoring methods, to be used in determining compliance with the plan.

Basis for the Refinement: Since the proposed EPA estuarine habitat standard is supposedly based on biological benefits derived from identified flow levels, it is effectively a salinity intrusion/flow standard. EPA does not have authority to establish and implement a flow standard because it does not have authority to control salinity intrusion or allocate water within the states. Therefore, the desired flow standard to protect estuarine habitat must be established and implemented by the State Water Resources Control Board, with State water rights hearings to determine responsibility for meeting such a standard among Bay/Delta watershed water users.

The narrative standard should be developed to allow the position of the zone of estuarine process where salinities range between 2 and 12 ppt (sometimes referred to as the entrapment zone) to vary over an optimum geographic area which has certain beneficial geomorphic features, such as shoals, tidal flats, and marshes. The geographic area specified by EPA to receive optimum benefits of the implementation of their proposed salinity standard is Suisun Bay, Grizzly Bay, and Honker Bay, and associated tidal flats, shoals and marshes. If the salinity standard for Roe Island were adopted as proposed by EPA, however, this area and estuarine biota associated with the range of salinities which characterize the entrapment zone (2-12 ppt) would not receive optimum benefit. On the contrary, the entrapment zone and its attendant beneficial characteristics would be pushed downstream, largely into Carquinez Strait, where there are very few productive tidal flats, shoals, and marshes. On the other hand, preliminary analysis indicated that optimum potential biological benefit could be provided through: 1) adopting the proposed three-way compliance; 2) the conversion of the proposed estuarine habitat salinity standard to an analogous flow standard with the point of compliance at Chipps Island (i.e. flow calculated to result in the average location of X_2 at Chipps Island); or 3) allowing the average (calculated or measured) salinity at Roe Island to vary within the specific biologically optimum range characteristic of the entrapment zone (2-12 ppt). This would not require storage releases to push the entrapment zone downstream into Carquinez Strait, a far less ecologically important area.

From a biological standpoint, one of the recommendations of the San Francisco Estuary Project workshop was to allow for "within-year" variability in the position of X_2 to prevent constancy of position (SFEP Report 1993). This proposal would allow the location of the entrapment zone (defined by the desired salinity range of 2 to 12 ppt) to vary within the desired shoals, tidal flats, and marshes of Suisun, Grizzly and Honker bays. This is the kind of variability the SFEP workshop had in mind, not the variability EPA attempts to satisfy by appealing to different types of water years (CUWA Reference 8). Although the location of the entrapment zone will vary based on wind, tide, antecedent flows, barometric pressure, and currents, estimates of flows required to place the entrapment zone in the desired geographic habitat area[3] range from 5,000 to 15,000 cfs (SFEP 1993). Testimony of Phillip B. Williams, at the 1987 State Water Resources Control Board Phase I Hearings indicated that when the upper limits of the entrapment zone (2-ppt) is placed at Chipps Island (74 km east of the Golden Gate Bridge), the length of the entrapment zone would be about 16 km, extending throughout Honker and Suisun bays to the Carquinez Strait (58 km). However, when flows are released to meet EPA's proposed Roe Island salinity standard (approximately 28,000 -35,000 cfs), a large portion of the entrapment zone is shifted downstream into a less desirable geographic location in terms of optimizing estuarine habitat, the Carquinez Strait. This location of the entrapment zone does not meet EPA's stated restoration goal (see Federal Register, Jan. 6, 1994, pg. 815 & 820).

In addition, EPA's proposed estuarine habitat standard is based on analysis of data by the CDFG and results of studies conducted by the San Francisco Estuary Project Workgroup which indicate that fish abundance is high when a zone defined by a range of salinity is located within the desired shoals, tidal flats, and marshes of Suisun, Grizzly, and Honker bays. Due to the uncertainty of the biological benefits of a specific location within those bays, the estuarine habitat standard should be modified to reflect the natural variation in the position of the imaginary 2-ppt isohaline and in the corresponding position of the entrapment zone.

