Received
APRIL 28 1994

COMMENTS OF

Westlands Water District

on

Water Quality Standards for Surface Water
of the Sacramento River, San Joaquin River
and San Francisco Bay and Delta
of the State of California
Proposed by the Environmental Protection Agency
in the Federal Register of January 6, 1994

March 11, 1994

WESTLANDS WATER DISTRICT
3130 N. Fresno Street
Fresno, CA 93703

March 11, 1994

Mr. Patrick Wright, Bay/Delta Program Manager
Water Quality Standards Branch, Water Management Division
U.S. Environmental Protection Agency
75 Hawthorne Street
San Francisco, CA 94105

Dear Mr. Wright:

This will serve as the **Transmittal Letter and Executive Summary** of the Comments of Westlands Water District on the proposed Water Quality Standards for Surface Water published by the Environmental Protection Agency (EPA) in the Federal Register of January 6, 1994. These comments, while they refer in text to the San Luis & Delta-Mendota Water Authority, were jointly prepared by the Authority and Westlands, and are submitted on behalf of Westlands' landowners and water users.

Westlands Water District

Westlands is a California Water District organized and operating under Section 34000 et seq. of the California Water Code. Westlands has contractual and legal entitlements to 1,150,000 acre feet of water a year from the federal Central Valley Project (CVP). This water can only be delivered to Westlands by export from the Sacramento - San Joaquin Delta.

Westlands supplies irrigation water to approximately 600,000 acres of highly productive land on the west sides of Fresno and Kings Counties. The farming operations in Westlands produce excellent yields of numerous high value crops, such as cotton, tomatoes, garlic, and melons, providing thousands of jobs, supporting several westside communities and generating revenues, in recent years, in excess of six hundred million dollars a year.

Existing Reductions in Water Supply

Through a series of recent federal actions, Westlands has experienced significant long term cutbacks in its CVP water supply. These cutbacks result primarily from successive layers of legislative and regulatory restraints on the Tracy Pumping Plant as well as the reallocation of our water supply for environmental purposes. The federal actions include the Central Valley Project Improvement Act (CVPIA), and the listing of the Winter Run Salmon and the Delta Smelt under the Endangered Species Act (ESA).

As a result of the implementation of these statutes, an average of around 600,000 af per year has been reallocated from Westland's historical use to environmental resource use. Westlands has been advised by the U.S. Bureau of Reclamation to expect an average cutback of 50% of their contract amounts over the next several years. Westlands analysis indicates that under the "best case" conditions, we could expect perhaps 65% of our contract entitlement.

Westlands has already lost a significant amount of water through CVPIA and ESA implementation - without compensation. It is in this context that we submit our comments on the additional cutbacks which would result from implementation of the proposed EPA standards.

Comprehensive Approach to the Delta Problems

We urge EPA to continue a dialogue with the State of California in an effort to develop a comprehensive plan for the Delta. Such a plan should address not only the salinity, outflow and habitat related problems which are the subject of the proposed standards, but also the many related factors which collectively have brought the Delta and its habitat conditions to the apparent state of deterioration which exists today. Issues of pollution, predation, exotic species, and unscreened diversions, among others, may be as significant, if not more so, than exports and outflow in terms of impact on Delta conditions.

As a part of this comprehensive State/Federal Plan for the Delta, Westlands agrees that EPA should develop Delta Standards which can achieve measurable and quantifiable environmental benefits while respecting the needs of the agricultural and urban areas of the San Joaquin Valley and southern California that rely on exports of Delta water.

Westlands supports development of a standard or set of standards which will contribute to the joint State/Federal Comprehensive Plan to protect habitat values of the Delta, and which will minimize the water supply and economic impacts of such standards.

Legal Reservations

Westlands has serious legal reservations about the nature and scope of EPA's authority to promulgate the standards set forth in the January 6 proposed standards. We believe that the proposal substantially exceeds the jurisdiction granted by Congress to the EPA in the Clean Water Act, and we further believe that the EPA's interpretation of certain provisions of the Clean Water Act is legally flawed. These legal reservations are set forth in detail in Section 2 of the Comments which follow.

Technically Flawed

Westlands has serious reservations about the scientific and technical validity of much of the analysis providing the basis for the proposed standards. In Section 5 of these

Comments, we identify a number of areas where we think the premises or assumptions are flawed or the correlations used to support a particular hypothesis are suspect.

Economic Impacts

Westlands believes that EPA's Regulatory Impact Analysis is fatally flawed. The analytic approach used seems to be to come up with a conclusion - then try to support it through any stretch of data imaginable. The apparent conclusion that the proposed standards will have no significant social/economic impacts, and EPA's cavalier attempt to support it, is unconscionable.

The analysis is based on a number of assumptions which simply have no basis in fact and which collectively lead to erroneous conclusions about the impact of the proposed standards on the agricultural economy of the State of California. Our response to the Regulatory Impact Analysis is set forth in Section 4 of these Comments.

Recommendations

In further recognition of the need for new Delta standards, Westlands has considereds several revisions and modifications to EPA's proposed standards which we believe are consistent with the general goals of habitat protection and conservation, and which would achieve such goals at a lesser cost to the waer users dependent on the Delta. In some cases, the modifications may actually be more protective of the most sensitive uses in the Delta (i.e., Winter Run and Delta Smelt) than the proposed standards. We encourage EPA to consider these modifications as the federal agencies work with the State on a long term, comprehensive plan for the Delta.

Finally, we urge you to keep in mind that implementation of new Delta standards, if and when they are devleoped, must not become an additional obligation of the federal projects. The CVPIA and ESA have already reallocated significant amounts of CVP water from federal water contractors to environmental uses. Much of this reallocation will result in increased Delta outflow. It is the strongly held view of Westlands that federal contractors south of the Delta must not be asked to give up more water. If more water is required for outflow, the proper procedure is for the State Water Resources Control Board to examine all water rights which result in diversions of water from the Delta, or which result in reduced inflows to the Delta, and then determine the appropriate contribution of all water rights holders.

Thank you for your consideration of these comments.

WESTLANDS WATER DISTRICT

for Michael Heaton
Jerald R. Butchert, General Manager

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SECTION I

THE PROPOSED EPA STANDARDS AND RECOMMENDED MODIFICATIONS TO THEM

This section begins with a description of the EPA standards and then presents the most important modifications to the proposed standards implied by EPA in their request for comments. Finally, this section includes recommendations of the San Luis & Delta-Mendota Water Authority for modifications to the proposed standards.

THE PROPOSED EPA STANDARDS

The Proposed EPA Standards ("Water Quality Standards for Surface Water of the Sacramento River, San Joaquin River, and San Francisco Bay and Delta of the State of California" 40 CFR Part 131) are comprised of three parts:

- An estuarine habitat standard which consists of salinity requirements for the western Delta
- A cold water habitat standard for salmonids migrating through the Delta toward the ocean
- A striped bass spawning standard which consists of salinity requirements for the lower San Joaquin River.

A description of each of these parts follows:

The estuarine habitat standard

EPA developed this standard in essentially four steps:

Step 1. EPA hypothesized that there is a strong relationship between the abundance of estuarine species and salinity[1] or Delta outflow in the western Delta.

Step 2. EPA drew on the work of the San Francisco Estuary Program, specifically, "Managing Freshwater Discharge to the San Francisco Bay/Sacramento-San Joaquin Delta Estuary: The Scientific Basis for an Estuarine Standard, Conclusions and Recommendations of

[1]Salinity in the western Delta, when averaged over a day or more, is determined by the Delta outflow that occurs in the period just prior to that averaging period. In other words, Delta outflow has a "memory effect" on western Delta salinity. When a storm occurs and Delta outflow increases, salinity drops and remains low for a time after the storm is over and Delta outflow subsides. Of course, over shorter periods, ie: several hours, salinity is strongly affected by the tides that move water back and forth from four to eight miles every 12 hours.

Members of the Scientific, Policy, and Management Communities of the Bay/Delta Estuary." This document presented the results of correlations between the abundance indices of seven species and salinity in the western Delta. Salinity was measured as X2, the distance of the 2 ppt salinity line from the Golden Gate Bridge.[2] In other words, in this step, EPA concludes that it has statistical confirmation of the hypothesis set forth in Step 1.

Implicit in Steps 1 and 2 is the conclusion that western Delta salinity, measured as X2, is the primary control variable affecting abundance of estuarine species. This leaves the question of what the western Delta salinity should be.

Step 3: EPA concluded that western Delta salinity should be what it was in the period 1968-1975. They appear to have based this conclusion on two reasons:

Conditions were generally good for estuarine species prior to 1976.

The state non-degradation policy took effect in 1968, and the corresponding federal policy took effect in 1975.

Further, by examining the results of the correlations in Step 2, they concluded that the period February-June was critical for the control of salinity in the western Delta.

Step 4. EPA developed a western Delta salinity standard to conform to the results of Steps 1-3. Specifically, they went through the following steps:

4a. They drew on results of the report cited above which included an equation relating western Delta salinity to Delta outflow based on data from the recent past.

4b. They concluded that the period 1940-1975 should be used to represent conditions in the period 1968-1975.

4c. They used daily data on Delta outflow and the equation from Step 1 to calculate X2, the location of the 2 ppt salinity line for each day in February-June in the years 1940-1975.

4d. They chose three locations (Roe Island, Chipps Island, and the confluence of the Sacramento and San Joaquin Rivers)

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[2]X2 is a measure of western Delta salinity. Specifically, X2 is the distance from the Golden Gate Bridge, in kilometers, of the location where the average salinity one meter off the bottom is 2.0 parts per thousand, about 6% as salty as sea water.

as control points.

4e. They divided the years 1940-1975 into the standard California year types (that is, wet, above normal, below normal, and dry). There were no critically dry years in that period.

4f. For the years in each year type, they found the average number of days in February-June that the 2 ppt line was downstream of each of the three control points.

4g. They extrapolated these four averages to get an estimate of the average number of days that 2 ppt would have been downstream of each of the three control points for critical years.

4h. They made these average number of days the standard, and allowed for the standard to be applied on the basis of a 14-day running average

EPA suggests that this standard could be implemented by using the equation in Step 4a to convert X2 values back into Delta outflow and using Delta outflow to measure compliance.

Note the key steps in developing the proposed standard:

The conclusion that western Delta salinity is the primary control variable.

The conclusion that western Delta salinity should be as it was in February-June in the period 1968-1975.

Note that if Step 4 is completed correctly, it should result in X2 (and, therefore, Delta outflow) in February - June being what it was at least 19 years ago. In other words, if Step 4 is completed correctly, the water available for use or storage in February - June should be what it was 19 to 26 years ago.

Of course, D-1485, adopted in 1978, would have some water cost relative to 1975. However, as a rough approximation, the water cost of EPA's proposed salinity standard should be no more than the increase in February - June use since 1975, given that EPA's Steps 1 - 3 are valid. If it is more than that increase, we could conclude that Step 4 results in a standard more stringent than that required to conform with the "return to 1975" basis.

EPA is not proposing an X2 standard because they fundamentally want particular X2 values. Instead, they are proposing this particular X2 standard in order to return the habitat conditions (as measured by salinity) in February - June to what they were in the late 1960's - early 1970's. They could just as well have used Delta outflow and not bothered with salinity at all.

In fact, EPA suggests that their X2 standard could be implemented as a flow standard. Note from Step 4 above, that they really started with Delta outflow to calculate daily X2 values that were then analyzed to arrive at the standard, which could then be converted back to flow for implementation. This, again, points up the nature of X2 as used in these standards. It is a surrogate for returning February - June Delta outflows to the late 1960's - early 1970's rather than being a parameter of fundamental biological importance itself.

Of course, the reason EPA did not simply use outflow is because they do not have the authority under federal law to set a flow standard. They can set a water quality standard, and X2 is a measure of water quality, namely, salinity.

The Cold Water Habitat Standard for Salmonids

This standard was developed from data on the survival of salmon smolts during their outmigration through the Delta in the Sacramento and San Joaquin Rivers.

The standards for each river are similar in that each is stated in terms of an equation. Each equation has two flow measurements on the right side and smolt survival on the left side. The Sacramento River equation also includes water temperature. The standard is stated in terms of the required percent survival of salmon smolts. Compliance is measured by inserting water temperature (generally uncontrollable) and then determining the particular combination of the other, flow-related terms that will yield the required calculated survival.

For the Sacramento River, the factors on the right side of the equation are:

Water temperature
Delta exports
Proportion of the Sacramento River diverted into the Central Delta via the Delta Cross Channel and Georgiana Slough

For the San Joaquin River, the factors on the right side of the equation are:

Delta exports
Flow in the San Joaquin River at Stockton

The Striped Bass Spawning Standard

This standard is based on studies indicating the desirable salinity for striped bass spawning. This standard sets upper limits on salinity in the San Joaquin River. The limits apply from Jersey Point to 1-41-4 1-4Vernalis from April 1 to May 31 in wet, above normal, and below normal years. They apply from Jersey Point to Prisoners Point in dry and critically dry years.

EPA's Suggested Modifications to the Proposed Estuarine Habitat (X2) Standard

In its request for comments EPA asks for information on various modifications to its proposed standards. The most important of these modifications to the X2 standard can be summarized as follows:

Use of a "sliding scale:" EPA based the standard on the average salinity conditions in the five standard year types. Use of year types is one way of recognizing that western Delta salinity depends on how much runoff there is from the Central Valley watershed. Another, more precise way of accounting for the difference in runoff would be to make the required standard dependent on some measurement of runoff in each year. This is the essence of the sliding scale.

No need for a "margin of error" in determining compliance with the standard: Salinity in the Western Delta is affected by a number of factors in addition to Delta outflow. Wind, barometric pressure, and the lunar tidal cycle are three such factors. If compliance is actually determined by measuring salinity, then the 2 ppt salinity would have to be maintained downstream of the three control points. Otherwise, these other factors could cause the 2 ppt line to move upstream of the control points and the required number of days would not be achieved. EPA suggests that compliance could be measured by converting salinity to Delta outflow using the equation in Step 4a above. This would eliminate the need for a "margin of error."

Historical period of reference: EPA stated that its goal was to re-establish western Delta salinity as it was in the period 1968-1975. However, in developing the standard they used the period 1940 -1975. EPA asks for suggestions on how to make the standard more accurately reflect 1968-1975 conditions.

Special requirements to avoid effects of a series of dry or critically dry years: EPA asks for comments on standards that would offset the adverse environmental effects of a series of dry years.

EPA's willingness to consider significant modifications of this type suggest that the proposed standards are likely to be changed and that the changes could be substantial.

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY RECOMMENDED MODIFICATIONS TO THE PROPOSED EPA STANDARDS

The San Luis & Delta Mendota Water Authority (Authority) supports the adoption of standards for estuarine habitat. The Authority concludes that standards for cold water habitat for salmonids and striped bass spawning should not be adopted at this time as proposed.

The Authority has serious concerns about the scientific and statistical basis for the estuarine habitat standard. Our analyses indicate that the relationship between estuarine species abundance and western Delta salinity (X2) differs from that used by EPA as a basis for the standard. Specifically, there appears to be less change in abundance with a given change in X2, and the certainty of the change is considerably less than the EPA analyses would indicate. In addition, the Authority's analyses suggests that other factors, besides western Delta salinity could be having significant, but as yet, unquantified, effects on estuarine species. Nevertheless, there does appear to be some relationship between western Delta salinity and the abundance of estuarine species.

The Authority also has serious concerns about the historical basis of 1968 - 1975 or the February - June X2 standard. Re-establishing salinity conditions for this period, 19 to 26 years ago, could impose serious water costs on the Agencies who make up this Authority. The Authority does not believe that the questionable scientific basis for the proposed standard justifies that large a potential water cost.

The Authority believes strongly that the co-existent problems of the Delta environment and the state's water supply cannot be solved by regulation alone. Facilities are needed in the Delta to solve both problems. The Authority has also concluded that progress on such facilities cannot be made until the issue of Delta standards has been resolved.

Therefore, the Authority supports adoption of an estuarine habitat standard with the understanding that once such a standard has been adopted, a more comprehensive solution to the Delta's problems can be developed. If such a standard is to be based on the period 1968 - 1975, then the recommended modifications below should make the standard more accurate than the one proposed by EPA.

The Authority also strongly believes that Delta protection standards should be adopted by the state, not the federal government. With these considerations in mind, the Authority makes the following recommendations for modifications to the proposed estuarine habitat (X2) standard.

Recommendations for Modifications to the Proposed Estuarine Habitat Standard

Historical Period: EPA proposed the period 1968-1975 as the historical basis for the standard. However, three independent analyses, one by the Department of Water Resources, one by the State Water Resources Control Board, and one by the Contra Costa Water District all show that the proposed standard reflects salinity conditions typical of periods much earlier than 1968 - 1975.

The Authority does not concur with the historical basis of 1968 - 1975. Setting aside the Authority's concerns, if a standard is to be based on the historical period 1968-1975, the standard should accurately reflect salinity conditions in the western Delta as of that period.

Roe Island: The Authority recommends that the Roe Island part of the standards should be eliminated. This part would establish conditions adverse to Delta smelt, a threatened species. The 2 ppt salinity is pushed downstream of Roe Island largely by unregulated flows. Compliance with the Roe Island standard requires larger outflows than can reasonably be provided by the water projects.

Sliding Scale: The standard as proposed is based on the five conventional water year types. There are two serious problems with this approach:

- Use of the average number of days as the standard for the 2 ppt salinity line to be downstream of each of the three control points is analogous to making "C," the average for a classroom, a failing grade. The water cost of compliance with such a standard is very large for the drier years of each year type. For the Roe Island control point, the water cost is especially high because at this downstream location, the natural variation of X2 from its mean value is larger. Therefore, compliance with the mean location would take very large amounts of Delta outflow to force the upstream variations in the 2 ppt line downstream to the mean value. This is the primary reason that compliance with the Roe Island standard would cost so much water.

- Use of the conventional five year types means that a small change in runoff, one that causes a shift from one year type to another, can cause a large change in the number of days required for compliance. It is possible that the timing of the change could be such that the number of days required is greater than the number of days remaining in the compliance period.

A sliding scale would correct these problems. The Authority is aware of several different versions of a sliding scale. These versions have not been compared in detail to determine which is the most representative and the most practical for use. The Authority recommends that over the next several months there should be an organized technical analysis of the various methods to reach consensus on the most appropriate sliding scale.

Dry Year Relaxation: The Authority recommends a three-year total number of days standard to allow for some relaxation of the required number of days in drier years. The water cost of compliance with critically dry or dry year standards could be very high. In addition, estuarine species have evolved to withstand single dry or critically dry years, provided there is not a succession of such years.

The Authority analyzed the total number of days that the 2 ppt salinity line was downstream of Chipps Island and the confluence in successive three-year periods from 1930 through 1975. Obviously, the lowest three-year total would not provide adequate protection because even though estuarine species survived that total, it occurred in the past when other factors may not have been adversely affecting those species. Therefore, the value representing the lower ten percentile was chosen. For Chipps Island this value was 150 days. For the confluence it was 223 days. This analysis used EPA's X2/outflow equation, although the Contra Costs Water District equation could also have been used and would change the numbers slightly.

The Authority recommends that the annual compliance values could be exceeded in a single dry or critically dry year so long as the three year running total number of days was not less than 150 days for Chipps Island and 223 days for the confluence.

Determining Days for Compliance: CCWD has proposed three criteria, any of which would suffice to allow credit for counting a day towards the total number of days required for compliance. The Authority concurs with this recommendation. The three criteria are as follows:

- The daily average salinity is below 2 ppt, OR
- The 14-day running average salinity is below 2 ppt, OR
- The net Delta outflow index is greater than the 2 ppt equivalent net Delta outflow index without regard to antecedent conditions (because these are essentially considered in the first two criteria).

Note that this recommendation, specifically the third criterion, amounts to converting the X2 standard back into a flow standard as suggested by EPA.

Recommendations for the Standards for Cold Water Habitat for Salmonids and Striped Bass Spawning

The Authority recommends that standards for cold water habitat for salmonids and striped bass spawning not be adopted at this time for the following reasons:

- The cold water habitat standard cannot be met under some circumstances. In addition, the development of the standard used a method whose basic statistical prerequisites were not complied with. This standard needs further work.

- Striped bass feed on the two species listed for protection under the Endangered Species Act, one species proposed for listing, and several species of concern. Therefore, this striped bass spawning standard should not be adopted until recovery of these endangered species is accomplished. In addition, the control of salinity in the lower San Joaquin River is more appropriately addressed by controlling the sources of pollution.

SECTION 2

LEGAL ANALYSIS OF EPA's PROPOSED RULE ON BAY DELTA STANDARDS

The San Luis & Delta-Mendota Water Authority and the member districts of the Authority adopt and incorporate by reference, to the extent consistent with the comments below, the comments contained in the legal memorandum submitted by Kern County Water Agency and the legal analysis contained in the comments submitted by the Urban State Contractors.

SUMMARY OF POSITION

1. The Clean Water Act (33 U.S.C. § 1251, et seq.), hereinafter the "CWA" or the "Act," does not authorize the EPA to adopt water resource control strategies to protect instream uses (such as fish and wildlife) when such strategies go beyond pollution and pollutant control and attempt to mandate water flows and water project operational controls which are the exclusive authority of the State.

2. That portion of the proposed Bay/Delta Standards which proposes to adopt a two part per thousand (2ppt) salinity standard at various locations in the Bay/Delta system exceeds the EPA's authority under the CWA, as the 2ppt standard measures a hydrodynamic (water flow) phenomenon rather than a water quality parameter.

3. Even assuming that the 2ppt standard could be categorized as a water quality parameter under the CWA, it could only be categorized as salinity intrusion resulting from reduced freshwater outflow. Salinity control has been exclusively reserved to the states under Section 208 of the CWA. Therefore, the EPA's attempt to adopt the 2ppt standard under Section 303 of the CWA exceeds its authority under the Act.

4. That portion of the proposed Bay/Delta Standards which proposes to adopt a salmon smolt survival percentage exceeds the EPA's authority under CWA, as the proposal would directly regulate the operations of the federal Central Valley Project's ("CVP") Delta Cross-Channel and the CVP and State Water Project's ("SWP") Delta pumping facilities, without affecting the quality of the water needed to protect downstream migrating salmon smolts.

5. EPA's attempt to impose the proposed Bay/Delta Standards on the operations of water projects regulated by the State violates Section 101(g) of the CWA as the proposed standard materially and directly impacts California's water rights and

water allocation system.

6. EPA's proposed salinity intrusion and salmon smolt survival controls would supersede or abrogate state-established water rights by taking water away from urban and agricultural water supply uses and dedicating it to environmental uses. Sections 101 (b), 101 (g), and 510 of the Clean Water Act require the Act to be implemented in a manner which will preserve the state's primary right to develop and allocate water and water rights among competing beneficial uses. Further, Section 303(c) of the Clean Water Act requires EPA to consider the impacts on other beneficial uses when water quality standards are developed. Nowhere, however, does the proposed standards indicate that EPA balanced or otherwise gave serious consideration to the needs of competing users in the course of developing the proposed standards.

7. As interpreted by EPA, where there are alternative ways to meet the requirements of the Act, Section 101(g) requires implementation of the alternative with the least cost to competing water users. The modifications to the EPA proposal recommended by the Authority would provide better protection to the most sensitive estuary species, and at the same time, mitigate impacts on other water uses such as urban and agricultural water supplies. Thus, EPA has available a regulatory program that is more consistent with the intent and requirements of the Clean Water Act. A failure by EPA to adopt such an alternative program would amount to arbitrary and capricious administrative conduct.