Potential Biological Effects of Refinement: As stated above, this refinement would allow the entrapment zone to vary, but still reside within the desired shoals, tidal flats, and marshes of Suisun, Grizzly, and Honker bays and not be shifted downstream into a biologically inferior geographic location, the Carquinez Strait.

Potential Water Requirements: Although modeling simulation studies of this refinement have not been completed, preliminary review indicates that less outflow would be required to meet the standards.

5.3 Spread Obligations to Comply with Standards Among All Responsible Parties

Description of the Refinement: At the present time, it is recognized that there is no simple statutory process in which to include the number of parties which should be responsible for meeting State/federal standards based upon their impacts to the Bay/Delta ecosystem. However, virtually all diverters from the Bay/Delta watershed are responsible to some degree for the impacts of water diversion. Many parties have an interest in participating in a negotiated solution to Bay/Delta problems. The federal agencies and the State should create a forum for negotiation which would expand the number of effected parties beyond the State Water Project (SWP) and the federal Central Valley Project (CVP) to include all in-Delta and upstream users in the Bay/Delta watershed. The level of responsibility for implementing standards should be

[3] The recommended geographic estuarine habitat location of the salt/freshwater mixing zone (known as the entrapment zone) is to place the leading edge downstream of Chipps Island which will allow this zone to fluctuate within the desired shallow shoals, tidal flats, and marshes of Suisun, Grizzly, and Honker bays.

determined based upon annual diversions or other reasonable basis which actually measures contribution by diverters to the problems of the Estuary.

Basis for the Refinement: Other diverters in the Bay/Delta watershed besides the SWP and CVP impact the conditions of the biological resources in the Bay/Delta Estuary. The main impacts that these diverters have on the system are the entrainment of fish in unscreened or inadequately screened diversions and the reduction of flows that would otherwise flow through the Delta and to the Bay. All those who effect the ecosystem should be required to share in the responsibility for protecting it. This approach would allow desirable protection to the Estuary's environmental resources in a manner that minimizes the concentration of water supply and economic impacts in limited areas, and would expand the group of parties interested in finally resolving Bay/Delta environmental problems.

Potential Biological Effects of Refinement: The biological resources would receive the same degree of protection but the impact to existing water users would be spread more broadly if more users are responsible for modifying their operations to protect the estuary. More protection would result if responsible parties contribute to a restoration fund for the purpose of funding environmental improvements.

Potential Water Requirements: Water supply impacts could be significantly minimized because they would be spread throughout a wider geographic region, thereby reducing the potential for severe economic impacts in any one concentrated area.

5.4 Establish a Water Supply Impact Threshold Beyond Which Standards are Met with Purchased Water

Description of the Refinement: Establish a water supply impact threshold beyond which standards are met with purchased water using funds from a Bay/Delta restoration fund. If sufficient funds are not available to purchase required water to meet standards above the cap, the standards would still be met through traditional regulatory means.

Basis for the Refinement: A cap or limit on regulatory reallocation of water from existing users would minimize the uncertainty of water supply impacts, and also greatly minimize the potential for severe economic impacts caused by water shortages. Studies by the University of California indicate that economic impacts are reduced by 90 percent when requirements are met from purchases in a voluntary market rather than through regulatory takings.

Potential Biological Effects of Refinement: There would be no adverse biological effects of a cap as long as sufficient funds are guaranteed to provide needed water purchases to meet standards above the cap. As stated above, if sufficient funds are not available to purchase required water to meet standards above the cap, the standards would still be met through traditional regulatory means.

Potential Water Requirements: A cap mechanism would allow the water cost of meeting the proposed standards, to be spread among more responsible parties, based on the social and economic value of the water supplies.

5.5 Create a Restoration Fund to Purchase Environmental Water

Description of the Refinement: A mechanism should be developed to create a statewide restoration fund, similar in concept to the fund contained in the CVP Improvement Act (Public Law 102-575). The fund could be financed by a combination of tax-payer supported bonds (Senate Bill 158 -Thompson is one such example), water user and discharger fees, and contributions made by water agencies pursuant to an environmental "mitigation credits" program. The fund would be used to finance habitat improvements, including those requiring State cost sharing in Public Law 102-575, and to purchase water to help meet the proposed standards (or Endangered Species Act requirements) in order to minimize the economic impacts that would occur from strict regulatory reallocations of water supplies.