8. The EPA has failed to comply in good faith with the requirements of Executive Order 12866 in its preparation of the Regulatory Impact Assessment, dated December 15, 1993. The gross inadequacy of this document supports the assertion that the attempt at compliance could not have been in good faith.

ARGUMENT

The proposed Bay Delta Standards contain numerous legal and factual defects. Most prominent is the failure to recognize the limits which Congress imposed on EPA's jurisdiction. EPA attempts to redefine Bay Delta outflow (a non-water quality parameter) as a water quality standard. It appears that the two part per thousand standard ("2ppt") contained in the proposed Bay Delta Standards has been cast in water quality terms because EPA recognizes the weakness of its legal position that it can require river flows that are unrelated to pollution control even if such flows may be important to fishery populations. Because of its weak legal position, EPA has grasped at the fact that in <u>any</u> estuary a given amount of river outflow mixing with the constant force of the tides will produce predictable salinity levels at various locations in the estuary. EPA has, therefore, decided to measure the outflows that it believes are needed for environmental purposes by measuring the salinity levels they will create and calling the result a water quality standard.

Even if the EPA were correct that the 2ppt standard can be characterized as a water quality standard, it still lacks the authority to impose such a standard through the Section 303 process. Salinity intrision is a non-point source of pollution under Section 208 of the CWA. It is clear from the Act and cases decided under the Act that EPA does not have the authority to adopt its own salinity control standards even if it disagrees with and disapproves State adopted standards.

EPA's first failure to recognize its jurisdictional limits is further shown by the attempt to treat a "Salmon smolt survival index" as a "water quality standard" as that latter term is defined by Section 303 of the Act. The CWA is limited in its application to activities that cause pollution or result in the discharge of pollutants. The proposed Bay/Delta Standards admit that the proposed index can only be met through modified operations of the Delta Cross-Channel and through reductions in pumping at the Banks Pumping Plant and the Tracy Pumping Plant. However, the proposed standards fail totally to discuss how Section 303, or any other section of the CWA, supports EPA's assertion that it may require modified operations of State regulated water supply projects, when the purpose of the modifications is not to impact pollution, the discharge of pollutants, or any other water quality parameter, but instead is to regulate Bay Delta flow patterns to insure that downstream migrating salmon are not misdirected from their normal migration route into the channels of the Central Delta.

The salinity intrusion issue is also relevant to the EPA's attempt to adopt its own striped bass spawning salinity standards. It may be true that certain salinity conditions in the San Joaquin River side of the Delta are important to successful striped bass spawning, and the State Water Resources Control Board included such a standard in its water quality control plan for salinity adopted under State law. However, EPA can only reject the State standard <u>and</u> adopt its own if the failure to meet its desired salinity standard is caused by the discharge of pollutants which increase salinity above the desired level. If the cause of the failure to meet a salinity criteria is ocean derived salinity intrusion, it once again falls within Section 208 of the CWA and the EPA does not have authority to adopt a water quality standard different from the one determined by the State to be reasonable and appropriate.

A. The CWA is Limited To Regulating Pollution and Pollutant Discharges and Does Not Authorize Regulation of Outflows Through the Bay/Delta System Resulting From the Operation of Water Supply Projects.

The CWA unambiguously limits the scope of federal authority over water bodies to the control of pollution and the discharge of pollutants. Section 101(a) of the Act recites that its objective is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." (33 U.S.C. § 1251 (a).) This is a broadly stated objective and has often been expansively interpreted by EPA to grant it approval/veto jurisdiction in a wide variety of circumstances. In the case of the Bay/Delta System, EPA appears to use the term "biological integrity" to attempt an even greater expansion of its regulatory reach to any activity which affects the biology of a water system.

Grasping onto these two words, however, ignores the rest of the Act and even the next six subsections of Section 101(a). In five of the next six sentences of that section, where Congress becomes more explicit as to how it expects to achieve the generally stated goals of chemical, physical and biological integrity, it describes five ways to control the discharges of wastes into the nation's waters. The sixth establishes the goal that by 1983, as a result of these discharge control programs, the nation's waters would become fishable and swimmable. Nowhere in this first section of the Act did Congress give any hint that it intended to regulate anything other than activities that impact water pollution.

Initially, environmental litigants attempted to argue that operation of dams and reservoirs (and by analogy water projects in general) were subject to regulation under the National Pollutant Discharge Elimination System (the "NPDES" permit system) established by Section 402 of the CWA. Since that section only applies to the "discharge of any pollutant," the question raised was whether operations of water projects which affect water quality should be categorized as discharges. In *National Wildlife Federation v. Gorsuch* (693 Fed 2d 156), the court answered this inquiry in the negative. The court also recognized the importance of Section 101(g) of the CWA as supporting the exclusion of water project operations from the NPDES program.

The law is, thus, settled that operations of water projects are not subject to the NPDES program and that the CWA is not to be expansively interpreted to strip states of their primary responsibility for balanced management and control of their water resource systems.

There is nothing in any other part of the Act, its regulations, or EPA guidance documents that can lead to a contrary conclusion. Even the broadly written Section 303, the planning provisions under which EPA is acting in this case, starts with the words "in order to carry out the purposes of this chapter." It then uses the term water quality standards throughout.

What are water quality standards? Section 303(c) (2) provides the definitional answer:

> Whenever the State revises or adopts a new standard, such revised or new standard shall be submitted to the Administrator. Such revised or new standard shall consist of the designated uses of the navigable waters involved and the water quality criteria for such water based upon such uses. Such standards shall be such as to protect the public health or welfare, enhance the quality of water and serve the purposes of this chapter. Such standards shall be established taking into consideration their use for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes, also taking into consideration their use and value for navigation. (Emphasis added.)

The EPA regulations then provide the definitions of the two elements of a water quality standard - designated uses and water quality criteria.

> *Designated uses* are those uses specified for each water body or segment whether or not they are being attained. (40 CFR § 131.3 (f))
>
> and
>
> *Criteria* are elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use. When criteria are met, water quality will generally protect the designated use. (40 CFR § 131.3 (b))

Once again Congress, and EPA interpreting Congress' words, limited the scope of required CWA compliance to those matters involving the constituent concentrations of chemicals and similar matter in the nation's waters. Nowhere can language be found to suggest that the Act also regulates the removal of quantities of water or changes in flow patterns resulting from water project operations, even if those activities may impact the aquatic environment. As important as such activities may be to the health of fish and wildlife populations, Congress left the consideration and control of these matters to the States.

B. Section 303 of the CWA Does Not Authorize the EPA To Adopt Salinity Control Standards for the Bay/Delta System.

There is no dispute that increased ocean salinity intrusion, when caused by man's activities that result in reduced fresh water outflows, is a nonpoint source of pollution under the CWA. This recognition does not, however, answer the relevant inquiry which is what level of government has been granted the authority to regulate activities which cause increased salinity intrusion. To answer that question one must return to the statute, regulations and legislative history.

The CWA distinguishes between "point" and "non-point" sources of pollution. A point source is defined at 33 USC § 1362 (14) as:

> any discernable, confined and discrete conveyance, including, but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants may be discharged.

A non-point source is not so clearly defined. In fact there is no corollary definition in the Act. As described in *National Wildlife Federation v. Gorsuch*:

> In EPA's view, the Act divides the causes and control of water pollution into two categories, *point sources of pollutants* (regulated through the § 402 permit program) and *nonpoint sources of pollution* (regulated by the states through "area-wide waste treatment management plans" under § 208, 33 U.S. C. § 1288). The latter category is defined by exclusion and includes all water quality problems not subject to § 402. (693 Fed 2d at 165-66)

This EPA view has been accepted by the courts and salinity intrusion resulting from water storage behind dams and from diversions from streams for consumptive uses is without dispute classified as a nonpoint source of pollution.

A careful reading of Section 303 of the Act shows that there is nothing in the statutory language that specifically limits the scope of water quality standards that must be contained in a plan to those quality constituents that can be regulated through the point source permit requirements of the NPDES program. The regulations, in turn, interpret this silence as inferring that the statutory language may be interpreted broadly as requiring Section 303 "water quality standards" to include water quality criteria which will protect the designated uses from the effects of nonpoint-source pollution. Both EPA's antidegradation policy and the language establishing the criteria for modifying designated uses require consideration of "cost effective and reasonable best management practices for nonpoint source control" as part of the water quality standard setting process.

However, it is improper to regulate, as EPA is attempting to do in the proposed Bay/Delta Standards, nonpoint source pollution resulting from salinity intrusion under the authority of Section 303 and its regulations. Salinity intrusion is specifically dealt with in Section 208 of the Act and, by that process, has been clearly excluded from the coverage of Section 303.

Section 208's purpose is stated as being "[f] or the purpose of encouraging and facilitating the development of area-wide waste treatment management plans." After describing which agencies of state or local government are to prepare the plans, Section 208 (b) (2) details their required contents. After listing such items as the identification of needed treatment works, the establishment of construction priorities for such treatment works, and the establishment of a regulatory program to implement waste treatment strategies, the section contains its first reference to non-point sources of pollution. Section 208 (b) (2) (F) requires the 208 plan to include:

> a process to (i) identify, if appropriate, agriculturally and silviculturally related nonpoint sources of pollution, including return flows from irrigated agriculture, and their cumulative affects, runoff from manure disposal areas, and from land used for livestock and crop production, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources.

Subsections (G) and (H) then described required elements of the 208 plan as they relate to mining and construction activities.

Finally, in subsection (I), salt water intrusion is folded into the process as follows:

> (I) a process (i) to identify, <u>if appropriate</u>, salt water intrusion into rivers, lakes, and estuaries resulting from reduction of fresh water flow from any cause, including irrigation, obstruction, ground water extraction, and diversion, and (ii) set forth procedures and methods to control such intrusion <u>to the extent feasible where such procedures and methods are otherwise a part of the waste treatment management plan</u>.

Section 208 (b) (3) requires area-wide waste treatment plans to be submitted to the EPA for its approval, and Section 208 (b) (4) (D) (i) allows the EPA, after public hearing and a finding that the State is not administering a program approved under this section in accordance with the requirements of Section 208, to withdraw approval of the program.

At this point, however, there is a marked difference between what EPA can do under Section 208 and what it may do under Section 303. Under Sections 303 (c) (3) and (4), EPA is authorized to adopt its own water quality standards if it disapproves state adopted standards and the state fails to amend them in a manner acceptable to EPA. <u>No similar authority is granted to the EPA under Section 208</u>. It thus becomes highly irregular to import a Section 208 salinity intrusion standard into a Section 303 water quality control standard, as the result is to grant EPA greater power over salinity intrusion management plans then Congress granted to EPA through the CWA.

Both logic and the legislative history of the CWA support the argument that Congress intentionally withheld from EPA the authority to adopt its own salinity control requirements when the EPA disagreed with a state's determination of what level of salinity control should be afforded to a particular estuary.

Starting with the language of the CWA itself, Section 101 (b) states:

> It is the policy of Congress to recognize, preserve, and protect the primary responsibilities and rights of the States to prevent, reduce, and eliminate pollution, to plan the development and use (including restoration, preservation, and enhancement) of land and water resources, and to consult with the Administrator in the exercise of his authority under this chapter. (33 USC § 1251 (b))

Section 101 (g), which has been referenced earlier, then continues:

> It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated or otherwise be impaired by this chapter. It is the further policy of Congress that nothing in this chapter shall be construed to abrogate rights to quantities of water which have been established by any State. Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce, and eliminate pollution in concert with programs for managing water resources. (33 USC § 1251 (g))

This latter provision, commonly known as the Wallop Amendment, was added to the law in 1977 (PL 95-217) out of a particular concern that the CWA was being interpreted in ways that improperly interfered with traditional State laws involving quantities of water. Since efforts by EPA to reduce salinity intrusion caused by operation of state regulated water storage and diversion projects will <u>always</u> significantly "abrogate rights to quantities of water that have been established by [the] State," it is only rational to conclude that Congress did not authorize EPA to so directly interfere in state water allocation decisions.

The legislative histories of Section 208 and the Wallop Amendment support this interpretation. Section 208 was adopted in the Clean Water Act of 1972 (1972 Amendments) and it contains the first explicit Congressional recognition that salt water intrusion would be subject to certain aspects of the Act. The legislative history expressly recognizes that until Section 208 was enacted, salt water intrusion caused by upstream diversions was <u>not</u> included within the Act's regulatory scheme. The senate Report discussing the need for Section 208 explained that:

> The present Federal water pollution control program does not consider

> degradation of water caused by reduction in fresh water flows which produce the intrusion of salt or brackish waters into estuaries and rivers." Senate Report on S.2770, SR 92-414; A Legislative History of the Water Pollution Control Act ("Legislative History"), Vol. 2, p. 1458.)

The water pollution program in existence at the time this statement was made included Section 10 (c), the forerunner of Section 303 (c). <u>It was essentially the same as Section 303 (c) requiring the states to adopt water quality standards for submission to EPA and authorizing EPA to adopt its own standards if the state proposals were inadequate.</u> Thus, it is absolutely clear that prior to 1972, while Section 303 type federal water quality standards were required, they, like the remainder of the Act, did "not consider degradation of water caused by reduction of freshwater flows which produce the intrusion of salt and brackish water."

Therefore, when Congress added Section 208, it adopted a <u>new</u> program authorizing appropriate <u>state</u> management and planning to address salt water intrusion and other nonpoint sources of pollution. Significantly, Congress chose to add this new program rather than to amend Section 303 (c) to add salt water intrusion as a subject of EPA control through the water quality standard process. Instead, with respect to what is now Section 303, the 1972 amendment simply "continues the use of water quality standards contained in the existing law" (Conference Report No. 92-1236: Legislative History, Vol. 1, p. 305).

C. Section 101(g) of the Act prohibits the Adoption of the EPA Proposal Because it Would Have Impermissible, Direct Impacts on State-Established Water Rights.

Even if it is assumed, despite the legislative history of Section 208 and case law already discussed that the Clean Water Act generally contemplates direct federal regulation of salinity intrusion, Section 101 (g) of the Act nevertheless precludes EPA adoption of the estuarine salinity standard contained in the proposed standards. This section clearly establishes limits upon EPA's authority to directly reallocate State water or impair water rights. Such reallocation is nonetheless <u>exactly</u> what the EPA estuarine standard is intended to do. Indeed, EPA has admitted as much:

> "Achieving compliance with the proposed standards will require increased freshwater flows through the Delta and, thus, a reallocation of water from agriculture and urban uses to instream use for fish and wildlife enchancement." (Draft Regulatory Impact Assessment of the Proposed Water Quality Standards for the San Francisco Bay/Delta and Critical Habitat Requirements for the Delta Smelt, at pp. 4-1.

EPA, in fact, has conceded that its proposed standards will reallocate a substantial quantity of water from consumptive uses to environmental uses. Thus, EPA is mandating a "reallocation of water" irrespective of the water rights allocations that have already been established by the State of California acting under its water resource and water rights laws.

The addition of Section 101 (g) to the Clean Water Act in 1977 made explicit the existing Congressional policy of deferring to the States with respect to water rights allocation decisions. Since 1866, Congress has adopted numerous statutes establishing a consistent and well defined policy of recognizing state water right laws, and of deferring to those laws in all respects not directly inconsistent with clear congressional directives. Section 101 (g) explicitly incorporates that century-old policy.

The Conference Report on the 1977 amendments to the Clean Water Act states with respect to Section 101 (g) that "This provision is intended to clarify existing law to assure its effective implementation. It is not intended to change existing law." (Conf. Rept. 95-830, p. 52; Legislative History, Vol. 3, p. 236.) Senator Wallop, the sponsor of the provision, also explained that his amendment was intended:

> ". . . to recognize the historic allocation rights contained in the State constitution.
>
> "It is designed to protect historic rights from mischievous abrogation by those who would use an act, designed solely to protect water quality and wetlands, for other purposes. It does not interfere with the legitimate purposes for which the act was designed.
>
> "The Amendment speaks only -- but significantly -- to the rights of the States to allocate quantities of their water and to determine priority uses. It recognizes the differences in types of water law across the Nation. It recognizes patterns of use. (Legislative History, Vol. 4, p. 1030)

Thus, section 101 (g) is intended to prohibit the federal government, acting through EPA, from interfering with state allocations of water and determinations of priority among different uses, including instream and consumptive uses. It recognizes the historic role of the State in allocating water according to state constitutional and statutory systems and is designed to protect those rights from "mischievous abrogation" by those who would stretch their authority under the Act to interfere with such rights.

On the other hand, Section 101 (g) also contemplates that "legitimate water quality measures" under the Act may "incidently" affect water use. The issue, then, appears to be whether an action contemplated by EPA would abrogate or otherwise interfere with state water rights allocations, or whether it will merely "incidently affect individual water rights." If the former is true, the proposed action is prohibited by section 101 (g).

In the *Gorsuch* case discussed above, the D.C. Circuit considered whether EPA regulation of salt water intrusion caused by upstream diversions was an invalid interference with state water allocations or merely had an incidental effect on water use. The court found, in Section 101 (g), "specific indication that Congress did not want to interfere any more than necessary with state water management." (693 F.2d at p.178.) It also recognized that the section was not intended to take precedence over "legitimate and necessary water quality considerations", citing Senator Wallop's statements. It concluded, nonetheless, that federal regulation of salt water intrusion, which otherwise might be a "legitimate" consideration, was specifically precluded:

> "However, with respect to one area where quality and quantity are in conflict -- salt water intrusion caused by water diversion for drinking or irrigation -- Congress explicitly declined to require the states to control water quality." (id.)

Under the unambiguous holding of *Gorsuch*, the salinity standard proposed by EPA as an "estuarine habitat" standard, is prohibited by section 101 (g). The standard is intended to control salinity intrusion through increased releases of freshwater outflow. Given the hydrology of the Bay-Delta Estuary, this can only be done by reducing the amount of water consumptively used by competing water uses in accordance with water rights previously granted by SWRCB. The unavoidable result is a reallocation of water from consumptive uses. EPA's standards would directly "supersede or abrogate rights to quantities of water" which have been established by California under its constitutional and statutory water allocation system. This result is not the "incidental" effect on water usage contemplated by Section 101 (g), but rather a direct reduction in state allocated water rights for consumptive use, prohibited by Section 101 (g).

D. EPA Has Failed to Designate Uses as Required by Section 303 of the Clean Water Act.

In the proposed standards, EPA discusses the background of Bay-Delta water quality regulation, including the past application of the Clean Water Act to protect the Delta's water quality. At page 6 of its Rule, EPA addresses the water quality standards contained in the 1978 Delta Plan submitted by the State Board to EPA. In its discussion of these standards, the Proposed Rule raises three categories of designated uses included in the 1978 Delta Plan followed by a footnote, which states:

> "The CWA and implementing regulations describe the two components of water quality standards as "designated uses" and "water quality criteria" (40 CFR § 131.3(i)), whereas California uses the terms "beneficial uses" and "objectives." It has been EPA's and California's longstanding practice to interpret these terms synonymously. To avoid confusion, this proposal will use the federal terms "designated uses" and "criteria." (Proposed Rule on Bay/Delta Standards, (1993) page 6, footnote 1.)

EPA, however, cites no authority for its statement that the "designated uses" described by the Clean Water Act and the "beneficial uses" provided for by California's Porter-Cologne Act (Water Code §§ 13,000 et. seq.) are to be interpreted synonymously. In fact, no such authority exists to support EPA's conclusion. Moreover, EPA's attempt to rely upon the State of California's "beneficial uses" as an excuse to avoid the development of the "designated uses" required by the Clean Water Act violates the requirements of both statutes since it ignores the balancing obligations imposed by both Acts to protect the interests of competing water users.

When a State adopts water quality standards pursuant to Section 303(c) of the Clean Water Act, it must specify "appropriate water uses to be achieved and protected." (40 CFR § 131.10(a)) The uses so specified are termed "designated uses" under the CWA. As recognized by the EPA regulations interpreting the Act, (Id.) the classification of State waters for the purpose of designating uses must take into consideration:

> ". . . the use and value of water for public water supplies, protection and propagation of fish, shellfish and wildlife, recreation in and on the water, agricultural, industrial, and other purposes including navigation." (40 CFR § 131.10(a), emphasis added.)

Thus, when "designated uses" are developed pursuant to Section 303, competing water uses, including the need for public water supplies and the need for water for industrial and agricultural purposes, must be taken into account.

Water quality standards developed pursuant to Section 303 are composed, of course, not only of "designated uses" but also the "water quality criteria" based upon such uses. (§ 303(c) (2) (A)) Logically, the Section 303(c) language which requires consideration of the uses of water should also apply to the adoption of criteria under that Section. EPA has taken the position, however, that no consideration of impacts on other uses is required when adopting criteria. According to the EPA regulations, criteria "must be based upon sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use." (40 CFR § 131.11) In short, under EPA's view of § 303, while the development of "designated uses" accommodates a consideration of competing water uses, the development of "criteria" includes no such flexibility and, instead, is driven only by the need to fully protect uses which are designated.

The California water quality law, which EPA seeks to equate to the federal process of developing water quality standards, takes a different approach. Under California's Porter-Cologne Act (California Water Code Sections 13,000 et. seq.), a two-step process is also followed for the purpose of developing water quality control plans. Unlike the federal process, however, no consideration of competing water uses occurs during the first step. Instead, a detailed balancing process occurs only after "beneficial uses" have been developed.

Thus, pursuant to the provisions of the Porter-Cologne Act, "beneficial uses" are simply defined as including:

> " . . . domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves." (Water Code § 13050(f).)

Once such "beneficial uses" have been identified, the Porter-Cologne Act then obliges the State to undertake a balancing process in the course of developing water quality "objectives." Water Code Section 13241 thus provides:

> "Each regional board shall establish such water quality objectives in water quality control plans as in its judgment will ensure the <u>reasonable</u> protection of beneficial uses . . . " (Emphasis added.)

As described by the California Court of Appeals in *United States v. State Water Resources Control Board.* (1986) 182 Cal.App.3d 82:

> "We think this statutory charge ["reasonable protection of beneficial uses"] grants the Board broad discretion to establish reasonable standards consistent with overall state-wide interest. The Board's obligation is to attain the highest reasonable water quality <u>'considering all demands being made and to be made on those waters</u> and the total values involved, beneficial and detrimental, economic and social, tangible and intangible.'" (182 Cal.App.3d 82 at 116, emphasis in original.)

In order to effectuate the balancing required by the Porter-Cologne Act, California's regional water quality control boards are thus required to consider the following issues when they establish water quality "objectives:"

> "a. Past, present, and probable future beneficial uses of water.
>
> . . .
>
> c. Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area.
>
> d. Economic considerations.
>
> e. The need for developing housing within the region.

The crucial difference in the development of "water quality standards" pursuant to the

Clean Water Act and the development of "water quality plans" under California's Porter-Cologne Act, is thus one of timing. While both processes incorporate a balancing process that takes competing water uses into consideration, the balancing occurs at a different time depending upon whether it is the EPA's process or the California process which is followed. Thus, if it is EPA's process of developing "water quality standards" which is used, the consideration of competing water uses occurs up-front, when uses are designated. Under California's Porter-Cologne Act, on the other hand, the balancing of competing water uses occurs at the end, when the State decides how to "reasonably protect" previously developed "beneficial uses."

By reaching the facile conclusion that California's previously designated "beneficial uses" are identical to the "designated uses" provided for by the Clean Water Act, EPA's proposed standards manage to neatly dispense with any consideration of competing water uses, even though such consideration is required by both state and federal law. Instead, the proposed rule combines state developed "beneficial uses" (which involve no consideration of competing water uses) with federal "criteria" (which EPA holds involve no consideration of competing water uses) to produce water quality "standards" which completely fail to "take into consideration the use and value of water for public water supplies . . . recreation in and on the water, agricultural, industrial, and other purposes . . . " (§ 303(c) (2) (A); 40 CFR § 131.10)

In short, if EPA is to comply with the requirements of the Clean Water Act and its own regulations in attempting to develop "water quality standards" for the Bay-Delta Estuary, it cannot simply treat the State of California's "beneficial uses" as "designated uses" under the Clean Water Act. Instead, since EPA has chosen to reject California's Water Quality Control Plan for the Delta, it cannot just piggy-back upon the State's "beneficial uses." To meet the requirements of the CWA and its own regulations, EPA must develop its own "designated uses" for Bay-Delta Estuary waters which take into consideration the competing uses of such waters made by all contractors reliant upon the Central Valley Project and State Water Project.

E. By Failing to Propose Standards Which Provide Better Protection of the Estuary's Most Sensitive Species At a Lower Cost to Competing Consumption Water Users, the Proposed Rule Violates Section 101 (g) of the Clean Water Act.

Apart from the jurisdictional considerations which arise from Sections 208,303 and 101 (g) of the Clean Water Act, EPA's own interpretation of Section 101 (g) casts considerable doubt upon the validity of the proposed standards. These doubts are greatly amplified by consideration of the modifications of the Bay/Delta Standards recommended in these comments.

After Section 101 (g) was added to the Clean Water Act in 1977, EPA developed and published a document dealing with the so-called "antidegradation policy" set forth in regulations adopted to implement the Act. (40 C.F.R. §1131.12) Entitled "Questions and Answer on Antidegradation," EPA's publication posed and answered, a series of questions regarding the Agency's antidegradation policy. Among them was the following:

> "30. What is the Relationship Between the Antidegradation Policy, State Water Rights Use Laws and Section 101 (g) of the Clean Water Act Which Deals With State Authority to Allocate Water Quantities?" (Questions and Answers of Antidegradation, p.11)

EPA's answered its own question as follows:

> "The exact limitations imposed by Section 101 (g) are unclear; however, the legislative history and the courts interpreting it do indicate that it does not nullify water quality measures authorized by CWA (such as water quality standards and their upgrading, and NPDES and 402 permits) even if such measures incidentally affect individual water rights; those authorities also indicate that if there is a way to reconcile water quality needs and water quality allocations, such accommodation should be pursued. In other words, where there are alternative ways to meet the water quality requirements of the Act, the one with the least disruption to water quality allocations should be chosen. Where a planned diversion would lead to a violation of water quality standards (either the antidegradation policy or a criterion), a 404 permit associated with the diversion should be suitably conditioned if possible and/or additional nonpoint and/or point source controls should be imposed to compensate." (Id., emphasis added.)

In short, where there are alternative approaches to meeting the Act's water quality requirements, EPA has interpreted Section 101 (g) to require that the least-cost alternative be chosen. An obvious question thus arises: How can it be determined whether a particular alternative "meets the water quality requirements of the Act"? Again, EPA has offered its own interpretation:

> "For waters with multiple use designations, the criteria should support the most sensitive use." (40 C.F.R. §131.11(a))

Assuming arguendo that this interpretation is correct, it indicates that if there is an alternative way to protect the Delta's most sensitive species and if that protection can be provided at a lower cost to competing consumptive water users, it would amount to arbitrary and capricious conduct for EPA to fail to adopt the alternative. (See also *Westlands Water Dist., et al. v. United States, et al.* No. CV-F-93-5327 OWW, U.S.D.C. E.D. Cal. Memorandum Opinion and Order, filed Feb. 11, 1994, pp. 84-85.) Here, the modifications to the EPA's proposal standards recommended by the San Luis & Delta-Mendota Water Authority amount to such an alternative.

The recommended modifications will provide better protection to the two species -- Winter Run salmon and Delta smelt -- listed under the Endangered Species Act, than the estuarine standard proposed by EPA. The recommended modifications will provide such protection, moreover, without a substantial reduction in protection for other, less sensitive, Bay-Delta species. Further, they will provide improved protection to the Estuary's listed species with substantially less disruption to water quality allocations previously made by the State of California. Given these circumstances, adoption of the estuarine standards proposed by EPA would offend the Clean Water Act -- as the Act has been previously interpreted by EPA itself.

F. The Regulatory Impact Assessment Fails to Comply With the Requirements of Executive Order 12866 Due to the Gross Inadequacy of the Economic Impact Analysis of the Proposed Standards.

Executive Order 12866 requires federal agencies promulgating regulations to assess alternatives, to assess the costs and benefit of any proposed regulations, and to adopt regulations which impose the least burden on society. As described in more detail in the Economic Effects Section of these comments, the EPA's economic analysis of the proposed standards is woefully inadequate.

The EPA's economic analysis is based on flawed assumptions, neglects critical factors such as groundwater pumping costs, ignores crucial impacts on employment levels and generally fails to quantify or measure the alleged benefits of the proposed standards. The inadequacy of the analysis raises a serious question whether it can be considered a good faith attempt at compliance with the Executive Order. Because of the significant impact of the EPA's proposed action, the economic analysis should be withdrawn and re-done in full compliance with Executive Order 12866.

SECTION 3

WATER COST OF THE PROPOSED EPA STANDARDS

INTRODUCTION

The proposed EPA standards are comprised of three parts:

Salinity standards for the western Delta

Salmon smolt (small, out-migrating salmon) survival standards

Striped bass spawning standards for the lower San Joaquin River.

The salinity standards can be further subdivided into standards for Roe Island, Chipps Island, and the confluence of the Sacramento and San Joaquin Rivers.

The water cost of these standards has been estimated by a variety of methods. In addition, there is considerable uncertainty about exactly how the standards would be applied. Therefore, several estimates of the gross water cost have been made under different assumptions about their application. Most of these estimates have been made by the State Department of Water Resources. DWR used mathematical models to simulate operation of the state and federal water projects. The California Urban Water Agencies/San Luis and Delta-Mendota Water Authority team, and the Contra Costa Water District, have also analyzed the water cost of the standards using a different approach which also takes into account (1) the sharing of water between the Central Valley Project and State Water Project and (2) within the Central Valley Project service area, the hierarchy of allocation to meet Central Valley Project obligations. These analyses are contained later in this section.

SUMMARY

The water cost of the proposed EPA standards is large, in the range of 0.5 to 1.5 million acre-feet (maf) per year on the average. For critically dry years, when water needs are greatest, the EPA standards would cost in the range of 1.5 to 3.0+ maf.[3] These estimates do not account for the water cost of certain parts of the standards. For example, the water cost of the striped bass standards in critically dry and dry years were not included because they could not be met. The water cost would, therefore, be even greater than estimated.

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[3] These ranges occur because of different assumptions that can reasonable be made as a basis for the water cost analysis. These assumptions are discussed later in this report.

In addition to this direct water cost, there is an indirect cost. This indirect cost arises from the riskier operation of the state and federal reservoirs. In other words, in attempting to comply with both the EPA requirements and the urban/agricultural needs, reservoirs must be drawn down more by the end of each water year than without the EPA standards.

These lower, end-of-year storage levels would cause water shortages in some years, and these shortages would be counted in the water cost estimates. In effect, the federal and state water systems would be operating with less water in reserve. So, in general, there would be greater risk of water shortages and the accompanying loss of hydropower energy and recreation benefits at reservoirs. In addition, there would be less opportunity to control instream temperature and provide instream flows for fish and a greater risk of not having enough water to keep salinity from intruding into the Delta in a series of dry and critically dry years.

There is another indirect water cost that has not yet been fully analyzed. This cost relates to the "transferability" of water. Water transfers (sometimes known as "water marketing") are generally assumed to be the method by which urban and some agricultural users can make up for the water shortages caused by the EPA and other Delta protection standards.

EPA's goal in proposing western Delta salinity standards is to achieve salinities typical of the late 1960's-early 1970's during February-June. In terms of water cost, the standards far exceed that goal. That goal should be achievable for a water cost no greater than about 0.7 maf/yr.[4] The western Delta salinity standards would have to be modified significantly to be consistent with EPA's stated goal.

The water cost of the EPA standards can be compared with the water costs of other new federal requirements already in effect or being proposed. These other requirements result from implementation of the federal Central Valley Project Improvement Act and actions under the Endangered Species Act (ESA) to protect three fish listed as threatened or endangered, the Winter-run salmon, the Delta smelt, and the Sacramento splittail. If all of these requirements were in effect along with the EPA standards, the water cost could be even higher than for the EPA standards alone. The additional water cost cannot be estimated with much certainty for several reasons:

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[4] We explain this conclusion later. In brief -- The goal is to achieve salinities in the western Delta typical of late 1060's - early 1970's. Salinities in the western Delta are controlled by Delta outflow. Therefore, the goal is to reproduce February-June Delta outflows as of the late 1960's - early 1970's. Therefore, the standards should cost no more than the increase in use in February-June since the late 1960's - early 1970's. This increase, most of which is in the form of increased Delta exports, is about 0.7 million acre-feet.

- The endangered species requirements have been changing annually.
- The recovery plans for these species have not been developed.
- The take limits for endangered species have unpredictable effects on export pumping and, therefore, on water cost.
- Requirements to achieve all objectives of the CVP Improvement Act have not yet been developed. Of particular concern is the requirement to double anadromous fish populations by the turn of the century. One of these anadromous fish, the striped bass, feeds on the endangered species, raising the possibility that if striped bass populations do double, more severe constraints might be required for water projects to offset the increased predation of striped bass on endangered species.

Despite these uncertainties, it is clear that the water cost of the EPA standards alone may be a considerable underestimate of the ultimate water cost of all the new federal requirements taken together.

ESTIMATING GROSS WATER COSTS

The water cost of the proposed EPA standards can be estimated by a three-step process:

1. Estimate the amount of water that can be delivered to urban and agricultural water users without the proposed standards.
2. Estimate the amount of water that can be delivered to urban and agricultural water users with the proposed standards. This will be a smaller amount.
3. Find the difference between the two amounts. This is the water cost of the proposed standards.

This three-step process has been completed by the State Department of Water Resources. We base our estimates of water cost on DWR's estimates. In addition, we will confirm DWR's estimates by another method developed by the Contra Costa Water District.

RESULTS OF ESTIMATES OF GROSS WATER COST

The estimates can be summarized as follows:

Estimates by the Department of Water Resources

If the combined state and federal export demand is 7.1 maf/year (roughly, current demand) and a conservative margin of error is provided (95% chance of compliance), the gross state and federal projects water cost of the EPA standards alone compared to D-1485 would be:

Average: 1.5 maf/yr
Critical Year: 3.1 maf/yr
Reduction in Carryover Storage: 2.5 maf

There is some concern that the particular method used by DWR may have overestimated the extra water required for the desired margin of error at the two upstream stations, Chipps Island and the confluence of the two rivers. However, DWR's method probably underestimated the water required at Roe Island, the downstream station.

If the combined state and federal export demand is 7.1 maf/year and no margin of error is provided,[5] the water cost of the EPA standards alone compared to D-1485 would be:

Average: 0.9 maf/yr
Critical Year: 1.6 maf/yr
Reduction in Carryover Storage: 0.6 maf

If the existing Winter-run requirements are added to the EPA standards, the water costs noted above would change as follows:

Average: 0.2 maf/yr increase
Critical Year: 0.0-0.1 maf/yr increase
Reduction in Carryover Storage: 0.2-0.3 maf decrease

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[5] There would be three general ways to avoid providing a margin of error. One would be to allow compliance to be measured on some sort of average basis. The other would be to convert salinity back into Delta outflow, as suggested by EPA in their request for comments. A third would be the "three ways to win" method of compliance recommended by the Contra Costa Water District.

If the combined state and federal export demand is 6.0 maf/year (the demand several years ago) the water costs noted above change as follows:

Average: 0.4 maf/yr decrease
Critical Year: no change (not enough water for 6.0 or 7.0 demand)
Reduction in Carryover Storage: 0.3-0.6 maf increase

There is some dispute over DWR's estimates of water required to comply with D-1485 alone. This dispute centers on DWR's use of carriage water, water ostensibly required to keep salinity from intruding up the San Joaquin River, thereby degrading water quality in the southern Delta. If the carriage water requirements are, in fact, not needed, then DWR's estimates of water required for compliance with D-1485 could be high by several thousand acre-feet per year. Consequently, their estimates of water cost for EPA standards (which supersede carriage water in part of the year) would be low.

Estimates by the Contra Costa Water District

If the EPA standard for western Delta salinity had been in effect from 1968 to 1991, the additional Delta outflow (water cost) would have been:

Average: 1.0 maf/yr
Critical Year: 1.6 maf/yr
Reduction in Carryover Storage: estimates not possible by this method

These water costs do not include any margin of error for a compliance safety factor as some of the DWR estimates do.

Note that these estimates do not account for any changes in water project operations that may have occurred had the EPA standards been in effect in the past. This would tend to make these estimates somewhat higher than they should be. Nor do they account for the lack of D-1485 standards prior to 1978. This would also tend to make these estimates somewhat higher than they should be. Finally, these water cost estimates are based on actual Delta outflows in the past, so they inherently include past export demands that were substantially less than even the lower 6.0 maf/yr demand used by DWR. This would tend to make these estimates of water cost lower than they should be. Nevertheless, the CCWD estimates are consistent with the DWR estimates.

Estimates by both agencies support the conclusion that the water cost of the EPA standards is high.

DISCUSSION OF THE METHODS OF ESTIMATING WATER COST

While the three-step process of estimating water cost, described above, is straightforward in concept, it is confounded by several factors, the most important being the following:

- The EPA standards are not the only standards[6] of concern. The others are described briefly below:

D-1485, the 1978 decision by the State Water Resources Control Board, includes requirements to protect Delta fish. These requirements are generally regarded as baseline environmental protection. Some parts of the requirements listed below might also fall into the category of baseline requirements.

The Central Valley Project Improvement Act is a federal law containing several important requirements to protect fish and wildlife. This law pertains to the federal Central Valley Project. It requires the allocation of 800,000 acre-feet/year of Central Valley Project water to environmental protection. It also requires that actions, as yet not defined, be taken to double the population of anadromous fish within a specified time period.

Requirements to protect the Winter-run salmon, an endangered species, occur in three forms. The first of these, the "biological opinion," includes requirements to protect the species from extinction. Second, the "incidental take limits" limit the losses of Winter-run salmon smolts at the state and federal pumps where water is exported from the Delta. These requirements have been in effect since 1992, although the numerical take limits are revised annually based upon estimated smolt counts. Third, the recovery plan, now being developed, would consist of measures to allow recovery of the Winter-run salmon population. These measures could include further requirements for the water projects in addition to addressing the other factors affecting the Winter-run.

Requirements to protect the Delta smelt, a threatened[7] species, occur in the same three forms as for Winter-run salmon, that is, a biological opinion, incidental take limits, and a recovery plan. The first two of these were in effect last year and have been revised for 1994. The recovery plan is being developed.

The question arises: Which of these requirements or parts of these requirements, if any, should be included along with D-1485 as the basis for determining water cost. Put

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[6] "Requirements" is probably a better term than "standards" and will be used herein to mean any rules set to protect environmental values in the Delta.

[7] As a practical matter, there is a little difference, in terms of protective requirements, between "threatened" and "endangered" species.

another way, in Step 1 above, just what does "without EPA standards" mean?

Obviously, the more requirements included in the basis of comparison, the lower the water cost of the EPA standards. For example, adding the current Winter-run requirements to D-1485 as the basis decreases the water cost of the EPA standards relative to D-1485 alone by roughly 400,000 acre-feet per year in critically dry years.

- The water cost is affected by the agricultural and urban water needs. The more water that is needed, the greater the shortfall in deliveries ("water cost") that will occur. EPA has argued that the needs they are trying to meet are those that existed in the recent past. These needs amount to about 6.0 maf/yr to be exported out of the Delta by the State Water Project and the federal Central Valley Project. However, the current demand for Delta exports is, in fact, nearly 7.1 maf/yr.

- Increasing the demands from 6.0 to 7.0 maf/yr increases the average water cost of the EPA standards by about 400,000 acre-feet per year. That is, the average shortfall is about 400,000 acre-feet per year more if the projects are trying to deliver 1.0 maf/yr more. This increase is in excess of the 0.5 to 3.0+ maf referred to above. The water cost for critically dry years does not increase as the demand increases; in those years, there is not enough water to meet a 6.0 million acre-foot need, much less a 7.1 maf need.

- The gross water cost increases if it is assumed that the proposed standard would be rigidly enforced. Rigid enforcement would require a margin of safety to ensure compliance. This margin of safety can be provided by having enough Delta outflow to keep the 2 ppt salinity somewhat downstream of (and X2 somewhat less than) what the standard requires. DWR assumed a margin of safety that would ensure compliance with the standard most of the time. This margin of safety roughly doubles the water cost. The upper values in the range of water costs cited above result from this margin of safety.

ERRORS IN THE CALCULATION OF THE WESTERN DELTA SALINITY STANDARD

Why would the proposed standards cost more water than necessary to conform with the late 1960's - early 1970's goal of EPA? The answer is that three errors were made in Step 4 of EPA's development of the western Delta salinity standards. These errors have been acknowledged by EPA and comments have been requested to correct them. Nevertheless, as proposed, the standards include these errors. They are as follows:

Using the average number of days as the standard, that is, making the average number of days for each year type the minimum number of days that must be achieved to comply with the standard. This results in making the values that would have occurred, during dryer years of each year type, a violation of the standard. Therefore, for those drier years of each year type, the water cost for compliance would be great.

Extrapolating to get the average number of days for critically dry years. This extrapolation was done incorrectly and resulted in an overestimate of the number of days that X2 was downstream of the three locations in critically dry years. This means that compliance with the critical year standard would take far more Delta outflow than would have occurred if there had been critically dry years around 1975, according to DWR's 1975 level of development analysis.

Using the period 1940-75 to represent the late 1960's-early 1970's. The early years of this period had far less water use than the late 1960's-early 1970's. Therefore, the water cost of compliance would be greater than that required to place X2 in the intended locations.

GENERAL EFFECT OF PROPOSED REFINEMENTS ON WATER COST

Note that refinements to the proposed standards are being considered by several parties:

- A different relationship between X2 and Delta outflow has been developed by the Contra Costa Water District.
- Surface salinity rather than bottom salinity has been considered.
- Movement of salinity sampling stations has been considered.

If such refinements are recommended, they cannot be assumed to result in lower water cost. Such refinements would have to be incorporated into the Step 4 sub-steps described above. If the same sub-steps were used, the resulting standard should have about the same water cost.

On the other hand, "sliding scales" have been developed by DWR and by CCWD. These two sliding scales are similar. A sliding scale would tie the western Delta salinity standard more directly to runoff. Now, runoff is used to place each year in one of five categories (year types, namely, wet, above normal, below normal, dry, and critically dry). The sliding scale would eliminate the stepwise nature of the proposed standard. That is, with the proposed standard, slight changes in runoff can cause a shift from one water year type to another and a corresponding significant change in the western Delta salinity standards and water cost. Without a sliding scale there will also occur instances when spring rains will trigger wetter year type flow requirements which cannot be met because too few days remain in the February - June period.

WATER SUPPLY IMPACTS TO CVP AGRICULTURAL WATER SERVICE CONTRACTORS SOUTH OF THE DELTA

An accurate evaluation of federal water costs can not be performed without also recognizing the specific distribution of water cost impacts resulting from the hierarchy of various water obligations. These water obligations can be categorized as follows:

Water Rights Exchange Agreements
Legislative Mandates
Municipal and Industrial Service Contracts
Agricultural Water Service Contracts
Litigation Settlement Supplies
Delivery Losses

Water rights and water service contracts are readily documented, consisting of agreements and contracts with specific terms and conditions. These terms and conditions may include deficiency provisions, terms for payment of water, repayment of capital obligations, etc. These terms and conditions vary depending upon whether a contract is of a water rights, agricultural water service, or municipal and industrial type.

Legislative mandates are exemplified by P.L. 102-575, which specifies increased levels of supply and maximum deficiencies to wildlife refuges and management areas.

Litigation settlement obligations are those such as the Barcellos Judgment. In this case, the U.S. Bureau of Reclamation is required to, among other things, deliver 250,000 acre-feet (AF) per year of agricultural water to Westlands Water District's Priority Area II, the former Westplains Water Storage District. Another example is the delivery of about 37,000 AF of alternative habitat mitigation water to Kesterson Natural Wildlife Refuge.

The last category is delivery losses. This is included as an obligation or demand, since such losses will occur with the delivery of water and are in addition to contractual or other obligations.

Each category of obligation is subject to a specific allocation priority. This allocation hierarchy occurs due to either prioritization of USBR/CVP agreements or reprioritization of obligations due to legislative mandates.

The allocation of CVP supplies can be represented by a two-tiered hierarchy herein after referred to as Group I and II. Under this allocation system, Group I obligations must be met first and generally have only two levels of supply, 100 percent or 75 percent. Group II obligations can only be served after Group I obligations have been met. Further, the supplies available to Group II are then apportioned, based upon contract entitlements which contain no minimum delivery provisions.

Table 3-1 lists the water obligations by Group along with the 100 percent, 75 percent, and typical allocation.

The overcommitment obligation of CVP Delta export supplies has contributed significantly to estimated deficiencies to be borne by Group II. Table 3-1 shows that the current total CVP Tracy export obligation is 3,353,736 AF.

Determining the level of overcommitment requires an analysis of CVP export capabilities as presented in Table 3-2. This analysis demonstrates that even under the most optimistic of unrestrained export operational scenarios, CVP export water obligations exceed supply by about 200,000 AF. Given the hierarchy of allocation, this over obligation, even under the most optimistic supply assumptions, produces an immediate Group II deficiency of approximately 10 percent, assuming Group I takes its full entitlement.

As discussed earlier, it is debatable as to which Delta protection requirements should be included with a water cost study that reflects conditions without EPA requirements. As a result, three different regulatory conditions have been analyzed to show the effects of how the Delta protection requirements interact with each other and with the proposed EPA standards. Furthermore, the previously stated state and federal water costs, based on a state and federal export demand of 7.1 maf/year, have been detailed to show the direct water costs to CVP.

Condition 1 D-1485 in place by itself
Represents the base condition without any federal action.

Condition 2 D-1485, CVPIA, and the proposed EPA standards in place. Reflects long-term regulatory constraints assuming that the goals of the Winter-run salmon and Delta smelt recovery plans are eventually reached and therefore the species-related standards would not be required.

Condition 3 D-1485, CVPIA, NMFS Winter Run Salmon Biological Opinion, and the proposed EPA standards in place. Represents regulatory conditions that will immediately affect exports, if the proposed EPA standards are finalized as currently written. This condition also reflects any overlap that may exist between EPA's standards and other agency requirements. The Delta smelt biological opinion was omitted from this condition because long-term export estimates were not available with this regulatory constraint in place. However, it is assumed that many of the requirements within the opinion, with the exception of the incidental take limits, overlap those contained within the proposed EPA standards.

The detailed effects to CVP exports under the three conditions are shown in Tables 3-3, 3-4, and 3-5. A summary of the three tables is shown below in Table A.