Basis for the Refinement: A restoration fund would provide a means of requiring responsible parties beyond the SWP and CVP to provide a means for protecting and restoring the estuary. It also provides a means of breaking the long-standing stalemate in addressing Bay/Delta improvement measures because it reduces the focus on who is responsible and rather helps initiate the many restoration projects that have been identified for years but have not been implemented. It would also provide State contribution to the environmental improvement measures contained in P.L. 102-575. Allows control of factors other than water diversion that have not adequately been addressed.

Potential Biological Effects of Refinement: Would provide increased protection to environmental uses since a source of funding would be made available for restoration measures including addressing unscreened diversions, rehabilitating channels, controlling poaching, cleaning up toxics, and providing flows for environmental enhancement.

Potential Water Requirements: Would not require water supplies.

5.6 Assure Access to Cross-Delta Water Transfers

Description of the Refinement: Access to an cross-Delta water market is essential, if the economy of California is to minimize the economic impacts of federal regulations intended to restore the environment. However, flow and other operational requirements and export limits mandated by the U.S. Fish and Wildlife Service and the National Marine Fishery Service, and salinity standards being proposed by EPA will significantly inhibit these water transfers. State and federal regulatory agencies should work cooperatively with water interests to identify voluntary water transfer strategies that: 1) will not serve to defeat environmental restoration efforts; 2) provide necessary flexibility for the California economy; 3) minimize the environmental impacts of cross-Delta transfers; and 4) generate upstream and in-Delta environmental benefits.

Basis for the Refinement: Access to cross-Delta water transfers (including above Delta and south-of-Delta) would provide a geographically diverse market for the purpose of water purchases to mitigate water losses from regulatory actions such as EPA standards. Such approaches would allow urban and agricultural areas to minimize the economic impacts that would result from water shortages through purchases of replacement supplies.

Potential Biological Effects of Refinement: The availability of a broad range of transfer strategies will mitigate water supply impacts of environmental improvements, making those improvements more achievable. Biological impacts could be minimized from cross-Delta water transfers if time windows are identified which would have very limited adverse effects to biological resources. Real-time monitoring would provide a means of identifying such window for transfers.

Potential Water Requirements: This refinement would have no water cost in terms of meeting proposed standards, but would provide a means of mitigating water reductions resulting from implementation of standards.

5.7 Develop a Phased Compliance Schedule for Implementation of the Standards

Description of the Refinement: A legally defensible and realistic compliance schedule should be developed for phasing in regulatory standards, similar in concept to how EPA implements requirements in the Clean Air Act or pollutant discharge requirements in the Clean Water Act. This concept would include implementation phasing as water users beyond the CVP and SWP are brought into the process of meeting the standards.

Basis for the Refinement: EPA has not publicly released a schedule describing when final standards will be promulgated once the public comment period ends on March 11, 1994. Although timely implementation of standards and restoration measures are essential for protection of the Bay/Delta fisheries, such measures would require participation of many entities which impact the Estuary. Phasing in of responsible parties would require the State Board to hold water rights hearings to determine which water rights would be affected and how much each party will be affected. Litigation could slow implementation until final court decrees are issued. EPA standards should be developed to allow gradual phasing in of responsible parties, making parties responsible for their share of the standard as they are included by the SWRCB.

Potential Biological Effects of Refinement: Even though the biological protection would be phased in, this type of approach is warranted because water users would not be responsible for impacts that were not caused by them, and such an approach to fairness would prevent possible continued political and legal gridlock and further decline of biological resources if parties are required to meet an unfair burden. Moreover, a major portion of the desired protection could be obtained relatively expeditiously by first focusing on the CVP, SWP, and other large local projects.