Table A

Average Export or Allocation by Year-Type (Percent of Contract Supply)

Year Type	Condition 1 D-1485 Only			Condition 2 D-1485 + CVPIA + EPA			Condition 3 D-1485 + CVPIA + NMFS Winter-Run + EPA		
	Total CVP	Exchange Contractors	Group 2 Contractors	Total CVP	Exchange Contractors	Group 2 Contractors	Total CVP	Exchange Contractors	Group 2 Contractors
Wet	93	100	90	78	100	59	76	100	56
Above Normal	99	100	98	82	100	66	76	100	56
Below Normal	100	100	100	79	100	62	74	100	53
Dry	93	95	92	78	96	61	73	94	54
Critical	84	83	83	66	83	50	58	79	38
71 year Average	94	99	91	77	97	59	72	95	52
Critical Period 1928-34	81	93	74	57	83	32	56	83	28

Note that during wet and above-normal year-types, the average export and Group 2 allocation percentages are lower than dryer year-types under conditions 1 & 2. This is possibly due to San Joaquin River flows to Mendota Pool supplementing exports in addition to lower consumptive use during wetter years. Thus, the export and allocation supplies listed for wet and above-normal year-types reflect lower export demands, non typical San Joaquin River flow contributions, and regulatory export restrictions. It is not clear, however, how much each factor has affected the estimated export or allocation percentage of full supply.

Table B, shown below, lists the average water costs of conditions 2 & 3 compared to condition 1.

Table B

Allocation of Export Shortages (TAF) Compared to Condition 1 (D-1485 Only)

Year Type	Condition 2 D-1485 + CVPIA + EPA			Condition 3 D-1485 + CVPIA + NMFS Winter-Run + EPA		
	Total CVP	Exchange Contractors	Group 2 Contractors	Total CVP	Exchange Contractors	Group 2 Contractors
Wet	404	0	552	458	0	606
Above Normal	453	0	573	652	0	760
Below Normal	603	0	694	756	0	850
Dry	415	-5	545	556	13	667
Critical	530	0	588	800	36	807

Under condition 2, export reductions could range on an average from approximately 400 to 600 TAF annually. However, condition 2 is currently unrealistic since the Winter-Run Salmon Opinion has been excluded. As a result, condition 3 is the most probable case with the proposed EPA standards which will reduce exports on an average from approximately 460 to 800 TAF annually. Also shown in Table B, the Group 2 Contractors' allocation incurs most of the export reductions. This is because of the hierarchy of water allocation discussed in a previous section. Note that under Condition 3, Group 2's allocation shortage for a Dry year-type is less than the shortage for a below-normal year-type. This is because, during the export impact analysis, the trigger for the Exchange Contractors 25% deficiency was not a Shasta in-flow criteria but rather a Dry or Critical year-type. This caused a slight amount of allocation variation between the Exchange Contractors and Group 2 during Below-Normal and Dry year-types and, as a result, created this inconsistency.

It is again stressed that the export and allocation impacts shown above do not reflect any water supply impacts as a result of incidental take limits defined in the Winter-Run and Delta -Smelt Opinions or instream flows required by the CVP Improvement Act. All such additional restrictions will further reduce CVP Group 2 supplies.

WATER CONSERVATION IN WESTLANDS WATER DISTRICT

The EPA Standards Regulatory Impacts Analysis assumes agricultural water agencies will implement water conservation measures to help overcome water supply deficiencies. The following section describes the Water Conservation Program is Westlands Water District, the largest agricultural member agency in the Water Authority.

The Program

Water conservation was a key objective in the design of Westlands' distribution system in the early 1960s. A closed pipeline distribution system and metered deliveries are required for optimum water management. This system enables the District to equitably and efficiently deliver its water supply with virtually no seepage and system losses.

Westlands' annual CVP Contract water supply is 1.15 million acre-feet (AF). But even in years when the full Contract amount is delivered, Westlands' supply is not sufficient to meet minimum farm needs in all areas of the District. The need for additional water for Westlands is also driven by the trend in cropping patterns away from low-water use grains to more water-intense vegetables. Also, the effect of federal Reclamation law has been a reduction in farm size which intensified the need to irrigate all available acres.

In 1972 the District began to look at on-farm water management as a means for immediate conservation gains. The goal then, as it is today, was to provide farmers with accurate and up-to-date information on water management planning and decisions.

As chronicled in the District's 1992 Water Conservation Plan, Westlands' Water Conservation Program far surpassed the goals of its 1985 Water Conservation Plan to meet the changing needs of its farmers under increasingly difficult water and drainage conditions. The Program responded to these needs and other critical issues with information and assistance programs in an effort to achieve the parallel goals of optimum use of available water and reduced deep percolation.

The Program is staffed by two graduate-level water management specialists under the direction of the Water Conservation Coordinator, a civil and agricultural engineer. The Program collects data, provides practical information to the farmers, renders technical assistance as necessary, and keeps abreast of statewide water conservation developments.

Over the years, there has been a substantial increase in the number of pressurized (sprinkler and drip) irrigation systems, and intensified irrigation management through the use of irrigation specialists and science-based irrigation management. This has resulted in improved irrigation efficiencies and a relative stabilization of shallow groundwater depths.

The current Water Conservation Program described in Westlands' 1992 Water Conservation Plan and the Draft 1993 Water Conservation Plan Update consist of the following elements:

Soil, water, and climatic data monitoring, collection, and analysis.

- The Irrigation Guide which provides farmers in the three District regions with water requirements for various crops based on actual weather and computer modeling.
- The Irrigation Management Handbook which provides water management information for Westlands-specific farming conditions.
- Profitable practices which highlights progressive efforts by farmers to conserve water and reduce costs or increase income.
- Workshops and meetings with small groups of farmers to facilitate a two-way flow of timely water management information.

- The Irrigation Improvement Program provided cost sharing to farmers to retain the services of approved private irrigation consultants (discontinued in 1991, data analysis continues).

- Technical assistance and water conservation computer programs provide farmers with one-on-one interaction on irrigation management concerns.

- Water measurement involving the installation, upgrading, and repair of District water meters.

- Groundwater monitoring provides farmers with information on the water quality and depth of deep groundwater.

Shallow groundwater monitoring provides farmers with information on the water quality and depth of shallow groundwater.

- Efficiency testing of District pumps which are a part of the water distribution system.

- Conjunctive use of surface and groundwater which improves overall water supply reliability.

  New programs on the drawing board for the next five years are:

- Financial assistance for improving irrigation systems.

- Incentive-based pricing which provides financial motivation for farmers to use less water and to utilize the water savings on water-deficient lands in the District.

- Salinity assessment and monitoring of salt-affected lands.

- Evaluation of pumping plant regulating reservoirs to determine seepage losses and if lining or treatment is economically feasible.

- Initiating a groundwater management program pursuant to California Water Code Section 10750 (A.B. 3030).

- Providing nonagricultural water users with water conservation information.

Limited Water Conservation Potential

The San Joaquin Valley Drainage Programs's (SJVDP) final report entitled, A Management Plan for Agricultural Subsurface Drainage and Related Problems in the San Joaquin Valley, dated September 1990, states on page 98:

> "Current average deep percolation in the study area is estimated to vary from about 0.90 to 1.05 feet (Burt and Katen 1988: D.G. Swain, 1990). Assuming 0.3 foot is the minimum amount necessary to achieve required salt leaching and is also the amount moving downward through the Corcoran Clay, nonbeneficial deep percolation contributes 0.60 to 0.75 foot annually to potential problem water."

The study area is the area in Westlands with a shallow groundwater depth of five feet of less. The actual deep percolation is 0.2 AF/Ac in shallow groundwater areas of five feet or less, as determined from analysis of the data collected as part of Westlands' 1987-91 Irrigation Improvement Program.

The SJVDP report entitled, Technical Information Record, Documentation of the Use of Data, Analysis, and Evaluation Process that Resulted in the SJVDP Recommended Plan, dated September 1990, states on pages 5-24 that:

> "Some advocates argue that the target level of deep percolation has already been reached, and any further efforts to add additional water conservation measures would not be beneficial. However, this conclusion was based on calculation of deep percolation without a subsurface drainage system in place . . . Consequently, with a drainage system in place, the irrigation application and water-use efficiency will be lower than is presently calculated by irrigation districts in areas with shallow groundwater and without on-farm drains. Thus, increased water conservation would be required to maintain the present applied water requirement once a drainage system is installed."

The report states that more water will be applied in the future when drains are installed and this additional water will be conserved.

The conditions described in the SJVDP report do not result in water that can potentially be conserved. *The Report describes the application of more water than is currently available. about 0.6 AF per acre, then reduces this inflated amount by about 0.35 AF per acre and identifies it as conserved water--water that did not exist in the first place.* This clearly demonstrates that the water conservation potential described in the SJVDP report does not exist in Westlands.

Economic Impacts

Westlands contains about 563,000 fertile acres in western Fresno and Kings Counties in California's San Joaquin Valley. The District water requirement is more than 1.5 million AF, because it requires about 2.7 AF of water to irrigate each acre in Westlands.

The District's current annual contract entitlement from the Central Valley Project (CVP) is 1.15 million AF. The available groundwater is approximately 0.2 million AF when pumping the annual safe yield. This leaves an annual shortage of approximately 0.15 million AF. Westlands must ration water to its farmers even in the wettest years. Even under the best conditions of a full CVP water supply and pumping groundwater at the safe yield of the aquifer, some land must be fallowed.

Groundwater pumpage in the San Joaquin Valley exceeds safe yield by hundreds of thousands of AF. This excess pumpage cannot continue because it causes subsidence and an increase in soil salinity because the groundwater is of a poorer quality.

Short-Term Water Shortages

The management decisions made by farmers during short-term water shortages, such as those caused by drought, are considerably different than those that would be made to cope with a long-term water supply shortage.

The water shortages caused by droughts usually come on quickly and last for a short period of time, then water supplies are restored. The farmer will make management decisions that will allow retention of farmland and equipment if possible so that farming can resume when normal water supplies become available. The decisions to increase the water supply might include pumping poorer-quality groundwater, overdrafting groundwater, or purchasing transferred water at an exorbitant price to save a crop.

The decisions to reduce the amount of water that will be necessary to grow a crop could include skip-row planting, underirrigation, or growing crops with a lower water requirement. Fallowing or the temporary idling of land is a standard practice during water shortages.

The economic objective is to maximize income or in some cases to minimize losses. The management objectives are not to use more or less water, fertilizer, or labor, but to have the greatest economic return from the use of available resources. Those resources include land, labor, equipment and fuel, and soil amendments, as well as water. Some farmers increase debt so they can drill wells or purchase transferred water. Some farmers spend money that has been set aside for retirement in order to save the family farm. Some members of the family work off the farm in order to maintain the farmstead.

Long-Term Water Shortages

The management decisions made by farmers during long-term water shortages must consider the loss of farm equity that occurs when water supplies are less than necessary to crop all the irrigable acreage in the farm.

The California Water Code requires water districts to rateably allocate available water supplies to all farmland in the District. So, if a portion of the land in a farm is sold, a portion of the water supply is lost.

One of the options is to permanently take some land out of production so that the remaining land will have an adequate water supply. As an example, if about one half of the land on a farm is permanently idled, the average value of all the land drops to almost one half.

The average appraised value of farmland in Westlands has lost about $1,000 per acre due to the short-term water shortages as estimated by a major agricultural lender and a real estate appraiser in the area.

Financing farming operations is very difficult during water shortages. Lenders require applicants to demonstrate that a guaranteed water supply is available prior to considering loan applications.

The lending policy of the Mutual Life Insurance Company of New York (MONY) is described in their letter of February 10, 1994, to Senator Dianne Feinstein which states:

> "Our underwriting criterion are well established and similar to most other lenders of long-term agricultural credit. Borrowers are evaluated on the basis of their historic and projected future ability to generate the cash flow necessary to repay the proposed loan and all other debt obligations with surplus adequate to cover living expenses, farming risks, and a return on their investment. The loan is

secured by real estate which is appraised to determine its adequacy for securing the loan in the event of default. The real estate is further evaluated to establish its capacity to generate a cash flow sufficient to service the prospective debt obligations.

A reliable and adequate supply of irrigation water is a foundational assumption in this evaluation. Since we must look a minimum of 15 years into the future, projecting water availability, commodity prices, and farm expenses with any certainty is difficult under the best of circumstances. However, the face that water contracts no longer have any assurance of renewal after 25 years, as stated in the Central Valley Improvement Act, and considering the onerous interim contract renewal requirements promulgated by the U.S. Bureau of Reclamation on December 16, 1993, the only possible assumption concerning water availability within the CVP service areas is that it can be neither reliable or adequate.

In consideration of the above, the following policies have been established respecting loan inquiries in areas served by CVP water contracts:

- Lands relying on CVP contracts for their sole source and supply are no longer considered to have a stable and uninterruptable supply of irrigation water and will therefore not generally be considered as acceptable security for lending.

- Lands relying on CVP contracts as their primary source and supply shall only be considered as acceptable security for financing as they can show a viable alternative and independent supply, either pump or surface water, adequate to meet all of their irrigation needs on an extended or possibly permanent basis.

- Lands proving groundwater as their backup supply must provide evidence of the stability of the aquifer and its ability to recharge quickly following extended periods of heavy pumping as occurred during the recent six-year drought. Groundwater in areas of chronic overdraft shall not be considered an acceptable backup water supply at any time.

- Water transfers shall not be considered an acceptable backup water supply until implemented on a statewide basis with well established rules and in a manner assuring long-term availability at prices allowing production agriculture to operate on an economic basis. Water transfers are not expected to be a viable alternative supply for long-term loan underwriting purposes during this decade.

The policies outlined above have considerably restricted the areas where we are willing to invest and have effectively eliminated much of the western and southeastern San Joaquin Valley as well as portions of the Sacramento Valley. However, we do continue to make every effort to serve existing borrowers in areas excluded by these policies, limited by the fact that we do not materially increase our investment exposure.

As indicated above, we are also giving increasing attention to pumped groundwater utilized for irrigation. Water supplies under CVP and SWP contracts aid considerably in reducing the groundwater overdrafts, particularly in the San Joaquin Valley. With the likelihood of continued delivery cutbacks, groundwater recharge rates and the stability of water tables is increasingly important and affects credit availability to farmers outside of the CVP service areas, as well as those within. Groundwater pumping will undoubtedly become a very high profile and political issue in the years ahead."

CVP water allocations are not considered reliable water supplies for long-term financial obligations and are only considered for short-term crop production loans after the USBR allocation has been made.

Westlands currently collects a portion of the revenue necessary to pay some of the long-term debt and some administrative costs by assessments on the land. The amount currently collected is about $6 per acre or more than $3.4 million. If one third of the land is taken out of production because of reduced water supplies, the remaining two thirds of the land that is irrigated must assume the other one third of the burden or $1.1 million.

Table 3 shows the economic effects of reduced CVP supplies in Westlands. The CVP water shortage is indicated in AF. The water requirements of 2.7 AF/Ac is the amount needed to farm one acre of land. The amount of CVP water shortage is divided by the water requirement which shows the amount of land that will go out of production. The lost revenue of $1,450 per acre is the gross income from each harvested acre in Westlands during 1992. The lost revenue was about $1,474 during 1991. This information is not available for 1993.

The economic impacts to the people in or near the District varies between $155 million to $464 million annually. Each $62,800 of lost gross farm income results in a jobless person. The lost jobs in or near the District varies between 2,450 and 7,400. These jobs could support approximately 7,500 to 22,000 people when one out three are working. This increases unemployment in areas in or near the District, some of which have unemployment rates approaching 50 percent, such as Mendota (confirm rate).

The revenue lost to the state varies between more than $0.5 billion to more than $1.6 billion annually. The job loss in the state is enormous and would be considered headline news if one company reduced its work force by 11,800 to more than 35,000 people. These lost jobs will contribute to increased spending by local state and federal government to provide the social needs of these unemployed people.

THE EFFECT OF EPA AND OTHER FEDERAL STANDARDS ON WATER TRANSFERS

The EPA's Regulatory Impact Analysis assumes water marketing transfers will make up large portions of water supply deficiencies. However, the new federal regulations for environmental protection, especially in the Delta, may constrain water transfers to the point where transfers cannot be relied upon to make up the water shortages caused by those environmental protections. This uncertainty raises serious questions about the prudence of assuming, without further analysis, that water transfers could make up for water lost as a result of new environmental protections.

The existing and proposed federal standards have two effects on water transfers (sometimes known as "water marketing").

First, these standards cause a re-allocation of water from agricultural and urban use to the environment. This re-allocation causes water shortages for these users. The water shortages provoke the need for water transfers. So, the existing and proposed federal standard create a need for water transfers.

Second, the existing and proposed federal standards constrain water transfers. Most transfers, especially those from north-to-south of the Delta, must pass through the Delta. In fact, the only inter-basin transfers (that is, from one major watershed to another) in California that do not pass through the Delta are those from the Colorado basin in the southeastern corner of the state to the southern California coastal area. The federal transfers place various constraints on Delta exports and, therefore, constrain the transfer possibilities. Other environmental requirements, especially those affect water storage and releases, can also constrain transfers.

There has been no comprehensive, detailed analysis of transfer possibilities for the state. In spite of this, there appears to be an underlying assumption that the social and economic costs of Delta environmental regulations can be largely mitigated by water transfers. This may not be true. Certainly, it would be imprudent to assume it was true without a thorough analysis of the transferability of water with complete set of new federal regulations.

The State Department of Water Resources has done some analyses of transferability. They estimated the amount of transferred water that could be exported from the Delta in the state and federal aqueducts. For this analysis, they assumed that the Winter-run salmon requirements and the proposed Delta smelt and EPA standards were in effect.

They did not include the effects of take limits for Winter-run salmon and Delta smelt. This analysis showed that about 1.0 maf/year could be transferred out of the Delta in an average year and about 2.0 maf/year during a drought comparable to the 1928-1934 drought.

DWR also separately analyzed the reduction in Delta exports attributable to take limits for the salmon and smelt in recent years. This analysis was done last December, when the preliminary Delta smelt take limits were more stringent than those actually proposed. This analysis shows that take limits would constrain exports in all months except September-November. These constraints did not apply throughout each month when they occurred. That is, there were some periods of each month when exports were not constrained and when, therefore, some capacity might have existed for water transfers. However, the only months when there were no export constraints caused by take limits were September-November. If these were the only months that water transfers could be counted on, then the transfer capacity out of the Delta would be considerably less, on the order of 0.25 maf/year in average years and about 1.0 maf/year during a drought comparable to the 1928-1934 drought if transfers could only occur in those three months, then sellers would have to be able to store the water until those months, and the buyers would have to be able to store the water south of the Delta after those months, until they needed it. No analysis of these storage possibilities has been done. Of course, if the seller were a Delta exporter, the transfer constraints attributable to Delta exports would not necessarily apply. However, it is not clear how much water Delta exporters would have and be willing to sell during droughts, when their needs were the highest.

It appears that most of the water that might be sold is north of the Delta. If so, then the constraints on Delta transfer capacity and the problems with storage raise serious questions about the feasibility of water transfers. Without further analysis, transfers cannot be assumed capable of making up the water shortages caused by new environmental regulations.

TABLE 3-1

CVP TRACY EXPORT WATER OBLIGATIONS (ACRE-FEET)

GROUP I - FIRST PRIORITY			
Type of Obligation	**100% Supply**	**75% Supply**	**Typical Allocation**
Water Rights Exchange	871,766	653,825	871,766
Municipal and Industrial			
Delta-Mendota Canal	10,000	7,500	7,575
San Luis Canal	17,190	12,893	12,893
San Felipe Unit	152,500	114,375	114,375
PL 102-575 Refuges, Level 2	210,400	157,800	210,400
Kesterson Mitigation (new lands)	37,000	27,750	37,000
Subtotal	1,298,856	974,143	1,253,934
Delivery Losses			
Upper DMC	55,000	55,000	55,000
Lower DMC	65,000	65,000	65,000
Mendota Pool Unit	80,000	80,000	80,000
San Luis Reservoir, Canal and O'Neill Forebay	60,000	40,000	40,000
Subtotal	260,000±	240,000±	240,000
TOTAL GROUP I	1,558,856	1,214,143	1,493,934
GROUP II - AG WATER SERVICE			
	100% Contract		
Contracting Unit			
Delta-Mendota Canal	382,300		
San Luis Canal	1,369,080		
San Felipe Unit	43,500		
Subtotal	1,794,880		
TOTAL CVP TRACY EXPORT OBLIGATIONS	3,353,736		

NOTE

Does not include Cross Valley Canal Contracts

Table 3-2

CENTRAL VALLEY PROJECT DELTA EXPORT CAPABILITIES

Theoretical Maximum Export, Pumping, Conveyance Capacity, and D-1485 May, June Limitations Only.

Month	Days/ Month	Tracy Avg. CFS	Multiplier CFS to Ac.-Ft.	Maximum Tracy AF	SWP/CVP Banks AF[4]	Absolute Historic Maximum[5] AF	YR
Jan.	31	4,150[1]	1.9835	255,177	0	254,400	1990
Feb.	28	4,200[1]	"	233,260	0	235,700	1988
Mar.	31	4,250[1]	"	261,326	0	263,370	1984
Apr.	30	4,300[1]	"	255,872	0	258,200	1987
May	31	3,000[2]	"	184,466	0	184,300	1986
June	30	3,000[2]	"	178,515	0	178,500	1985
July	31	4,600[3]	"	282,847	65,000[4]	282,900	1989
Aug.	31	4,600[3]	"	282,847	65,000[4]	282,900	1989
Sept.	30	4,500[1]	"	267,773	65,000[4]	273,300	1988
Oct.	31	4,200[1]	"	258,252	0	259,300	1989
Nov.	30	4,150[1]	"	246,946	0	247,800	1989
Dec.	31	4,150[1]	"	255,177	0	256,100	1988
				2,962,458[6]	195,000	2,976,770[6]	
				+195,000		+195,000	
				3,157,458		3,171,770	

Total CVP Tracy Export Obligations: 3,353,736 (Table 1).
Total Over Obligation: 196,278 AF or 10.9 percent of Group II obligation.

[1] Tracy export limited by conveyance capacity of the Delta-Mendota Canal (DMC) which decreases from 4,600± cfs at Tracy Pumping Plant to 4,150 cfs at O'Neill Pumping Plant (upper DMC reach). Does not reflect water quality limitations or impacts from scheduled or unscheduled outages, incidental take restrictions under ESA, or pulse flow export restrictions.

[2] Tracy export limited to 3,000 cfs pursuant to D-1485 for the protection of striped bass.

[3] Maximum permitted export rate under U.S. Army Corps of Engineers diversion permit.

[4] Pumpage of Central Valley Project (CVP) water, totalling 195,000 acre-feet (AF), by State Water Project (SWP) to makeup for May-June D-1485 export curtailments by CVP. Does not include pumping for Cross Valley Canal contracts.

[5] Based upon period of record 1953-1992.

[6] Absolute maximum annual water year export was 2,895,351 AF for the period of October 1987 through September 1988. Adding 195,000 AF SWP/CVP equals 3,090,351.

Table 3-3

CVP Water Supply Allocation Estimate Solely Under D-1485

Year	Sacramento Index	Year Type	Four River Index	Year Type	Total CVP Exports	Exchange Contractor Allocation	M&I, Refuges, Losses	Available For Group 2 Contractors	Group 2 Allocation (%)
1922	6666	5	17,981	5	3108	871.8	552.6	1683.6	93.8
1923	5287	4	13,206	4	3283	871.8	578.5	1832.7	102.1
1924	3294	2	5,736	2	2580	871.8	474.4	1233.8	68.7
1925	8078	5	15,993	5	3283	871.8	578.5	1832.7	102.1
1926	5674	3	11,765	3	3297	871.8	580.5	1844.7	102.8
1927	10971	6	23,834	6	3166	871.8	561.2	1733.0	96.6
1928	7634	5	16,762	5	3283	871.8	578.5	1832.7	102.1
1929	4399	2	8,400	2	2585	871.8	475.1	1238.1	69.0
1930	6096	4	13,518	4	3293	871.8	580.0	1841.2	102.6
1931	3296	2	6,096	2	2579	871.8	474.2	1233.0	68.7
1932	5082	4	13,116	4	3165	871.8	561.0	1732.2	96.5
1933	4591	3	8,938	2	1780	653.9	388.2	737.9	41.1
1934	4502	3	8,630	2	1656	653.9	369.9	632.3	35.2
1935	7493	5	16,587	5	3192	871.8	565.0	1755.2	97.8
1936	7075	5	17,351	5	3191	871.8	564.9	1754.3	97.7
1937	5979	4	13,331	4	3073	871.8	547.4	1653.8	92.1
1938	14677	6	31,826	6	2813	871.8	508.9	1432.3	79.8
1939	4370	2	8,180	2	3280	871.8	578.0	1830.2	102.0
1940	10493	6	22,434	6	3241	871.8	572.3	1796.9	100.1
1941	14314	6	27,079	6	3012	871.8	538.4	1601.8	89.2
1942	11261	6	25,236	6	3137	871.8	556.9	1708.3	95.2
1943	8497	6	21,125	6	3152	871.8	559.1	1721.1	95.9
1944	4703	3	10,433	3	3296	871.8	580.4	1843.8	102.7
1945	6699	4	15,063	4	3288	871.8	579.2	1837.0	102.3
1946	8169	5	17,621	5	3079	871.8	548.3	1658.9	92.4
1947	5074	3	10,388	3	3284	871.8	578.6	1833.6	102.2
1948	7650	4	15,754	4	3289	871.8	579.4	1837.8	102.4
1949	6033	3	11,970	3	3280	871.8	578.0	1830.2	102.0
1950	5718	4	14,442	4	3296	871.8	580.4	1843.8	102.7
1951	9086	6	22,947	6	3245	871.8	572.8	1800.4	100.3
1952	11544	6	28,600	6	2837	871.8	512.4	1452.8	80.9
1953	9666	6	20,086	6	3222	871.8	569.4	1780.8	99.2
1954	9283	5	17,428	5	3289	871.8	579.4	1837.8	102.4
1955	5663	3	10,983	3	3288	871.8	579.2	1837.0	102.3
1956	13306	6	29,887	6	3028	871.8	540.7	1615.5	90.0
1957	7170	4	14,889	4	3292	871.8	579.8	1840.4	102.5
1958	15121	6	29,710	6	3025	871.8	540.3	1612.9	89.9
1959	6737	3	12,049	3	3283	871.8	578.5	1832.7	102.1
1960	6459	4	13,057	4	3288	871.8	579.2	1837.0	102.3
1961	7165	3	11,972	3	3288	871.8	579.2	1837.0	102.3
1962	7463	4	15,115	4	3206	871.8	567.1	1767.1	98.5
1963	9899	6	22,993	6	3206	871.8	567.1	1767.1	98.5
1964	5218	3	10,921	3	3289	871.8	579.4	1837.8	102.4
1965	10360	6	25,663	6	3122	871.8	554.6	1695.6	94.5
1966	7278	4	12,950	4	3211	871.8	567.8	1771.4	98.7
1967	10510	6	24,059	6	2790	871.8	505.5	1412.7	78.7
1968	6909	4	13,640	4	3223	871.8	569.6	1781.6	99.3

Table 3-3

CVP Water Supply Allocation Estimate Solely Under D-1485

Year	Sacramento Index	Year Type	Four River Index	Year Type	Total CVP Exports	Exchange Contractor Allocation	M&I, Refuges, Losses	Available For Group 2 Contractors	Group 2 Allocation (%)
1969	11797	6	26,980	6	2757	871.8	500.6	1384.6	77.1
1970	11711	6	24,058	6	3222	871.8	569.4	1780.8	99.2
1971	10785	6	22,572	6	3284	871.8	578.6	1833.6	102.2
1972	6606	4	13,426	4	3294	871.8	580.1	1842.1	102.6
1973	9639	5	20,047	6	3120	871.8	554.3	1693.9	94.4
1974	15876	6	32,495	6	3037	871.8	542.1	1623.1	90.4
1975	9387	5	19,222	5	3247	871.8	573.1	1802.1	100.4
1976	4845	2	8,266	2	2514	871.8	464.6	1177.6	65.6
1977	3422	2	5,131	2	1804	653.9	391.8	758.4	42.3
1978	12003	6	23,807	6	2835	871.8	512.1	1451.1	80.8
1979	5617	3	12,348	3	3184	817.2	571.9	1794.9	100.0
1980	9736	6	22,326	6	2838	871.8	512.6	1453.6	81.0
1981	6392	2	11,098	2	3293	871.8	580.0	1841.2	102.6
1982	13276	6	33,324	6	2925	871.8	525.5	1527.7	85.1
1983	17180	6	37,685	6	2522	871.8	465.8	1184.4	66.0
1984	9520	6	22,351	6	3214	871.8	568.3	1773.9	98.8
1985	5506	3	10,595	3	3288	871.8	579.2	1837.0	102.3
1986	10946	6	25,704	6	2862	871.8	516.1	1474.1	82.1
1987	5278	2	9,001	2	3292	871.8	579.8	1840.4	102.5
1988	5410	2	9,190	2	3288	871.8	579.2	1837.0	102.3
1989	6619	4	14,782	4	3279	871.8	577.9	1829.3	101.9
1990	4738	2	9,233	2	2588	871.8	475.6	1240.6	69.1
1991	4002	2	9438	2	2550	871.8	470.0	1208.2	67.3
1992	5168	2	8890	2	2480	871.8	459.6	1148.6	64.0

	Total CVP Exports	Exchange Contractor Allocation	M&I, Refuges, Losses	Available For Group 2 Contractors	Group 2 Allocation (%)
71 Year Average (%	93.9	98.9	91.0		91.0
!928-34 Average (%)	80.9	92.9	73.6		73.6

Assumptions:

Exports:	Annual exports generated with DWRSIM based on a 7.1 MAF CVP & SWP demand Includes wheeled D-1485 water pumped through Banks.
Exchange Contractors	871.8 KAF full supply and 653.9 KAF (75% supply) when Sac. River Index is less than 4 (below-normal year-type)and no interim water exists to supplement their shortage.
Refuges and M&I:	Receive the same percentage allocation as Group 2 contractors. (95.2 KAF Level 1 refuge supply plus Kesterson Mitigation 37 KAF and 179.7 KAF M&I full supply)
Losses:	260 KAF regardless of delivered quantites (includes losses in DMC and Mendota Pool).
Group 2 Contractors:	1794.9 KAF full supply (excludes 128 KAF for Cross Valley Canal). San Luis Unit 1369.1 KAF DMC (Ag Only) 382.3 KAF San Benito Co. W.D. 43.5 KAF

(TAB) Revised CVP_B.WB1
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Table 3-4

CVP Water Supply Allocation Estimate Under D-1485, CVPIA, and EPA X2 Salinity Standards

Year	Sacramento Index	Year Type	Four River Index	Year Type	Total CVP Exports	Exchange Contractor Allocation	M&I, Refuges, Losses	Available For Group 2 Contractors	Group 2 Allocation (%)
1922	6666	5	17,981	5	2811	871.8	687.1	1252.1	69.8
1923	5287	4	13,206	4	2733	871.8	687.1	1174.1	65.4
1924	3294	2	5,736	2	1697	653.9	580.3	462.9	25.8
1925	8078	5	15,993	5	2904	871.8	687.1	1345.1	74.9
1926	5674	3	11,765	3	2781	871.8	687.1	1222.1	68.1
1927	10971	6	23,834	6	2588	871.8	687.1	1029.1	57.3
1928	7634	5	16,762	5	2804	871.8	687.1	1245.1	69.4
1929	4399	2	8,400	2	1837	653.9	580.3	602.9	33.6
1930	6096	4	13,518	4	2034	871.8	580.3	581.9	32.4
1931	3296	2	6,096	2	1508	653.9	580.3	273.9	15.3
1932	5082	4	13,116	4	2290	871.8	580.3	837.9	46.7
1933	4591	3	8,938	2	1679	653.9	580.3	444.9	24.8
1934	4502	3	8,630	2	1319	653.9	580.3	84.9	4.7
1935	7493	5	16,587	5	2570	871.8	687.1	1011.1	56.3
1936	7075	5	17,351	5	2699	871.8	687.1	1140.1	63.5
1937	5979	4	13,331	4	2875	871.8	687.1	1316.1	73.3
1938	14677	6	31,826	6	2566	871.8	687.1	1007.1	56.1
1939	4370	2	8,180	2	2992	871.8	624.8	1495.4	83.3
1940	10493	6	22,434	6	2672	871.8	687.1	1113.1	62.0
1941	14314	6	27,079	6	2513	871.8	687.1	954.1	53.2
1942	11261	6	25,236	6	2774	871.8	687.1	1215.1	67.7
1943	8497	6	21,125	6	2892	871.8	687.1	1333.1	74.3
1944	4703	3	10,433	3	2855	871.8	687.1	1296.1	72.2
1945	6699	4	15,063	4	2744	871.8	687.1	1185.1	66.0
1946	8169	5	17,621	5	2645	871.8	687.1	1086.1	60.5
1947	5074	3	10,388	3	2903	871.8	687.1	1344.1	74.9
1948	7650	4	15,754	4	2694	871.8	687.1	1135.1	63.2
1949	6033	3	11,970	3	2712	871.8	687.1	1153.1	64.2
1950	5718	4	14,442	4	2730	871.8	687.1	1171.1	65.2
1951	9086	6	22,947	6	2688	871.8	687.1	1129.1	62.9
1952	11544	6	28,600	6	2481	871.8	687.1	922.1	51.4
1953	9666	6	20,086	6	2800	871.8	687.1	1241.1	69.1
1954	9283	5	17,428	5	2801	871.8	687.1	1242.1	69.2
1955	5663	3	10,983	3	2794	871.8	687.1	1235.1	68.8
1956	13306	6	29,887	6	2530	871.8	687.1	971.1	54.1
1957	7170	4	14,889	4	2870	871.8	687.1	1311.1	73.0
1958	15121	6	29,710	6	2514	871.8	687.1	955.1	53.2
1959	6737	3	12,049	3	2963	871.8	687.1	1404.1	78.2
1960	6459	4	13,057	4	2731	871.8	687.1	1172.1	65.3
1961	7165	3	11,972	3	2828	871.8	687.1	1269.1	70.7
1962	7463	4	15,115	4	2774	871.8	687.1	1215.1	67.7
1963	9899	6	22,993	6	2574	871.8	687.1	1015.1	56.6
1964	5218	3	10,921	3	2885	871.8	687.1	1326.1	73.9
1965	10360	6	25,663	6	2495	871.8	687.1	936.1	52.2
1966	7278	4	12,950	4	2893	871.8	687.1	1334.1	74.3
1967	10510	6	24,059	6	2470	871.8	687.1	911.1	50.8
1968	6909	4	13,640	4	2989	871.8	687.1	1430.1	79.7
1969	11797	6	26,980	6	2549	871.8	687.1	990.1	55.2

Table 3-4

CVP Water Supply Allocation Estimate Under D-1485, CVPIA, and EPA X2 Salinity Standards

Year	Sacramento Index	Year Type	Four River Index	Year Type	Total CVP Exports	Exchange Contractor Allocation	M&I, Refuges, Losses	Available For Group 2 Contractors	Group 2 Allocation (%)
1970	11711	6	24,058	6	2877	871.8	687.1	1318.1	73.4
1971	10785	6	22,572	6	2536	871.8	687.1	977.1	54.4
1972	6606	4	13,426	4	2832	871.8	687.1	1273.1	70.9
1973	9639	5	20,047	6	2741	871.8	687.1	1182.1	65.9
1974	15876	6	32,495	6	2582	871.8	687.1	1023.1	57.0
1975	9387	5	19,222	5	2753	871.8	687.1	1194.1	66.5
1976	4845	2	8,266	2	2298	653.9	580.3	1063.9	59.3
1977	3422	2	5,131	2	1006	653.9	352.2	0.0	0.0
1978	12003	6	23,807	6	2438	871.8	687.1	879.1	49.0
1979	5617	3	12,348	3	2762	871.8	687.1	1203.1	67.0
1980	9736	6	22,326	6	2696	871.8	687.1	1137.1	63.4
1981	6392	2	11,098	2	2914	871.8	611.4	1430.8	79.7
1982	13276	6	33,324	6	2550	871.8	687.1	991.1	55.2
1983	17180	6	37,685	6	2712	871.8	687.1	1153.1	64.2
1984	9520	6	22,351	6	2667	871.8	687.1	1108.1	61.7
1985	5506	3	10,595	3	2744	871.8	687.1	1185.1	66.0
1986	10946	6	25,704	6	2634	871.8	687.1	1075.1	59.9
1987	5278	2	9,001	2	3091	871.8	641.9	1577.3	87.9
1988	5410	2	9,190	2	3027	871.8	630.9	1524.3	84.9
1989	6619	4	14,782	4	1848	871.8	580.3	395.9	22.1
1990	4738	2	9,233	2	1790	653.9	580.3	555.9	31.0
1991	4002	2	9,438	2	1999	653.9	580.3	764.9	42.6
1992	5168	2	8,890	2	2310	653.9	580.3	1075.9	59.9

	Total CVP Exports	Exchange Contractor Allocation	M&I, Refuges, Losses	Available For Group 2 Contractors	Group 2 Allocation (%)
71 Year Average (%	76.5	96.5	93.9		59.3
1928-34 Average (%	57.4	83.3	75.0		32.4

Assumptions:

Exports:	Annual exports generated with DWRSIM based on a 7.1 MAF CVP & SWP demand Includes wheeled D-1485 water pumped through Banks.
Exchange Contractors	871.8 KAF full supply and 653.8 KAF (75% supply) when Sac. River Index is less than 4 (below-normal year-type).
Refuges and M&I:	Receives not less than 75% of Level 2 supplies under CVPIA. (247.4 KAF refuge full supply with 37 KAF for Kesterson Mitigation. M&I never receives less than 75% of 179.7 KAF) Refuges receive full supply if year-type is greater than 2 (Dry) or (Dry with Group 2 @ >50%)
Losses:	260 KAF regardless of delivered quantites (Includes losses in DMC and Mendota Pool).
Group 2 Contractors:	1794.9 KAF full supply (excludes 128 KAF for Cross Valley Canal). San Luis Unit 1369.1 KAF DMC (Ag Only) 382.3 KAF San Benito Co. W.D. 43.5 KAF

Table 3-5

CVP Water Supply Allocation Estimate Under D-1485, CVPIA, Winter Run Salmon Opinion, and EPA X2 Salinity Standards

Year	Sacramento Index	Year Type	Four River Index	Year Type	Total CVP Exports	Exchange Contractor Allocation	M&I, Refuges, Losses	Available For Group 2 Contractors	Group 2 Allocation (%)
1922	6666	5	17,981	5	2812	871.8	687.1	1253.1	69.8
1923	5287	4	13,206	4	2550	871.8	687.1	991.1	55.2
1924	3294	2	5,736	2	1404	653.9	580.3	169.9	9.5
1925	8078	5	15,993	5	2620	871.8	687.1	1061.1	59.1
1926	5674	3	11,765	3	2637	871.8	687.1	1078.1	60.1
1927	10971	6	23,834	6	2548	871.8	687.1	989.1	55.1
1928	7634	5	16,762	5	2746	871.8	687.1	1187.1	66.1
1929	4399	2	8,400	2	1809	653.9	580.3	574.9	32.0
1930	6096	4	13,518	4	1865	871.8	580.3	412.9	23.0
1931	3296	2	6,096	2	1275	653.9	580.3	40.9	2.3
1932	5082	4	13,116	4	2315	871.8	687.1	756.1	42.1
1933	4591	3	8,938	2	1645	653.9	580.3	410.9	22.9
1934	4502	3	8,630	2	1386	653.9	580.3	151.9	8.5
1935	7493	5	16,587	5	1791	871.8	580.3	338.9	18.9
1936	7075	5	17,351	5	2324	871.8	687.1	765.1	42.6
1937	5979	4	13,331	4	2856	871.8	687.1	1297.1	72.3
1938	14677	6	31,826	6	2566	871.8	687.1	1007.1	56.1
1939	4370	2	8,180	2	2283	653.9	580.3	1048.9	58.4
1940	10493	6	22,434	6	2450	871.8	687.1	891.1	49.6
1941	14314	6	27,079	6	2512	871.8	687.1	953.1	53.1
1942	11261	6	25,236	6	2641	871.8	687.1	1082.1	60.3
1943	8497	6	21,125	6	2844	871.8	687.1	1285.1	71.6
1944	4703	3	10,433	3	2757	871.8	687.1	1198.1	66.8
1945	6699	4	15,063	4	2718	871.8	687.1	1159.1	64.6
1946	8169	5	17,621	5	2564	871.8	687.1	1005.1	56.0
1947	5074	3	10,388	3	2751	871.8	687.1	1192.1	66.4
1948	7650	4	15,754	4	2522	871.8	687.1	963.1	53.7
1949	6033	3	11,970	3	2739	871.8	687.1	1180.1	65.7
1950	5718	4	14,442	4	2572	871.8	687.1	1013.1	56.4
1951	9086	6	22,947	6	2644	871.8	687.1	1085.1	60.5
1952	11544	6	28,600	6	2482	871.8	687.1	923.1	51.4
1953	9666	6	20,086	6	2536	871.8	687.1	977.1	54.4
1954	9283	5	17,428	5	2648	871.8	687.1	1089.1	60.7
1955	5663	3	10,983	3	2523	871.8	687.1	964.1	53.7
1956	13306	6	29,887	6	2452	871.8	687.1	893.1	49.8
1957	7170	4	14,889	4	2798	871.8	687.1	1239.1	69.0
1958	15121	6	29,710	6	2492	871.8	687.1	933.1	52.0
1959	6737	3	12,049	3	2711	871.8	687.1	1152.1	64.2
1960	6459	4	13,057	4	2601	871.8	687.1	1042.1	58.1
1961	7165	3	11,972	3	2554	871.8	687.1	995.1	55.4
1962	7463	4	15,115	4	2571	871.8	687.1	1012.1	56.4
1963	9899	6	22,993	6	2571	871.8	687.1	1012.1	56.4
1964	5218	3	10,921	3	2421	653.9	687.1	1080.1	60.2
1965	10360	6	25,663	6	2366	871.8	687.1	807.1	45.0
1966	7278	4	12,950	4	2657	871.8	687.1	1098.1	61.2
1967	10510	6	24,059	6	2412	871.8	687.1	853.1	47.5
1968	6909	4	13,640	4	2891	871.8	687.1	1332.1	74.2
1969	11797	6	26,980	6	2524	871.8	687.1	965.1	53.8

Table 3-5

CVP Water Supply Allocation Estimate Under D-1485, CVPIA, Winter Run Salmon Opinion, and EPA X2 Salinity Standards

Year	Sacramento Index	Year Type	Four River Index	Year Type	Total CVP Exports	Exchange Contractor Allocation	M&I, Refuges, Losses	Available For Group 2 Contractors	Group 2 Allocation (%)
1970	11711	6	24,058	6	2868	871.8	687.1	1309.1	72.9
1971	10785	6	22,572	6	2522	871.8	687.1	963.1	53.7
1972	6606	4	13,426	4	2590	871.8	687.1	1031.1	57.4
1973	9639	5	20,047	6	2682	871.8	687.1	1123.1	62.6
1974	15876	6	32,495	6	2582	871.8	687.1	1023.1	57.0
1975	9387	5	19,222	5	2753	871.8	687.1	1194.1	66.5
1976	4845	2	8,266	2	2292	653.9	580.3	1057.9	58.9
1977	3422	2	5,131	2	1006	653.9	352.2	0.0	0.0
1978	12003	6	23,807	6	2439	871.8	687.1	880.1	49.0
1979	5617	3	12,348	3	2733	871.8	687.1	1174.1	65.4
1980	9736	6	22,326	6	2725	871.8	687.1	1166.1	65.0
1981	6392	2	11,098	2	2734	871.8	580.3	1281.9	71.4
1982	13276	6	33,324	6	2504	871.8	687.1	945.1	52.7
1983	17180	6	37,685	6	2712	871.8	687.1	1153.1	64.2
1984	9520	6	22,351	6	2667	871.8	687.1	1108.1	61.7
1985	5506	3	10,595	3	2683	871.8	687.1	1124.1	62.6
1986	10946	6	25,704	6	2442	871.8	687.1	883.1	49.2
1987	5278	2	9,001	2	2849	871.8	600.2	1377.0	76.7
1988	5410	2	9,190	2	1829	653.9	580.3	594.9	33.1
1989	6619	4	14,782	4	1382	871.8	510.2	0.0	0.0
1990	4738	2	9,233	2	1690	653.9	580.3	455.9	25.4
1991	4002	2	9,438	2	1941	653.9	580.3	706.9	39.4
1992	5168	2	8,890	2	2125	653.9	580.3	890.9	49.6
			71 Year Average (%		72.3	95.4	93.1		52.1
			1928-34 Average (%		55.5	83.3	79.2		28.1

Assumptions:

Exports:	Annual exports generated with DWRSIM based on a 7.1 MAF CVP & SWP demand Includes wheeled D-1485 water pumped through Banks.
Exchange Contractors	871.8 KAF full supply and 653.8 KAF (75% supply) when Sac. River Index is less than 4 (below-normal year-type).
Refuges and M&I:	Receives not less than 75% of Level 2 supplies under CVPIA. (247.4 KAF refuge full supply with 37 KAF for Kesterson Mitigation. M&I never receives less than 75% of 179.7 KAF) Refuges receive full supply if year-type is greater than 2 (Dry) or (Dry with Group 2 @ >50%)
Losses:	260 KAF regardless of delivered quantites (Includes losses in DMC and Mendota Pool).
Group 2 Contractors:	1794.9 KAF full supply (excludes 128 KAF for Cross Valley Canal). San Luis Unit 1369.1 KAF DMC (Ag Only) 382.3 KAF San Benito Co. W.D. 43.5 KAF

TABLE 3-6

ECONOMIC IMPACTS CAUSED BY REDUCED CVP WATER SUPPLIES				
Reduction		25%	50%	75%
CVP Water Shortage	AF	290,000	600,000	860,000
Water Requirement	AF/Ac	2.7	2.7	2.7
Land Out of Production	Ac	107,000	270,000	320,000
Lost Revenue	$/Ac	1,450	1,450	1,450
District Impacts				
Lost Revenue	$	155,000,000	320,000,000	464,000,000
Lost Jobs	Ea.	2,450	5,100	7,400
State Impacts				
Lost Revenue	$	550,000,000	1,130,000,000	1,640,000,000
Lost Jobs	Ea.	11,800	24,250	35,150

SECTION 4

ECONOMIC EFFECTS OF THE PROPOSED WATER QUALITY STANDARDS

A. CRITIQUE OF THE ECONOMIC ANALYSIS IN THE REGULATORY IMPACT ASSESSMENT REPORT

The U.S. Environmental Protection Agency has prepared a draft "Regulatory Impact Assessment of the Proposed Water Quality Standards for the San Francisco Bay/Delta and Critical Habitat Requirements for the Delta Smelt," dated December 15, 1993. Chapter 4 of that report contains an economic analysis of the costs that are likely to be imposed on agricultural and urban water users as a result of reductions in surface water supplies that will be implemented to achieve water quality standards. Chapter 5 of the Draft RIA includes an economic analysis of the benefits that might be generated by improving water quality in the San Francisco Bay and Delta. Chapter 6 describes a comparison of the costs and benefits, with some additional discussion regarding the regional economic effects of the proposed standards.