Potential Water Requirements: Total water requirements of meeting the full standards would reach full magnitude over time as responsible parties are brought into compliance.

5.8 Assure Development of an Ecological Risk Assessment During Triennial or Shorter Review Periods

Description of the Refinement: In order to ensure that the estuarine ecosystem as a whole is benefited by the proposed estuarine habitat standard, and does not favor or disfavor certain assemblages of fish which are directly dependent on the location of a 2-ppt isohaline, EPA should perform an Ecological Risk Assessment that addresses all factors potentially influencing species abundance and distribution in the Bay/Delta. This assessment should be developed as soon as possible to assure that the setting of a 2-ppt isohaline would have the desired effect on all the estuarine/aquatic organisms. This assessment should also address the relative impact each of these factors is having on estuarine/aquatic resources. This assessment is consistent with the goal of the San Francisco Estuary Project (a part of the National Estuary Program developed by EPA) which is to develop a comprehensive understanding of the environmental and public health values in the Bay/Delta and to recommend priority actions and compliance schedules to restore and maintain the chemical, physical, and biological integrity of the Estuary.

Basis for the Refinement: The implied objective of setting a X_2 standard by EPA is that the location of the imaginary 2-ppt isohaline in the Bay/Delta will influence the *overall* health of the ecosystem. However, the Status and Trends reports, completed as part of EPA's San Francisco Estuary Project (SFEP) program, repeatedly noted that there are many other factors (many of them unquantifiable) which are influencing certain fish populations, and for which the X_2 standard would have no effect. Although an analysis by Jassby in the SFEP indicates that there are other species which likewise have a relationship to X_2, the desegregation of the data demonstrates that X_2 explains just a part of the variability in relative abundance for these species below a certain location in the Bay/Delta (i.e. Chipps Island). Thus, there is a real potential that the setting and implementation of the X_2 standard, as it is presently defined, would not achieve the overall desired effect of maintaining total ecosystem health, but rather favor one or two species. Given the uncertainty of the biological relationships to X_2 and the increased variability in the relationships with distance below Chipps Island, the X_2 standard should allow for modifications during the first three years, so that it can be effectively and realistically administered.

This type of overall ecosystem risk analysis was also addressed during the development of the SFEP workplan. SFEP participants, recognizing that no single factor was controlling the existing populations of aquatic/estuarine biota, identified five issues which they believed should be addressed. These included, in no specific order: 1) decline of biological resources; 2) freshwater diversion and altered flow regime; 3) increased pollutants; 4) intensified land use; and 5) increased dredging and waterways modification.

Potential Biological Effects of Refinement: The use of an Ecosystem Risk Analysis can only help to gain additional knowledge of the relative impacts on other organisms in the Bay/Delta, and avoid unintentional negative impacts on certain species.

Potential Water Requirements: Water requirements to meet standards would possibly change along with the standard. Possible changes cannot be determined at this time.

5.9 Limit Potential Impacts of Anti-Degradation Policies

Description of the Refinement: Ensure that anti-degradation policies, to the extent applicable, are applied to not preclude the modification of standards when science or the public interest identifies a need to change. It should be remembered that it is beneficial uses, and the conditions necessary to support those uses, and not the numerical representation of those conditions, which are the subject of antidegradation policies. In order to achieve those objectives, the standard could be developed as a narrative describing the conditions required to protect and support beneficial uses. The standard would describe general physical and chemical properties necessary for achieving these conditions. The standard would also define mechanisms which would be expected to achieve these conditions.

Basis for the Refinement: EPA's present statutory regulations for issuing water quality standards include an anti-degradation policy that concerns both Bay/Delta water users and those working to protect the environmental resources. Because the Bay/Delta is such a complex ecosystem, with limited knowledge of cause-and-effect relationships between environmental factors and abundance of biological resources, protection must be provided in a manner that allows for adjustments to standards as scientific information or changes to the physical habitat indicates a need.

Potential Biological Effects of Refinement: Applying the anti-degradation policy in a manner that allows for standards to be modified as additional scientific information is collected and physical habitat improvements are made would allow for improved protection of biological resources.