The purpose of this critique is to provide specific, technical comments regarding the economic analyses presented in the Draft RIA. This critique does not provide final estimates of pertinent economic benefits and damages associated with the proposed water quality regulations, but such estimates will be developed as time permits.

In brief, the economic analyses in the draft RIA include estimates of the costs and benefits that might arise in response to implementing the proposed water quality regulations. Cost estimates are developed for both agricultural and urban water users. The agricultural cost includes the expected economic losses due to reductions in crop production that will occur when surface water supplies to federal contractors are reduced. The authors do not consider the indirect and induced effects of losses in crop production and they do not consider the employment effects, neither directly, nor throughout the state.

The authors examine three scenarios that involve different levels of water marketing activities and different geographic distributions of reductions in surface water supply. However, the scenario that is chosen by the authors as "most likely," includes greater water marketing opportunities and a larger geographic distribution of water supply reductions, than will likely arise when the water quality regulations are implemented. Hence, their estimates of costs imposed on agriculture will under-estimate the most likely result.

The economic analysis in the draft RIA also neglects the added costs of groundwater pumping and the impacts on pumping depths that will occur when groundwater is used as a substitute for surface water. In addition, the report does not consider the loss in value that will result from overdrafting of groundwater, as farmers attempt to maintain production levels when surface water supplies are reduced. Groundwater provides significant values to California residents, particularly as a hedge against sustained drought periods. Well-managed conjunctive use of groundwater resources ensures that groundwater supplies will be available during those periods. Significant reductions in surface water supply will cause overdrafting to increase, and the opportunities for well-managed conjunctive use will diminish.

The benefits section of the draft RIA is notably sparse, and the authors report that the economic values of benefits cannot be measured in many cases. The authors do provide an estimate of benefits to commercial fishing and sport fishing, but these estimates are significantly lower than the costs imposed on agriculture, even in the scenarios analyzed in the draft RIA. Despite this result, the authors conclude that the benefits of the proposed standards will exceed the costs, because they expect that the sum of use benefits (that are described, but not estimated) and the nonuse benefits (that are not described or estimated), will exceed the costs imposed on agricultural and urban water users. This conclusion is not valid and it is not supported by any of the data or the analyses presented in the draft RIA report.

There are additional shortcomings in the economic analysis presented in the draft RIA. Most of these are discussed in the following section of this critique.

SPECIFIC COMMENTS REGARDING THE ECONOMIC ANALYSIS

The economic analysis of potential costs to the agricultural sector, as a result of reductions in surface water supplies includes three scenarios that describe different distributions of water supply reductions and different levels of water market activity. In specific, Scenario 1 includes "no trading opportunities and the impacts are borne by a small geographic area south of the Delta. Under Scenario 2, there are trading opportunities and the impacts are borne by a larger geographic area south of the Delta. Under Scenario 3, a very efficient market exists and the water supply reductions are distributed throughout the entire Central Valley." A limited subset of the potential economic losses is estimated for each of these scenarios. However, several major components of economic losses are not included in the analysis.

The authors of Chapter 4 acknowledge that "the costs associated with changes in agricultural water supply include resource allocation costs, welfare losses, decreased value of displaced labor and equipment resources, and government regulatory costs." However, in their analysis, the authors estimate only the direct costs of reducing water supplies. They do not provide any estimates of the reductions in land and equipment values that will result when surface water is permanently removed from regions that have had access to that water for several decades. In most of the regions that will be affected by reductions in surface water supplies, there are few alternative uses for those land and equipment resources that do not require an allotment of surface water.

Two examples of the actual reductions in land values that have occurred in the San Joaquin Valley during recent years are found in the County Assessors reports for Fresno and Kings Counties in California. In Fresno County, the total assessed value of farmland in the Westlands Water District has declined from $659 million in fiscal year 1990-1991 to $560 million in fiscal year 1993-1994. This decline of almost $100 million (15%) is due largely to increased uncertainty regarding long-term surface water supplies in the Westlands Water District. In many cases, the actual sale price of land in the district has fallen by an even greater proportion than the 15% average reduction in assessed value. In addition, the actual reduction in assessed value was limited by the declining interest rate on long-term government bonds. That rate declined from a high of 9.00% in 1991-1992, to 7.25% in 1993-1994. The long-term bond rate must be used to evaluate lands in Open Space Contracts and most of the land in the Westlands Water District is enrolled in that program.

Assessed values of farmland have also declined in Kings County, California, which includes about 80,000 acres of land in the Westlands Water District. The Kings County tax assessor presented a news release on July 19, 1993 that contains the following information:

> "... the area of the County that lies within Westlands Water District has had some adverse effects on their valuation due to reduction of water allocation in favor of the environmental concerns for fish under the Endangered Species Act. This year the Kings County Assessor's Office had calculated an average reduction in assessed value of 37% in Westlands due to reductions in anticipated income, under the enforceable restricted open space land, resulting in an approximate $91 million overall decrease to the County's assessed value."

The total reduction in assessed value in both Fresno and Kings Counties is almost $200 million. Data describing the current value of farm buildings and equipment are not available at this time, but similar reductions in value are likely, given the uncertainty regarding surface water supplies.

RESOURCE ALLOCATION COSTS

The authors of the RIA estimate changes in crop production values using two models. The first is a modified version of the California Agricultural Resources Management (CARM) model. The second model is a rationing model developed by Zilberman, that allocates water to alternative crops according to the average revenue products that are generated through irrigation. The CARM model is a large-scale representation of agricultural production throughout California. It is not designed for detailed analysis of small production regions within the state, particularly when those small regions include areas with very different soil and water endowments.

The rationing model imposes an artificial structure on cropping decisions that considers only the average revenue product of irrigation water. The model does not address interactions among crops, such as those that exist for crops that are grown in rotation. The model also neglects the issue of commodity markets, processing contracts, and commodity programs that often limit the area planted to higher value crops in any one region. In addition, a model that only considers average revenue products will not capture farm-level decisions regarding the maintenance of contracts with commodity processors or participation in federal agricultural commodity programs. Economically rational farmers will choose their cropping patterns to maximize net revenue, subject to constraints that include participation in those contracts and programs. A model that addresses only average revenue products will over-estimate the role of crop revenues in cropping pattern decisions.

The authors use the rationing model to estimate changes in cropping patterns that may occur with the assumptions in Scenario 1, and they use the CARM model to estimate cropping changes in Scenarios 2 and 3. Their estimates, presented in Table 4-3 of the RIA, are described for both average water supply years and critically dry years. In average water supply years, the estimated reductions in harvested area are 213,000 acres, zero acres, and 130,000 acres for Scenarios 1 through 3, respectively. The estimated losses in production value include $10 million in Scenario 3, $28 million in Scenario 2, and $80 million in Scenario 1. During critically dry years, the authors estimate that zero acres would be fallowed in Scenario 3, and that 200,000 acres and 277,000 acres would be fallowed in Scenarios 2 and 1, respectively. Estimated crop production losses include $48 million in Scenario 3, $200 million in Scenario 2, and $277 million in Scenario 1.

In all cases, the estimated costs are lowest in Scenario 3, in which the water supply reductions are apportioned throughout the Central Valley. In addition, Scenario 3 assumes that water marketing opportunities will be extensive and that the state-wide water market will function efficiently. Scenario 3 also "assumes that the implementation program is economically efficient in that the only crops affected by the regulations are irrigated hay and pasture." The assumptions that create Scenario 3 are not realistic and the estimated costs for that Scenario are not useful in describing the likely impacts of the proposed water quality standards.

The authors suggest that Scenario 2 is the most representative of current conditions and they choose that Scenario for estimating the likely impact of surface water reductions on crop production values. However, it should be noted that even Scenario 2 assumes a wider distribution of water supply reductions than may actually occur, due to the existing pattern of water rights and priorities in California. This is particularly true for water that is delivered from north of the Sacramento/San Joaquin River Delta to districts located south of the Delta. It is very likely that most of the impact of the surface water supply reductions proposed by EPA will be felt by federal contractors in the San Luis Unit of the Central Valley Project. In addition, water marketing opportunities for districts located south of the Delta will be limited by the same regulations that are causing reductions in contractual supply allocations. It is not realistic to consider that an efficient water market will be able to operate independently of the water quality standards.

Scenario 1 is the most limited of the three alternatives considered by the authors of the RIA. In that scenario, the surface water supply reductions required to achieve the water quality objectives are implemented within 1.4 million acres of the Central Valley Project service area in the San Joaquin Valley. This is probably the most likely allocation scenario, given the existing set of water rights and priorities regarding water supplies south of the Delta. The assumptions in Scenario 1 that "no interdistrict water trades occur, and that crop switching is infeasible" are not completely realistic, but they do portray current opportunities better than the assumptions in Scenarios 2 and 3. In particular, water marketing opportunities will be limited for districts south of the Delta, because aggregate water supplies will be constrained by restrictions on the operation of Delta pumping stations. In addition, the cropping patterns that are observed in districts located south of the Delta, while not completely rigid, are certainly constrained to a significant degree by soil and water management considerations, output markets, contracts with commodity processors, and government programs.

In summary, Scenario 1 contains the most likely set of assumptions regarding water marketing opportunities and cropping pattern shifts that will be observed as farmers respond to reductions in surface water supplies. The authors of the RIA estimate that 213,000 acres will be fallowed each year and that $80 million in crop production value will be lost, as a result of reductions in surface water supply required to achieve the EPA's water quality objectives. Their estimates increase to 277,000 acres and $293 million in critically dry years. These estimates arise from a water rationing model that allocates water among crops according to average revenue products. Therefore, this approach will under-estimate the true economic costs of water supply reductions if farmers allocate water according to a different set of criteria. These problems with Scenario 1 are addressed in further detail, below.

WELFARE LOSSES

The welfare losses that are pertinent in this analysis include the changes in consumers' and producers' surplus that will result from implementing the proposed regulations. Consumers' surplus will be reduced if agricultural prices rise when crop production is reduced, as a result of the water supply reductions. Producers' surplus is affected by changes in net operating revenues and agricultural land rents that arise in response to the water supply reductions.

The authors of the RIA assume that agricultural prices will not be affected by the water supply reductions and they do not estimate any reductions in consumers' surplus. The authors also assume that land values and rents will decline as a result of the water supply reductions, but they suggest that reduced land values will "have a positive effect on net operating revenues corresponding to reduced costs for land rental." This effect might occur in regions where water supplies are not linked directly to land resources. However, in regions where this linkage is explicit and rigid, reduced land values will not contribute to reductions in operating costs.

Reductions in land value and the corresponding reductions in land rental rates that are caused by reductions in surface water supply, are not beneficial to farmers in the San Joaquin Valley. Surface water supplies are allocated according to land area in the Central Valley Project and farmers receive annual allotments that are based on the number of acres owned or leased. Therefore, when water supplies are reduced by 50%, farmers must rent twice the normal land area, in order to irrigate crops on half of that area. For example, a farmer who once rented 160 acres, with a full water supply, for $200 per acre, can no longer afford to pay that price for land that comes with only 50% of the normal water supply. A 50% reduction in water supply may result in a negotiated lease price of $100 per acre, but the farmer must still lease all 160 acres in order to obtain water that is sufficient to irrigate 80 acres. Hence, the average cost of land, per acre-farmed, has not been reduced by the reduction in rental rates. Rather, the net revenue potential has been reduced for farmers leasing land, at the same time that rental income to the owners of land has been reduced.

Land values in many parts of the San Joaquin Valley have already been depressed by short-term reductions in surface water supply and by the perception that those short-term reductions will become long-term restrictions on the volume of water that is permitted to flow through the Sacramento/San Joaquin River Delta. Land prices are determined by the capitalized value of the earnings potential throughout many future years. Permanent reductions in water supply reduce those potential earnings and, in the process, reduce the market value of land and equipment resources. Empirical examples of this trend include ranches in the Westlands Water District that have seen their market value halved in recent years, as a result of reductions in surface water supply. These reductions in land value represent significant losses in asset value that will not be recovered until surface water supplies are restored with reasonable certainty.

The estimates of annual changes in producers' surplus that are presented in Table 4-4 of the RIA do not include the impact of declining land values or reductions in asset values that result from implementation of the water supply reductions. As noted above, Scenario 1 is the most likely of the three scenarios presented in the RIA, but even those costs under-estimate the likely economic impact of the reductions in water supply.

Reductions in land value that are caused by uncertainty regarding surface water supplies are not consistent with the intent of recent modifications in Reclamation Law, that are designed to encourage ownership of farmland by farm families and small businesses. Many families and small farm operators will not be able to absorb the reductions in asset values that are caused by actual reductions in surface water supplies or by an increase in the uncertainty regarding the future availability of those supplies. As a result, many small-scale farmers will lose the financial capability to own and operate their farming operations.

DISPLACED RESOURCES

The authors of the RIA assume that the "idling of farming equipment would be temporary in most cases because the equipment could be used elsewhere in the San Joaquin Valley or another farming region." They conclude that the decline in value of farming equipment would be relatively small. This assumption and the subsequent conclusion are difficult to justify in the San Joaquin Valley. The region receives very little rainfall and agricultural production depends on the availability of supplemental irrigation using either surface water or groundwater. When permanent reductions in surface water supplies are implemented, groundwater pumping will increase substantially (where suitable groundwater is available) by farmers attempting to maintain production levels. Eventually, pumping depths will increase and the quality of water extracted from the aquifers will decline. In the end, there will be insufficient surface water and the cost and quality of groundwater will be unacceptable. At that time, farming will cease throughout a large portion of the San Joaquin Valley and there will be little or no salvage value for most agricultural equipment.

Some portion of the farm equipment that is transportable may be sold to farmers in other regions, but in most cases the transportation costs will limit the number of such transactions. The fixed equipment resources will be even less mobile when farming is discontinued. For example, agricultural buildings will have little value in an arid valley with an inadequate water supply. Groundwater wells that were drilled at significant cost, to provide supplemental water supplies during dry years caused by natural drought or policy actions, will have no salvage value when the groundwater becomes unsuitable due to diminishing quality or increasing cost. The pumps may be transportable, but the largest component of cost is in the drilling of the well. That cost, and its associated value, will not be recoverable when the groundwater can no longer be pumped for agricultural production.

The authors of the RIA estimate the number of workers that will be displaced as a result of reductions in surface water supplies using crop-specific labor requirements reported in the Impact Analysis for Planning (IMPLAN) database. Their estimates of displaced labor during average water supply years include 213 person-years in Scenario 3, 314 person-years in Scenario 2, and 828 person-years in Scenario 1. These estimates increase during critically dry years to 538 person-years in Scenario 3, 1,927 person-years in Scenario 2, and 3,290 person-years in Scenario 1. As noted above, Scenario 1 is the most likely of the three scenarios presented in the RIA. However, there are shortcomings in that scenario that under-estimate the true potential impact of the water supply reductions.

The labor displacements estimated by the authors include only the direct effects on labor resources, or the number of person-years that will be lost in the direct production of agricultural crops in the Central Valley. The true number of jobs that may be lost, however, includes jobs in backward-linked industries and jobs that are needed to satisfy the demands of households that earn income in the agricultural production and input sectors. As noted above, there will be limited opportunities for labor that is displaced when water supplies are reduced in the Central Valley. Water is a unique resource that is required for agricultural production and for any other economically viable activity in an arid region. It is not likely that some other industry will hire agricultural labor in a region that has lost its water supply. Hence, it is appropriate to examine the indirect and induced effects of reductions in agricultural output, in addition to the direct effects.

The indirect effects of labor displacement include jobs that are lost in the industries that supply the inputs required for agricultural production. The induced effects include jobs that will be lost in all other economic sectors that provide the goods and services that are demanded by households earning income in the agricultural sector. If the authors of the RIA include these indirect and induced effects in their estimates of displaced labor, those estimates would increase to more than 1,600 person-years in Scenario 1 during average water years, and more than 6,500 person-years in Scenario 1 during critically dry years. However, given the other limitations of Scenario 1, the true employment effects would be larger than these estimates.

IMPACTS ON FARMERS' ACCESS TO CREDIT

The authors of the RIA describe several potential implications of the proposed water quality standards on the ability of farmers to obtain short-term and long-term production loans. In recent years, many farmers have had considerable difficulty obtaining production loans because banks have become very cautious in providing loans in regions where the water supply has been restricted due to natural drought or due to specific environmental policy actions. The **uncertainty** regarding water supplies, created largely by environmental regulations, has caused several banks to modify their lending practices in cases where surface water supplies are required to achieve profitable production results. These banks will often loan money only in direct proportion to the water supply that has been officially announced by the appropriate water supply agency. In recent years, these announcements have become more conservative, thereby limiting farm-level access to production loans.

As noted above, the authors of the RIA acknowledge the changes in access to credit that have occurred during recent years. However, the authors do not assign an economic cost to this problem and they do not propose any specific implementation guidelines that might minimize its significance. Instead, they suggest that extent of the problem cannot be determined at this time. While this may be true, the problem of access to credit needs to be considered very carefully as the water quality standards are considered and as implementation plans are developed.

Most farmers cannot operate without short-term production loans that are financed by local banks each year. The size of annual production loans required by farmers will increase as they shift from field crops to higher valued vegetable crops. In addition, farmers will require long-term loans to invest in new irrigation technologies, such as sprinkler and drip irrigation systems. Farmers will also need long-term loans to invest in new plantings of high-valued perennial crops including nuts and fruit crops. Diminished access to credit could be one of the most serious implications of the proposed water quality standards, particularly if this limits the ability of farmers to implement the water management methods that are required to achieve those standards.

The Director of Agricultural Investments for the Municipal Life Insurance Company of New York (MONY), Mr. Stephen Kritscher, describes the policies that have been implemented by his company regarding agricultural loan inquiries in areas that are served by CVP water contracts (in a letter to Senator Diane Feinstein, dated February 10, 1994):

1. Lands relying on CVP contracts for their sole source and supply are no longer considered to have a stable and uninterruptable supply of irrigation water and will therefore not generally be considered as acceptable security for lending.
2. Lands relying on CVP contracts as their primary source and supply shall only be considered as acceptable security for financing as they can show a viable alternative and independent supply, either pump or surface water, adequate to meet all of their irrigation needs on an extended or possibly permanent basis.
3. Lands proving groundwater as their backup supply must provide evidence of the stability of the aquifer and its ability to recharge quickly following extended periods of heavy pumping, such as occurred during the recent six year drought. Groundwater in areas of chronic overdraft shall not be considered an acceptable backup water supply at any time.
4. Water transfers shall not be considered an acceptable backup water supply until implemented on a state-wide basis with well established rules and in a manner assuring long term availability at prices allowing production agriculture to operate on an economic basis. Water transfers are not expected to be a viable alternative supply for long term loan underwriting purposes during this decade.

Mr. Kritscher also provides a vivid example of the impact that reductions in water supply can have on land values in the San Joaquin Valley. He reports that the appraised value of a 1,280-acre farm near Three Rocks, California, has fallen from $2,843 per acre in 1984, to $860 per acre in 1992. At present, the current owner of the parcel is unable to generate any written offers to purchase the land. Verbal offers have been made in the range of $300 per acre to $400 per acre.

COMMENTS REGARDING THE ESTIMATED BENEFITS

Chapter 5 of the RIA presents an estimate of the benefits that the proposed water quality regulations are expected to generate. The authors state that those benefits include both use and nonuse components. The use benefits are said to include commercial fishing in the ocean, and sport fishing in the ocean, in inland waters, and in the San Francisco Bay and Delta. Use benefits also include wildlife viewing and other nonconsumptive recreation (Figure 5-1 in the RIA). The nonuse benefits are said to include existence values, bequest values, and option values. A third category of benefits is said to include the avoided costs of future endangered species listings and the avoided costs of further declines in recreational and commercial fisheries. Each of these categories of benefits is addressed in this critique.

USE BENEFITS

The authors of the RIA state that the "chinook salmon, starry flounder, bay shrimp, and Pacific herring fisheries are the most important commercial fisheries associated with the Bay/Delta estuary." They also report the value of the statewide commercial salmon catch to be about $9 million in 1991. The authors refer to a population model that is described in greater detail in a report by Dumas and Hanemann (1992), but they do not provide any details of that model in the RIA. Therefore, the procedures used in estimating the values presented in Table 5-1 of the RIA are not described. It appears that the values in that table are intended to portray the change in income that would be generated by one additional fish, beyond the current rate of harvest. However, the current harvest rate is not defined and it is, therefore, difficult to interpret the information presented in Table 5-1. A more complete description of the methods used to generate Table 5-1 would be helpful.

It appears that the authors are estimating the economic impact of additional salmon harvest, as a result of improved water quality in the Bay/Delta estuary. The values presented in Table 5-1 include direct impacts, indirect impacts, and induced impacts. It is useful to note that this full set of regional economic impacts is being included by the authors for the estimation of benefits, even though similar regional economic values were excluded when estimating the costs imposed on the agricultural sector. This asymmetric treatment of costs and benefits should be revised to include the same set of economic impacts in each case. Otherwise, the results are biased because the benefits include direct, indirect, and induced effects, while the costs include only the direct effects.

The authors state that the "proposed regulations are predicted to increase the commercial catch of California chinook salmon by 90,000 fish to 130,000 fish, depending on the type of water year. They conclude that the total benefit of increased salmon harvest is $9.9 million annually in above-normal water years and $8.1 million annually during critically dry years. It is not possible to accept these estimates, based upon the limited description of procedures provided in the RIA. In addition, it is difficult to accept that the water quality standards will result in a $9.9 million increase in commercial salmon catch, when the total value reported for that industry in 1991 is just $9 million.

The authors suggest that the value of harvest in the starry flounder fishery was $19,544 in 1992 and that the estimated increase in that value as a result of implementing EPA's water quality standards is $150 in above-normal water years and $15,700 in critically dry years. The estimated change in harvest is 471 additional fish in above-normal water years and 49,054 fish in critically dry years. The very large differences in the estimated incremental changes in harvest and economic values in dry years and in wet years is not explained. As in the case of salmon, described above, the procedures for deriving these estimates are not discussed in the RIA. Therefore, it is not possible to evaluate their accuracy.

SPORT FISHING

The authors state that the proposed water quality regulations would benefit recreation activities, including consumptive and nonconsumptive uses, and that "the primary benefits would be to sport fisheries." However, the authors do not provide any defensible evidence of the relationship between the proposed regulations and any recreational activities. Instead, they state that "an overall increase in recreational fishing is a reasonable expectation," without providing any conceptual or empirical foundation for this assertion.

The authors do present a single-equation regression model that attempts to explain variation in the number of ocean sport-fishing trips for salmon as a function of a salmon abundance index (page 5-18 of the RIA). The model is estimated in logarithmic form, using 22 annual observations from 1970 through 1992 (evidently one year's data are missing). The summary statistics presented in the RIA suggest that only 20% of the variation in sport fishing trips is explained by variation in the abundance index (R^2adj. = 0.20). This result describes a model that does not fit the data very well, and that should not be used for predicting changes in salmon fishing trips as a function of salmon abundance. The regression results actually indicate that there are other factors that are more important in determining the number of salmon fishing trips, than the measure of salmon abundance.

Coefficients estimated in the regression model are combined with estimates of consumers' surplus from another study to estimate the changes in sport-fishing benefits that would result from implementing the water quality regulations. Those estimates include almost $900,000 in above-normal water years and about $800,000 in critically dry years (Table 5-5 of the RIA). A small amount of additional benefits are estimated for striped bass. As noted above, the regression model used to predict changes in salmon fishing trips is not appropriate for generating the numbers that are used to construct these estimates of increased benefits.

The authors note several other recreational activities that might benefit from implementing the proposed water quality standards, but they do not provide any evidence of a relationship between those standards and recreation. Instead, they present a list of estimates of consumers' surplus for various recreational activities in California (Table 5-6 in the RIA). No discussion or analysis is offered regarding those estimates or their role in determining recreational benefits generated by the proposed water quality standards. The information presented in Table 5-6 should be deleted from the revised version of the RIA.

NONUSE BENEFITS

The authors provide no firm evidence of nonuse benefits that would be enhanced by implementing the proposed water quality standards. They present, instead, several estimates of what the average household in California would be willing to pay to protect environmental resources. The methods for generating those estimates are not described in the RIA and their pertinence to the issue of nonuse benefits is not discussed. Those estimates (in Table 5-7 of the RIA) should be deleted from the revised version of the RIA, because they provide no information regarding actual costs or benefits.

OTHER BENEFITS

The authors claim, on page 5-23 of the RIA, that the "avoided costs of continued declines in species and the estuarine fisheries can be considered benefits of the proposed federal actions." They proceed to describe "delisting" benefits that would result if water quality regulations implemented in the near-term would prevent the listing of additional species on the threatened or endangered species list. This claim assumes that there is a known relationship describing species survival as a function of water diversions from the Delta. Such a relationship has never been defined.

In reality, there are many variables and influences that determine the survival of a species in a natural environment. Diversions from the Delta are just one such variable. Given all of the uncertainty regarding the impact of Delta diversions on the health and survival of species in the Delta, it is not appropriate to suggest that policy actions taken in the present will prevent further policy actions in the future. There is a very large error bound involving any policy that reduces Delta diversions to promote the survival of individual species. It is prudent and efficient to observe the response to such policies before proceeding to implement additional measures. It is not appropriate to attribute as benefits the "avoided costs" of potential problems in the future.

COMPARING COSTS AND BENEFITS

The estimated costs of the water quality 3 estimates presented in the RIA include about $10 million for the commercial salmon fishery and about $1 million for sport fishing in the Bay and Delta. The sum of these estimates is less than

$11 million, annually. This is substantially less than the expected losses from any of the three agricultural scenarios presented by the authors. Those losses range from $80 million to $293 million in crop production values in Scenario 1, from $28 million to $173 million in Scenario 2, and from $10 million to $48 million in Scenario 3. Yet, the authors conclude that the "USEPA believes that the benefits are commensurate with the costs." Such a conclusion is not supported by any of the data or any of the analyses presented in the draft RIA.

The cost and benefit data presented in the draft RIA are actually sufficient to conclude that the proposed water quality standards will impose a significant economic cost on agriculture in California, and that California residents will be less wealthy as a result of those regulations. The estimated loss in crop production value in Scenario 1 is $80 million during average water supply years and $294 million during critically dry years. The estimated loss of jobs throughout the state economy is 1,275 person-years in average water supply years and 5,198 person-years in critically dry years (Table 6-2 in the RIA). The same conclusion should also be reached regarding either of the other scenarios.

The estimated increase in commercial salmon fishing is expected to generate an additional $10 million in revenue and an increase of 298 to 364 full-time equivalent jobs (page 6-11 of the RIA). An additional $1.0 million to $1.5 million in revenue, and 60 to 80 full-time equivalent jobs, are expected to be generated in sport fishing activities. The sum of these estimated benefits is about $12 million in revenue and 360 to 450 full-time equivalent jobs. Both of these estimates are substantially less than the economic costs imposed on agriculture in any of the three scenarios presented in the RIA.

The authors conclude that the proposed regulations are cost-effective, even though the costs far exceed the estimated benefits. The rationale behind their decision is, evidently, that the nonuse benefits and the use benefits that have yet to be quantified, are sufficient to compensate for the damages imposed on the agricultural sector. However, those benefits are likely not sufficient to offset the significant reductions in direct crop values and in the indirect and induced economic values that result from agricultural production in California. The appropriate conclusion to the draft RIA is that the proposed water quality standards will impose significant economic costs on agriculture, and that those costs will not be offset by increases in commercial fishing activity or by improvements in sport-fishing activities. The net economic effect of the proposed standards is significantly negative, as shown by the data and by the analyses presented in the draft RIA. An alternative conclusion cannot be justified by any of the data or any of the analyses presented in that report.

B. ECONOMIC IMPACTS OF THE PROPOSED STANDARDS

Several estimates of the potential economic impacts of the proposed water quality standards are presented in the Regulatory Impact Assessment report prepared by the EPA. Some of those estimates are derived using an aggregate model of agricultural supply and demand for the entire state of California, while others are derived using a conceptual model of farm-level water allocation decisions.

The aggregate supply and demand model described in the RIA simulates agricultural production decisions in more than 20 regions throughout California. Such a model is appropriate for estimating statewide impacts of large-scale changes in resource availability, but it is not designed to examine small production regions within the state, which may vary significantly in terms of resource endowments. The conceptual model used to examine farm-level water allocation decisions does not portray those decisions realistically, because it does not permit farmers to shift water among different crops, as their water supply is reduced. Rather, it considers only the estimated returns to irrigation for alternative crops and allocates water accordingly, until the available water supply is exhausted.

Properly constructed simulation models can often provide a useful indication of the changes in resource use and production that may occur when water supplies are reduced, but the predictions of those models need to be tested against actual experience, when possible, to determine their accuracy. In many cases, empirical information describing actual changes in resource use and production may be more useful than aggregate simulation models or farm-level behavioral models in describing the economic impacts of proposed policies or regulations. Empirical data describing actual economic impacts of changes in resource endowments, when available, are often very useful in predicting the actual economic changes that will result from policies or regulations that will mandate similar changes in the availability of key resources.

The six-year drought that occurred during 1987 through 1992 in California has provided an excellent opportunity to observe actual changes in crop production patterns and values that result when water supplies in the San Joaquin Valley are reduced significantly. Contractual water deliveries to districts in the federal Central Valley Project were reduced by 50% in 1990, 75% in 1991 and 1992, and by 50% in 1993. These reductions were due partly to drought conditions and partly to concerns regarding the protection of certain species in the San Francisco Bay/Delta region. As of this writing, contractual water supplies to CVP districts located south of the Delta region have still not been fully restored.

Short-term responses to reductions in water supply will differ, somewhat, from long-term responses, but some of the same farm-level changes in cropping patterns will be observed in both cases. This study examines the actual changes in cropping patterns and crop values that occurred in a set of CVP water districts, during 1989 through 1993. Those changes include reductions in the areas planted to grains and cotton in some districts, and reductions in the area planted to higher value crops in other districts. The actual response to a reduction in water supply, in any one district, is a function of the cropping opportunities in that district, soil quality, existing contracts with commodity processors, and other unique production or marketing situations.

DEFINITIONS OF ECONOMIC MULTIPLIERS

When farmers reduce the number of acres planted, in response to reductions in their water supply, the farm-level demand for inputs and the dollar-value of farm production are also reduced. Hence, the economic impacts of reductions in water supply extend beyond the farm to include industries that produce the inputs used by farmers. In addition, households earning income in agriculture, either directly in crop production, or in industries that produce inputs for agriculture, will see their income reduced as the farm-level demand for inputs declines. The extent of these economic effects can be estimated using economic multipliers that describe quantitatively the linkage among crop production activities and industries that provide inputs for agriculture.

Definitions of the multipliers used to evaluate the four case studies in this report are provided in this section, prior to describing the case studies. Numerical values of those multipliers and the definitions described here are presented in a report titled "Micro IMPLAN User's Guide," prepared by the Land Management Planning Systems Group in the USDA Forest Service, in Fort Collins, Colorado. The authors are Carol Taylor, Susan Winter, Greg Alward, and Eric Siverts, and the date of publication is May, 1993.

Five sets of economic multipliers are used in this report to describe the complete economic impacts of reductions in water supply to farms in the San Joaquin Valley. Each of those multipliers addresses three levels of economic impacts that are described as the direct, indirect, and induced effects of crop production. **Direct effects** are changes in crop production that occur as a direct result of reductions in water supply. These include the reductions in total crop value, personal income, and employment that occur when farmers reduce the area planted, in response to reductions in their water supply. **Indirect effects** are the impacts on backward-linked industries of reductions in the farm-level demand for inputs in crop production. For example, farmers planting fewer acres of cotton will purchase less fertilizer and other inputs used in cotton production. Indirect effects measure the dollar-value of reductions in farm-level demand for inputs. **Induced effects** measure the changes in regional household spending patterns that are caused by changes in regional employment, when water supplies are reduced. These are measured for households directly involved in crop production and for households that are employed in the industries that provide inputs for crop production. Hence, the induced effects include both the direct and indirect effects on household spending patterns.

Industry Output Multipliers describe the value of production that is required from all sectors of an economy to generate one dollar's worth of output in the sector under consideration. Both direct and indirect effects are considered in the estimation of industry output multipliers. For example, if the industry output multiplier for cotton production is 2.20, then for each $1.00 of output generated by cotton producers, an additional $1.20 of output is generated in industries that provide inputs to cotton producers and in industries that provide goods and services to households earning income in cotton production or in the backward-linked industries.

Personal Income Multipliers describe the value of employee compensation earned by households that are employed in crop production, or in industries that provide inputs to crop producers, as a function of the total value of output produced. In addition, the employee compensation required to meet the demand for goods and services by those households is included in this multiplier. For example, if the personal income multiplier for cotton is 0.50, then for each $1.00 of output generated by cotton producers, households earn $0.50 in income. All of the direct, indirect, and induced effects are included in the personal income multipliers used in this report.

Total Income Multipliers are similar to personal income multipliers, but the total income measure includes proprietary income and other property income, in addition to employee compensation. All of the direct, indirect, and induced effects are included in the total income multipliers used in this report.

Value Added Multipliers describe the net addition to the total value of output that is generated in a production activity. In particular, value added is the total value of output, less the cost of inputs used in production (excluding the cost of labor). Another way to calculate value added is to sum the cost of employee compensation, proprietary income, other property type income, and indirect business taxes. The value added multipliers used in this report include direct, indirect, and induced effects of changes in crop production.

Employment Multipliers estimate the effect on employment, for each $1 million of output generated in crop production. For example, if the direct employment multiplier for cotton is 12, then 12 persons are employed in cotton production for each $1 million in the value of cotton produced. If the indirect and induced employment multipliers for cotton are 8 and 14, respectively, then for each $1 million in the value of cotton produced, 8 persons are employed in backward-linked industries and 14 persons are employed in sectors that produce goods and services demanded by households employed directly in cotton production or in the backward-linked industries. The employment multipliers used in this report include direct, indirect, and induced effects of changes in crop production.

FOUR CASE STUDIES

1. BROADVIEW WATER DISTRICT

The 10,000-acre Broadview Water District is located on the west side of the San Joaquin Valley, near Firebaugh, California. Broadview has a contract with the U.S. Bureau of Reclamation for 27,000 acre-feet of water that are delivered through the Delta-Mendota Canal, each year. However, the district has not received a full water supply from the Bureau since 1989. The major crops produced in Broadview include cotton, cantaloupes, processing tomatoes, and alfalfa seed. The district has excellent soils and highly skilled farmers who produce some of the highest crop yields that are recorded in Fresno County, each year.

Broadview is among the group of water districts in the San Luis and Delta-Mendota Units of the Central Valley Project that received a 50% reduction in their water supply during 1990, a 75% reduction during 1991 and 1992, and a 50% reduction in 1993. As a result of these reductions, the area planted to crops in Broadview declined significantly during those years. In particular, the area planted in Broadview declined from 8,686 acres in 1989 to 4,475 acres in 1992, before rising again to about 6,600 acres in 1993 (Table IV-1). At the same time, the total value of crops produced in Broadview declined from almost $12 million in 1989, to $5.2 million in 1992, before rising again to $8.8 million in 1993.

The reduction in total crop value in Broadview and in other water districts causes a reduction in the demand for labor in agriculture and a reduction in the income earned by farmers. In addition, the demand for goods and services required to conduct farming operations, and the activities of processors and marketers of farm products, are reduced. These reductions in economic activity cause ripple effects throughout the regional and state economies, due to the reduction in employment and due to the reduction in spending by households that earn income in agriculture and associated industries. The magnitude of regional and statewide economic effects can be estimated using economic multipliers that describe the linkage among agricultural activities and the regional economy.

In a full water supply year, such as 1989, the total value of crop production in Broadview is $13.5 million (in 1992 dollars), as shown in Table IV-1. This value of production requires an estimated $4.5 million in output from industries that produce inputs for crop production. This is the estimated indirect effect of crop production in Broadview. In addition, an estimated $10.5 million in output is required to meet the demands of households earning income in crop production and in the industries producing the inputs used to produce crops in Broadview. This is the estimated induced effect of crop production. The total value of output that is associated with crop production in Broadview is an estimated $28.5 million, in 1992 dollars.

The income effects of crop production in Broadview, in 1989, are estimated to be $6.5 million for households earning income either directly in crop production, or in a supporting industry, or in an industry that supplies goods and services to meet the demands of households earning income in agriculture. The total income effect includes employee compensation and non-wage income, such as proprietary income and other property income. This effect is an estimated $15.0 million, in 1989. The value added, as a result of crop production in Broadview, is estimated to be $16.4 million, in 1992 dollars. This value represents the portion of California's gross state product that is generated as a result of crop production in Broadview. That production also supports an estimated 468 jobs in a year when the district receives a full water supply.

The impact of water supply reductions on the economic values generated by agricultural production in Broadview are best understood by examining the changes in those values that have occurred during 1992 and 1993. As noted above, 1989 was the most recent year in which Broadview received a full water supply. However, in 1990, all of the farmers in Broadview had water remaining in their allocations from 1989 and they were able to plant a nearly full complement of crops, despite the 50% reduction in water supply to the district, that year. In 1991, Broadview's water supply was reduced by 75% and the area planted in the district declined by about 3,000 acres (Table IV-1). The water supply was reduced by 75% again in 1992, and the area planted declined by another 1,000 acres. Broadview farmers were able to plant about 6,600 acres in 1993, when their water supply was increased to 50% of their contractual volume.

As described above, 1992 is the third consecutive year in which water supplies to Broadview have been reduced. Hence, that year is most representative of the potential <u>long-term</u> economic impacts of a 75% water supply reduction. Similarly, the 50% reduction in water supply to Broadview occurred after three consecutive years of water supply reductions. There was no carry-over water from 1992 available to farmers at the beginning of 1993. Hence, that year is most representative of the potential long-term economic impacts of a 50% water supply reduction.

As shown in Table IV-1, the 50% reduction in water supply in 1993 caused farmers to plant 2,087 (24.0%) fewer acres than were planted in 1989. This resulted in a $3.1 million reduction in total crop value, in current dollars, or $4.9 million in constant 1992 dollars. This loss in crop value caused the demand for inputs to fall by an estimated $1.6 million and the induced effects declined by an estimated $3.8 million. The total effect on output in the regional economy is estimated to be $10.4 million, in 1992 dollars. Personal income was reduced by an estimated $2.4 million, total income was reduced by an estimated $5.4 million, and value added declined by an estimated $6.0 million, in 1992 dollars. In addition, the number of jobs supported by crop production in Broadview declined by an estimated 170 jobs.

The 75% reduction in water supply in 1992 caused farmers to plant 4,211 (48.5%) fewer acres than were planted in 1989. This resulted in a $6.7 million reduction in nominal total crop value, or an $8.3 million reduction in constant 1992 dollars (Table IV-1). The indirect and direct effects of crop production in Broadview declined by $2.8 million and $6.4 million, respectively, resulting in an estimated reduction in total output of $17.5 million. Personal income was reduced by an estimated $4.0 million, total income was reduced by an estimated $9.2 million, and value added declined by an estimated $10.1 million, in 1992 dollars. In addition, the number of jobs supported by crop production in Broadview declined by an estimated 287 jobs.

The economic impacts of water supply reductions in Broadview are particularly severe because the district does not have a usable source of groundwater to replace surface water when its contractual supply is reduced. However, this situation is likely representative of the situation that will be faced by many districts in the region, if surface water supplies are permanently reduced. In the near term, the farm-level response to reductions in surface water will be to increase the pumping of groundwater, in an effort to maintain production levels. Over time, however, pumping depths and costs will increase and the quality of groundwater will deteriorate. Eventually, the usable supply of groundwater in the region will be reduced significantly and many farmers and districts will be in the same situation that Broadview is in at this time. Hence, the economic impacts observed in Broadview during recent years are likely indicative of the long-term economic impacts that will be observed throughout the region, if water supplies are permanently reduced.

The economic impacts observed in Broadview during 1991 through 1993 would have been even more severe than the values reported here, if the district had not been able to obtain some additional water through water marketing agreements. In 1991, Broadview was able to import more than 4,000 acre-feet in such agreements, thereby allowing farmers to plant significantly more acres than they would have been able to cultivate using only their reduced CVP supply. Broadview farmers imported about 3,000 acre-feet in 1992 and in 1993, to supplement their reduced surface water supplies in those years.

2. PANOCHE WATER DISTRICT

The Panoche Water District is also located on the west side of the San Joaquin Valley, where it receives surface water from the U.S. Bureau of Reclamation, through both the San Luis and Delta-Mendota Canals. Like Broadview, Panoche has not received its full supply of surface water since 1989. The major crops produced in this 38,000-acre district include cotton, cantaloupes, processing tomatoes, alfalfa hay, and dry beans. The district also has several plantings of perennial crops including almonds, walnuts, and grapes.

Farmers in Panoche produced crops on 35,686 acres in 1989, for a total crop value of $40 million (Table IV-2). The estimated indirect and induced effects of that production are estimated to be $15.1 million and $35.2 million, respectively, in 1992 dollars. These estimates result in a total output effect of $95.8 million for the Panoche Water District, in 1989. The personal and total income effects are estimated to be $21.8 million and $50.4 million, respectively, in 1992 dollars. The total value added to California's gross state product, as a result of crop production in Panoche in 1989, is estimated to be $55.1 million, in 1992 dollars. In addition, an estimated 1,571 jobs were supported by crop production activities in Panoche, and in industries that provide goods and services to households earning income in the agricultural sector.

The number of acres planted in the Panoche Water District declined steadily during 1990 through 1992, as the district's surface water supply was reduced. As in the case of Broadview, Panoche received a 50% water supply in 1990 and a 25% water supply in 1991 and 1992. Consequently, the area planted in Panoche declined by about 3,400 acres in 1990, and an additional 4,000 acres in 1991 (Table IV-2). In 1992, there were about 8,000 fewer acres planted in Panoche, than were planted in 1989.

The total value of crops produced in the district declined by $4.5 million, nominally, between 1989 and 1992, or by $9.9 million in constant, 1992 dollars (Table IV-2). The estimated losses in output due to indirect and induced effects are estimated to be $3.3 million and $7.7 million, respectively, resulting in an estimated loss in total output of $21.0 million, in 1992 dollars. Personal and total income declined by an estimated $4.8 million and $11.0 million, respectively, and the value added to California's gross state product declined by an estimated

$12.1 million, in 1992 dollars. In addition, an estimated 344 fewer jobs were supported by crop production in 1992 than were supported in 1989.

The 50% reduction in surface water supply during 1990 resulted in delivery of only 47,000 acre-feet from the Bureau of Reclamation to the Panoche Water District. Farmers in the district were able to pump an estimated 7,000 acre-feet of groundwater in 1990 and an additional 9,000 acre-feet were obtained through water marketing agreements. These additional sources of water resulted in a total water supply of 63,000 acre-feet in 1990. The district's surface water supply was reduced by 75% in 1991and 1992, resulting in contractual deliveries of only 23,500 acre-feet in those years. Farmers pumped an estimated 6,200 acre-feet and 7,000 acre-feet in 1991 and 1992, and about 13,500 acre-feet were transferred into the district in each of those years.

A comparison of 1989 with 1992 reveals that as the volume of water delivered to Panoche from the Bureau of Reclamation declined by 68,345 acre-feet (74.4%), the volume of groundwater pumped by farmers in the district increased by 6,166 acre-feet (739.3%). The volume of water transferred into the district in water marketing agreements also increased significantly, rising from 1,792 acre-feet in 1989 to 13,500 acre-feet in 1992 (753.3%). However, even with these significant increases in groundwater pumping and water marketing, the total water supply in the district declined by more than 50,000 acre-feet (53.4%) between 1989 and 1992.

The water supply data for the Panoche Water District during 1989 through 1992 suggest that groundwater pumping and water marketing are not the preferred sources of irrigation water, at prevailing costs and prices. Farmers pumped only 834 acre-feet of groundwater and they imported only 1,792 acre-feet in water marketing agreements in 1989, which was the last year that the district received its full allotment of surface water. Groundwater in the Panoche Water District, and in other districts in the region, is often relatively high in salts and boron and is not desirable for use in irrigation. It may be used to supplement surface water supplies during short periods of drought, but it cannot be used successfully, in perpetuity.

Water marketing may also provide a viable short-term response to reductions in surface water supplies, but the long-term role of water markets is not yet clear. When the supply of water to irrigation districts located south of the San Joaquin/Sacramento River Delta is reduced, due to drought or to the implementation of environmental policies, the price of water in regional water markets rises to reflect the scarcity of the resource in any districts located south of the Delta. Therefore, farmers wishing to purchase water to supplement their reduced contractual supply, must pay a premium price that includes a geographic scarcity component, in addition to the normal water supply and wheeling charges. In addition, the geographic scarcity component will likely increase as the severity of the drought or the rigidity of the environmental policies increases. For these reasons, the price and availability of water in the marketplace will likely not be appropriate for replacing large reductions in surface water supplies at an acceptable cost, in agricultural districts located south of the Delta.

3. SAN LUIS WATER DISTRICT

The San Luis Water District includes about 45,000 acres of productive crop land on the west side of the San Joaquin Valley, where it receives surface water from the U.S. Bureau of Reclamation, through both the San Luis and Delta-Mendota Canals. Like Broadview and Panoche, San Luis has not received its full supply of surface water since 1989. The major crops produced in the San Luis Water District include cotton, cantaloupes, processing tomatoes, almonds, and assorted vegetable crops. The district also has significant areas planted in table grapes, citrus fruit, and apricots.

The total value of crops produced on 44,764 acres in the district in 1989 is $46.9 million (Table IV-3), or about $1,047 per acre. The estimated indirect and induced effects of crop production are estimated to be $17.8 million and $41.3 million, respectively, resulting in an estimated total output effect of $112.4 million, in 1992 dollars. The estimated personal and total income effects in 1989 are $25.5 million and $59.1 million, respectively, and the estimated contribution to California's gross state product is $64.7 million, in 1992 dollars. In addition, an estimated 1,843 jobs were supported by crop production activities, and the indirect and direct effects of those activities, in 1989.