Potential Water Requirements: Water requirements to meet standards would possibly change along with the standard. Possible changes cannot be determined at this time.

5.10 Assure Commitment to Long-Term Comprehensive Program

Description of the Refinement: Standards should be developed that not only reasonably meet the immediate needs for protection of the Bay/Delta environment, but also are consistent with an overall strategy or plan for protecting the varied uses of Bay/Delta waters for the long-term. A provision should be added to the EPA proposed standard (and to the Biological Opinion for winter-run chinook salmon and Delta smelt) which commits federal agencies to participate in the development and implementation of a long-term comprehensive program that takes into consideration physical and flow-related improvements that would be made throughout the watershed to improve habitat conditions for fisheries (e.g. a joint State/Federal multi-species ecosystem approach for the San Francisco Bay/Delta Estuary). In addition, future modifications of the standard should be included as part of a routine (triennial) review and revision process, once sufficient information is available to justify such revisions.

Basis for the Refinement: The Bay/Delta ecosystem would be best restored and protected if standards which are set work along with other improvements that are to be made. If they are inconsistent with each other, then the biological resources would not receive the anticipated or intended degree of protection from any of the actions taken.

Potential Biological Effects of Refinement: Providing that standards are developed and set which are consistent with other actions to be taken would assure gradual, but steady restoration of the ecosystem.

Potential Water Requirements: A consistent, comprehensive approach for regulation and restoration would reduce unnecessary water cost.

6. PROPOSALS FOR BAY/DELTA LONG-TERM IMPROVEMENT MEASURES

6.1 Establish a Multi-Species Ecosystem Approach

Description of the Refinement: Federal and State agencies should commit to participate in the development and implementation of a joint State/Federal multi-species ecosystem approach for the San Francisco Bay/Delta Estuary, with the following elements:

1. Develop a comprehensive plan to improve both habitat and reduce take of endangered species in the Bay/Delta, in tributary rivers and streams, and at sea, thereby encouraging recovery of these species and reducing controls on the operation of the State Water Project and the Central Valley Project by the end of 1996-97, with implementation beginning as program elements are developed and continuing until all practicable measures have been implemented;

2. Integrate the current State and federal water resources planning and fishery management programs. This includes integrating: the Central Valley Project Improvement Act Fish and Wildlife Mitigation and Enhancement Programs; the San Francisco Estuary Project's Comprehensive Conservation and Management Plan; the federal Endangered Species Act recovery programs; the State Central Valley Salmon and Steelhead Restoration and Enhancement Plan; the State Striped Bass Management Plan; and others;

3. Develop a mechanism for funding of ecosystem recovery and to purchase water for habitat enhancement; and

4. Develop a proactive public involvement program to ensure that the public understands the need for and can support recovery efforts and the funding provisions which will make these efforts feasible.

This multi-species ecosystem effort should be initiated and implemented cooperatively, with implementation of habitat recovery and endangered species take-reduction measures initiated, under appropriate mitigation agreements with regulatory agencies, as soon as practicable. A goal of implementation should be simultaneous completion of habitat recovery and endangered species take reduction programs, no later than 2003.

Basis for the Refinement: The Bay/Delta needs a coordinated ecosystem, multi-species approach to ensure that regulations to solve one fishery problem do not create another. Individual actions, such as the EPA's proposed standards, the USFWS's Delta smelt listing, and the NMFS's winter-run chinook salmon listing, focus almost exclusively on flow, neglecting other factors such as pollution, loss of habitat, exotic species, loss of food supply, and others. The search for solutions must recognize that even though reasonable outflow standards and fish take limits are an important part of protecting the ecosystem, without appropriate control of other parties and factors effecting the Estuary, we would not be able to reach our goal of improving and restoring the Bay/Delta ecosystem.

State and federal agencies, along with the water supply and environmental community, need to initiate a comprehensive multi-species ecosystem planning process which would address the full range of problems in the Bay/Delta watershed. The benefits of a multi-species approach include:

1. Allows planning which accommodates both economic and environmental needs.

2. Subsumes many regulatory approaches into one plan both federal and State.

3. Requires consideration of the needs of several species rather than the needs of single species, leading to a habitat-based approach. Therefore, what works for endangered species will often take care of other species as well.

4. Addressing multiple factors may more equitably distribute the appropriate responsibility for the problem among user groups.

In general terms, we need to commit ourselves to implementing solutions that are broad enough in scope and beneficial from an ecosystem perspective, so that there can be a general consensus on their benefits and the need to implement them. We will need to replace micro-management of the ecosystem with restoration of the ecosystem and its dynamic processes.

As Governor Pete Wilson stated in his letter, dated November 17, 1993, to EPA Administrator Carol Browner:

> *"It is my belief that an ecosystem focus and better coordination among State and federal agencies should be the emphasis of any strategy to resolve these issues. Continuing the old methodology of producing recovery and habitat plans and consultations on individual species is likely to only move us further down the tracks toward an environmentally and economic train wreck . . ."*

<u>Potential Biological Effects of Refinement</u>: As discussed above, this multi-species effort has positive biological benefits because it considers the needs of several species and encourages proactive approaches to solving these problems. It also encourages all parties to work together to develop a solution rather than constraining the process through legal actions.

<u>Potential Water Requirements</u>: In the long-term, the multi-species effort would resolve environmental issues in a permanent and proactive manner while minimizing water costs and maintaining operational flexibility for the State in the management of its water resources.

6.2 State/Federal Cabinet-Level Water Management Task Force

Description of the Refinement: Develop a State/Federal Cabinet-Level Water Management Task Force to coordinate efforts to solve environmental problems while assuring a reliable supply of water for urban and agricultural areas. The Task Force would ensure broad support in coordinating State and federal policy regulations.

The Task force would appoint a State/Federal Advisory Council to integrate State and federal water resource planning and fishery management programs, and develop and implement a joint State/Federal multi-species ecosystem approach for the San Francisco Bay/Delta Estuary. This Council would consist of representatives from the State Water Resources Control Board, the California Department of Water Resources, the California Department of Fish and Game, the California Environmental Protection Agency, the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, the National Marine Fishery Service, an environmental interest, an agricultural interest, and an urban interest. The Advisory Council would also advise the Task Force and negotiate: 1) an interim operating/management plan; 2) a long-term operating/management plan; and 3) a funding mechanism.

Basis for the Refinement: The San Francisco Bay/Delta Estuary has been the focus of environmental and water interests for decades as years of regulatory and legal battles have led to deadlocks in developing solutions to the Estuary's problems. The continuing decline in the Bay/Delta ecosystem resources is evidence that the management and mitigation actions of the past have not been adequate. Addressing water quality (salinity/flow) issues should help to halt the general decline of the Estuary, but a more comprehensive approach is needed to ensure the recovery of the ecosystem in the long-term.

A State and federal partnership to cooperatively solve these issues is essential to protect the high-stake interests involved in the Estuary. This commitment would be beneficial to all parties. It would reduce polarization and promote understanding. As Senator Dianne Feinstein stated in her letter, dated November 30, 1993, to Secretary of the Interior Bruce Babbitt:

> *"While I am pleased that the Club Fed team of federal officials indicate that they are establishing a cooperative working relationship with state officials, I believe that a more formal structure and process is needed. This would further encourage state cooperation in allocating water flows, as well as creating an opportunity to look at longer term improvements in the overall system that are needed to make it work as efficiently and in as environmentally beneficial a manner as possible."*

Potential Biological Effects of Refinement: As discussed above, this effort has numerous positive biological benefits and encourages proactive approaches to solving these problems. It also encourages all parties to work together to develop a solution rather than constraining the process through legal actions.

Potential Water Requirements: A State/federal partnership would provide the necessary step in the long-term effort to resolve environmental issues in a permanent and proactive manner while minimizing water costs and maintaining operational flexibility for the State in the management of its water resources.