The economic impacts of crop production in San Luis remained very positive in 1990, even though the surface water supply was reduced by 50% during a portion of that year. Many farmers in the district had water remaining from their allocation for 1989 that could be used for pre-irrigation of cotton lands or for early-season irrigations of vegetable and perennial crops. The total area planted in 1990 was typical of previous years and the total value of crop production was slightly higher than in 1989. Hence, the regional economic effects did not change significantly from 1989 to 1990.

The area planted in San Luis declined significantly in 1991, when the surface water supply was reduced by 75%. Farmers planted only 32,585 acres, or about 11,000 fewer acres (25.2%) than were planted in the previous year (Table IV-3). The total value of crop production declined to $38.1 million, or about $9 million less than in 1990. However, in real terms, the value of crop production declined from $53.3 million in 1989 to $39.3 million in 1991, for a loss of $14.0 million (26.2%), in 1992 dollars. The economic impacts of the drought were evident again in 1992, when the district's water supply was reduced by 75% for the second consecutive year. Farmers planted only 31,179 acres in 1992, or 13,585 fewer acres (30.3%) than were planted in 1989. The total value of crop production declined to $37.5 million, for a loss in total value of $15.8 million (29.6%), in 1992 dollars.

The estimated losses in the indirect and induced effects of crop production, due to the water supply reduction in 1992, are $5.3 million and $12.3 million, respectively, resulting in an estimated reduction in total output of $33.3 million, in 1992 dollars. The estimated losses in personal and total income are $7.6 million and $17.5 million, respectively, and the estimated reduction in California's gross state product is $19.2 million, in 1992 dollars. In addition, an estimated 547 fewer jobs (20.1%) were supported by crop production in San Luis during 1992, than were supported in 1989, when the district received a full water supply.

The economic impacts of reductions in surface water supplies in the San Luis Water District would have been worse than those reported above, if the district had not been able to augment its water supply significantly with groundwater and with water transferred into the district in water marketing agreements. Groundwater pumping increased from just 3,000 acre-feet in 1989 to about 8,000 acre-feet in 1990, and about 20,000 acre-feet in 1991. In 1992, the volume of groundwater used to produce crops in San Luis exceeded the volume of surface water received from the Bureau of Reclamation. However, it should be noted that the volumes of groundwater pumped during 1991 through 1993 are likely not sustainable in the long term, given the marginal quality of groundwater in the region and the increase in pumping cost that occurs as depth to groundwater increases. While groundwater has been helpful in minimizing the short-term economic impacts of water supply reductions in the San Luis Water District, the resource cannot be expected to provide the same benefit, in perpetuity, if surface water supplies are permanently reduced.

The volume of water obtained by the San Luis Water District in water marketing agreements has varied throughout the drought, declining from about 24,000 acre-feet in 1990 to just 3,403 acre-feet in 1991. Much of this water was obtained at a price significantly higher than the cost of water from the Bureau of Reclamation, and many farmers used the water to finish irrigating a crop that was already planted, rather than to furnish the entire crop water requirement. The high price of water available in marketing agreements is largely responsible for the significant reduction in the volume transferred into the district in 1991.

In 1992, the volume of water transferred out of San Luis was about equal to the volume of water transferred into the district, resulting in a minimal net gain to the district's water supply. In 1993, the volume of water transferred out of the district actually exceeded the volume transferred into the district. Most of the water transferred out of the district in 1992 and 1993 was water that was moved from a farmer's operation in the San Luis Water District to that same farmer's operation in another water district within the Central Valley Project. Many farmers in the San Luis Unit of the CVP chose to move a portion of their limited water allotment among districts during those years, in order to maximize the usefulness of their limited water supplies. Hence, the water marketing data for 1992 and 1993 do not necessarily represent a net increase in the supply of water available to farmers in the San Luis Unit. In many cases, those data represent name-transfers of water among districts, resulting in no net increase in water supply.

4. WESTLANDS WATER DISTRICT

The Westlands Water District includes about 600,000 acres of land in both Fresno and Kings Counties in California. The district has a water supply contract with the Bureau of Reclamation for 1.15 million acre-feet per year. However, the district has not received its full water allocation since 1989. The major crops produced in Westlands include cotton (both acala and pima), tomatoes, garlic, cantaloupes, safflower, lettuce, and beans. There are also more than 11,000 acres of almonds and more than 5,000 acres of wine grapes in the district. During recent years, many farmers in Westlands have increased their production of high-value vegetable crops, to maximize their returns to limited water supplies.

In 1989, the total market value of crops produced on 515,000 acres of land in the Westlands Water District was more than $730 million (Table IV-4). The estimated indirect and induced effects of that production are $277.0 million and $645.3 million, respectively, resulting in an estimated total output effect of $1.75 billion, in 1992 dollars. The estimated personal and total income effects are $398.3 million and $922.0 million, respectively, and the estimated value added, or the contribution to California's gross state product, is almost 1.0 billion, in 1992 dollars. In addition, an estimated 28,753 jobs were made possible by crop production activities in Westlands during 1989.

Westlands received a 50% reduction in surface water supply during the 1990 water year, but most farmers were able to maintain their 1989 levels of production by using water remaining from the 1989 water year and by increasing their use of groundwater. Farmers pumped an estimated 300,000 acre-feet of groundwater in 1990 and an additional 39,000 acre-feet of water were transferred into the district in water marketing agreements. The total water supply available during the 1990 crop year was about 150,000 acre-feet less than was available in 1989.

Surface water supplies to Westlands and other San Luis Unit contractors were reduced by 75% in 1991 and 1992. As a result, farmers in Westlands increased their use of groundwater to an estimated 600,000 acre-feet in each of those years. In addition, 36,000 acre-feet and 94,000 acre-feet of water were transferred into the district in 1991 and 1992, respectively. The use of groundwater and water obtained through transfers resulted in total water deliveries during 1991 and 1992 that were about 67% of the volume delivered in 1989. However, the farm-level cost of those deliveries increased significantly, due to the relatively high costs of groundwater pumping and the high price of water in the marketplace.

Extensive groundwater pumping and intensive water marketing efforts in 1991 and 1992 enabled farmers in Westlands to produce crops on about 85% of the land that was farmed in 1989. However, in a district as large as Westlands, the removal of a moderate percentage of land area from production can result in significant economic impacts. For example, a comparison of 1989 with 1992 reveals that the land area in crops was reduced by 47,211 acres (9.2%), resulting in a loss in total crop value of almost $74.5 million (10.2%) in current values, or $174.3 million (21.0%) in constant, 1992 dollars. The estimated losses in the indirect and induced effects of crop production are $58.1 million and $135.3 million, respectively, resulting in an estimated loss in total output of $367.6 million, in 1992 dollars. The estimated losses in personal and total income are $83.5 million and $193.3 million, respectively, and the estimated loss in value added is $211.5 million, in 1992 dollars. In addition an estimated 6,029 fewer jobs were supported by crop production activities in the Westlands Water District in 1992, than were supported in 1989.

Farmers in Westlands were able to increase the area planted in the district by an estimated 15,000 acres in 1993, as the district's CVP water supply was increased to 50% of the contractual volume. Even with these additional acres in production, the direct and indirect economic impacts were significant. Total crop value was about $154 million less than the value that was produced in 1989, and the estimated total output effect was about $325 million less than was generated in that year. The estimated personal and total income effects were about $74 million and $171 million less than in 1989, respectively, and value added was reduced by $187 million. In addition, 5,332 fewer jobs were supported by crop production in Westlands, than were supported in 1989.

The economic impacts of reductions in surface water supplies in the Westlands Water District would have been worse than those reported above, if the district had not been able to augment its water supply significantly with groundwater and with water transferred into the district in water marketing agreements. As noted above, groundwater pumping increased from an estimated 175,000 acre-feet in 1989, to an estimated 300,000 acre-feet in 1990, and an estimated 600,000 acre-feet in 1991 and 1992. This increase in groundwater pumping is very similar to the farm-level response observed during the 1977 drought, when farmers increased their use of groundwater by about 400,000 acre-feet, to offset reductions in surface water supply.

The dramatic increases in groundwater pumping observed during 1990 through 1993 in the Westlands Water District are not sustainable, given the natural rate of recharge to the aquifer underlying the district. Hydrologists have estimated that the sustainable safe yield of groundwater in Westlands is about 200,000 acre-feet per year. If farmers continue to overdraft the aquifer, pumping costs will escalate as depths increase, and the quality of water will deteriorate. As in the case of San Luis Water District, described above, groundwater pumping is a viable short-term response to reductions in surface water supply. However, the resource is not sufficiently large, and the recharge rate is not sufficiently rapid, to compensate for permanent reductions in surface water supplies to the region.

SUMMARY OF FOUR CASE STUDIES

The four water districts examined in this analysis represent a total productive area of more than 600,000 acres during a year when the districts receive a full surface water supply. For example, in 1989, the total area planted in these four districts was 604,295 acres and the total value of production was more than $830 million (Table IV-5). The estimated indirect and induced effects of crop production in 1989 are $314.4 million and $732.4 million, respectively, resulting in a total output effect of almost $2.0 billion, in 1992 dollars. The estimated personal and total income effects of crop production are $452.1 million and $1.05 billion, respectively, and the estimated value added is $1.15 billion, in 1992 dollars. In addition, an estimated 32,640 jobs were made possible by crop production activities in the four districts during 1989.

Surface water supplies to each of the four districts were reduced by 50% in 1990, by 75% in 1991 and 1992, and by 50% in 1993. As a result of these consecutive reductions in surface water supply, the total area in production declined by almost 73,000 acres between 1989 and 1992 (Table IV-5). The total value of production declined by $95.1 million in nominal terms, or by $208.3 million, in constant 1992 dollars. The estimated losses in the indirect and induced effects of crop production are $69.4 million and $161.7 million, respectively, resulting in an estimated loss in total output of $439.4 million, in 1992 dollars. The estimated losses in personal and total income are $99.8 million and $231.0 million, respectively, and the estimated loss in value added is $252.8 million, in 1992 dollars. In addition, an estimated 7,206 fewer jobs were supported by crop production, and the associated indirect and induced effects of that production, in 1992, than were supported in 1989.

FURTHER CONSIDERATIONS

The economic losses observed in these four districts during 1990 through 1993, when surface water supplies were reduced significantly, vary among districts according to the availability of groundwater and the availability and price of water in the marketplace. As described above, some districts were able to maintain a larger proportion of their normal production level than other districts, and the economic impacts vary accordingly. However, even in districts with better access to groundwater and with better ability to participate in water markets, there were significant reductions in the area planted in 1991 and 1992, and there were corresponding reductions in the economic value of crop production. As a result, regional economic activity was reduced by almost $440 million in 1992 and more than 7,200 jobs that had been available in 1989 were not available in 1992.

The magnitude of both the district-level and regional economic impacts of reductions in surface water supplies will increase in the future, if those reductions are implemented permanently. As described above, the groundwater pumping levels observed during 1990 through 1993 are not sustainable, given the natural rate of recharge to the regional aquifer. If surface water supplies are reduced permanently, farmers will continue to pump groundwater until the pumping cost becomes prohibitive or until the quality becomes unacceptable. At that time, the resource will no longer be an economically viable replacement for surface water supplies, and crop production levels will diminish significantly.

The changes in cropping patterns and crop values that have occurred in the Broadview Water District in recent years provide a useful indication of the changes that are likely to occur in other districts, if surface water supplies are permanently reduced. As noted above, Broadview does not have a viable source of groundwater and, therefore, its farmers have been affected more severely than farmers in other districts by the drought-induced reductions in surface water supply. A larger proportion of the Broadview Water District was fallowed during 1991 through 1993, than in any of the other three districts examined in this study. However, while the conditions at Broadview are relatively unique at present, those conditions may represent the most likely future scenario for most districts in the region, if surface water supplies are permanently reduced.

The long-term economic impacts of permanent reductions in surface water supply are estimated for the four districts in this study by examining the water supply and crop production data observed during 1989 through 1992, and using those data to predict the likely pattern of crop production in those districts in the future. The purpose is to use existing data that describe actual farm-level and district-level responses to short-term water shortages, to predict long-term

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The existing data provide estimates of surface water deliveries, groundwater pumping, water transfers, and crop production during years when contractual water supplies have been reduced significantly. These data can be used to predict long-term responses to reductions in contractual water supplies, provided that appropriate assumptions regarding groundwater pumping and water markets are incorporated in the analysis. For example, in this analysis, water marketing is restrained by the same proportions that surface water supplies are restrained, when projecting future water supplies.

Groundwater pumping is limited, in this analysis, to the estimated safe yield of groundwater in the Westlands Water District (200,000 acre-feet per year) and similar proportional reductions in groundwater pumping are imposed on the Panoche and San Luis Water Districts. These assumptions reflect the expectation that both groundwater pumping and water marketing will eventually be reduced, over time, if surface water supplies are permanently reduced, in regions located south of the Delta. Groundwater pumping reductions will be caused by increasing depths to groundwater, higher pumping costs, and diminishing quality of the resource. Water marketing in regions south of the Delta will be limited by the same policies that restrict the movement of contractual supplies through the Delta during specific months of the year.

The results of this analysis suggest that the value of crops produced in the Broadview Water District will decline by $3.4 million per year if the surface water supply is permanently reduced by 25% (Table IV-6). That estimated loss increases to $9.6 million per year if surface water supplies are permanently reduced by 75%. The estimated reduction in total output ranges from $7.1 million per year to $20.2 million per year, depending on the magnitude of the water supply reduction. Personal and total income will be reduced by an estimated $4.6 million and $10.6 million, respectively, if surface water supplies are reduced by 75%. The value added to California's gross state product will decline by an estimated $11.6 million in that same scenario. In addition, the number of jobs made possible by crop production in Broadview will decline by an estimated 331 positions.

The information presented in Table IV-6 describes similar results for the other three districts examined in this study. The estimated losses in crop value range from $8.4 million in the Panoche Water District to $216.7 million in the Westlands Water District, if surface water supplies are reduced by 25%. In that scenario, the estimates of reductions in total output range from $17.7 million in the Panoche Water District to $457.0 million in the Westlands Water District. Similarly, the estimated reductions in value added range from $10.2 million in Panoche to $263.0 million in Westlands. The estimated reductions in jobs range from 290 positions supported by crop production in Panoche to 7,495 positions supported by crop production in Westlands.

The estimated reductions in crop value that will occur if surface water supplies are permanently reduced by 75% range from $21.8 million in the Panoche Water District to $511.3 million in Westlands (Table IV-6). Similarly, the estimated losses in total output range from $46.1 million in Panoche to $1.1 billion in Westlands, and the estimated losses in value added range from $26.5 million to $620.5 million. The estimated reductions in jobs range from 755 positions supported by crop production in Panoche to 17,685 positions supported by crop production in Westlands.

The sum of losses in the value of crop production that can be expected in all four districts ranges from $241.0 million if surface water supplies are permanently reduced by 25%, to $527.9 million if water supplies are reduced by 75% (Table IV-6). Similarly, the sum of losses in total output ranges from $508.3 million if water supplies are reduced by 25%, to $1.2 billion, if water supplies are permanently reduced by 75%. At the same time, the number of jobs made possible by crop production in the four districts would decline by an estimated 8,336 positions in the 25% reduction scenario, and by an estimated 19,818 positions in the 75% reduction scenario.

It should be noted that all of the information presented in Table IV-6 pertains to just four water districts in the San Luis and Delta-Mendota Units of the Central Valley Project. The four districts range in size from the 10,000-acre Broadview Water District to the 600,000-acre Westlands Water District, and they include the 38,000-acre Panoche Water District and the 45,000-acre San Luis Water District. Although the total area represented by these districts is almost 700,000 acres, there remain many other districts in the region that have not been examined in this study. However, those districts will likely face similar reductions in economic activity if surface water supplies are permanently reduced. Hence, the complete economic effects of those reductions will be significantly greater than the values presented in Table IV-6.

In summary, the most likely reductions in crop values due to permanent reductions in surface water supplies in four water districts range from $241.0 million per year if supplies are reduced by 25% to $572.9 million if supplies are reduced by 75%. The total output effects of those reductions in crop value range from $508.3 million to $1.2 billion, respectively. The number of jobs that will be lost in the region range from 8,336 positions to 19,818 positions, depending on the severity of the water supply reduction. All of these estimates are based on actual experience in these four water districts during 1989 through 1993, when surface water supplies were reduced by 50% in two years, and by 75% in two additional years. Furthermore, all of these estimates exceed the projections of agricultural losses developed using conceptual models of agricultural production, and presented in the Regulatory Impact Assessment of EPA's proposed water quality standards, dated December 15, 1993.

Table 4-1.

Estimated Regional Economic Impacts of Crop Production in the Broadview Water District, 1989 through 1993

Year	Acres in Production	Total Crop Value: Nominal Value	Total Crop Value: In 1992 Dollars	Regional Output Effects, Income, and Value Added, in 1992 Dollars: Indirect Effects	Induced Effects	Total Output Effects	Personal Income	Total Income	Value Added	Total Jobs
		(Million Dollars)		(Million Dollars)			(Million Dollars)			
1989	8,686	11.9	13.5	4.5	10.5	28.5	6.5	15.0	16.4	468
1990	8,132	9.4	10.0	3.3	7.8	21.2	4.8	11.1	12.2	347
1991	5,484	6.1	6.3	2.1	4.9	13.2	3.0	6.9	7.6	217
1992	4,475	5.2	5.2	1.7	4.1	11.0	2.5	5.8	6.4	181
1993	6,599	8.8	8.6	2.9	6.7	18.2	4.1	9.6	10.5	298
Comparison	**Reduction**	**Reductions**		**Losses in Regional Output, Income, Value Added, and Jobs**						
1989 vs. 1992	4,211	6.7	8.3	2.8	6.4	17.5	4.0	9.2	10.1	287
1989 vs. 1993	2,087	3.1	4.9	1.6	3.8	10.4	2.4	5.4	6.0	170

Source: Production data are from the Broadview Water District and the regional economic effects are calculated using economic multipliers reported in IMPLAN, USDA, Forest Service, May, 1993.

Notes: Values for personal income, total income, value added, and total jobs include the sum of direct, indirect, and induced effects.
Nominal values are converted to 1992 dollars using the consumer price index for urban consumers, published by the Bureau of Labor and Statistics. The conversion for 1993 is preliminary, pending publication of the final price index for that yea
Total jobs are calculated using the 1990 dollar values of crop production in each year.
The information in this table is preliminary and is subject to revision, as better data become available.

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Table 4-2.

Estimated Regional Economic Impacts of Crop Production in the Panoche Water District, 1989 through 1992

Year	Acres in Production	Total Crop Value: Nominal Value	Total Crop Value: In 1992 Dollars	Regional Output Effects, Income, and Value Added, in 1992 Dollars: Indirect Effects	Induced Effects	Total Output Effects	Personal Income	Total Income	Value Added	Total Jobs
		(Million Dollars)		(Million Dollars)			(Million Dollars)			
1989	35,686	40.0	45.4	15.1	35.2	95.8	21.8	50.4	55.1	1,571
1990	32,232	43.1	45.8	15.3	35.5	96.6	21.9	50.8	55.6	1,584
1991	28,126	32.6	33.6	11.2	26.1	70.9	16.1	37.3	40.8	1,163
1992	27,742	35.5	35.5	11.8	27.5	74.8	17.0	39.3	43.1	1,227
Comparison	**Reduction**	**Reductions**		**Losses in Regional Output, Income, Value Added, and Jobs**						
1989 vs. 1992	7,944	4.5	9.9	3.3	7.7	21.0	4.8	11.0	12.1	344

Source: Production data are from USBR Crop Reports and the Panoche Water District. Regional economic effects are calculated using economic multipliers reported in IMPLAN, USDA, Forest Service, May, 1993.

Notes: Values for personal income, total income, value added, and total jobs include the sum of direct, indirect, and induced effects.
Nominal values are converted to 1992 dollars using the consumer price index for urban consumers, published by the Bureau of Labor and Statistics.
Total jobs are calculated using the 1990 dollar values of crop production in each year.
The information in this table is preliminary and is subject to revision, as better data become available.

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Table 4-3.

Estimated Regional Economic Impacts of Crop Production in the San Luis Water District, 1989 through 1992

Year	Acres in Production	Total Crop Value: Nominal Value	Total Crop Value: In 1992 Dollars	Regional Output Effects, Income, and Value Added, in 1992 Dollars: Indirect Effects	Induced Effects	Total Output Effects	Personal Income	Total Income	Value Added	Total Jobs
		(Million Dollars)		(Million Dollars)			(Million Dollars)			
1989	44,764	46.9	53.3	17.8	41.3	112.4	25.5	59.1	64.7	1,843
1990	43,536	47.1	50.1	16.7	38.9	105.6	24.0	55.5	60.8	1,732
1991	32,585	38.1	39.3	13.1	30.5	82.8	18.8	43.5	47.7	1,358
1992	31,179	37.5	37.5	12.5	29.1	79.0	17.9	41.5	45.5	1,296
Comparison	**Reduction**	**Reductions**		**Losses in Regional Output, Income, Value Added, and Jobs**						
1989 vs. 1992	13,585	9.4	15.8	5.3	12.3	33.3	7.6	17.5	19.2	547

Source: Production data are from USBR Crop Reports and the San Luis Water District. Regional economic effects are calculated using economic multipliers reported in IMPLAN, USDA, Forest Service, May, 1993.

Notes: Values for personal income, total income, value added, and total jobs include the sum of direct, indirect, and induced effects.
Nominal values are converted to 1992 dollars using the consumer price index for urban consumers, published by the Bureau of Labor and Statistics.
Total jobs are calculated using the 1990 dollar values of crop production in each year.
The information in this table is preliminary and is subject to revision, as better data become available.

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Table 4-4.

Estimated Regional Economic Impacts of Crop Production in the Westlands Water District, 1989 through 1992

		Total Crop Value		Regional Output Effects, Income, and Value Added, in 1992 Dollars						
Year	Acres in Production	Nominal Value	In 1992 Dollars	Indirect Effects	Induced Effects	Total Output Effects	Personal Income	Total Income	Value Added	Total Jobs
		(Million Dollars)		(Million Dollars)			(Million Dollars)			
1989	515,159	731.6	831.3	277.0	645.3	1,753.6	398.3	922.0	1,009.0	28,758
1990	522,914	699.3	743.9	247.9	577.4	1,569.1	356.4	825.0	902.9	25,734
1991	445,360	635.9	655.5	218.4	508.8	1,382.7	314.1	727.0	795.6	22,677
1992	467,948	657.1	657.1	218.9	510.0	1,386.0	314.8	728.7	797.5	22,730
1993	482,289	690.8	677.2	225.6	525.6	1,428.4	324.4	751.0	821.9	23,426
Comparison	**Reduction**	**Reductions**		**Losses in Regional Output, Income, Value Added, and Jobs**						
1989 vs. 1992	47,211	74.5	174.3	58.1	135.3	367.6	83.5	193.3	211.5	6,029
1989 vs. 1993	32,870	40.8	154.1	51.4	119.6	325.1	73.8	170.9	187.1	5,332

Source: Production data are from WWD Crop Reports and the regional economic effects are calculated using economic multipliers reported in IMPLAN, USDA, Forest Service, May, 1993.

Notes: Values for personal income, total income, value added, and total jobs include the sum of direct, indirect, and induced effects.
Nominal values are converted to 1992 dollars using the consumer price index for urban consumers, published by the Bureau of Labor and Statistics.
Total jobs are calculated using the 1990 dollar values of crop production in each year.
The data for 1993 are preliminary.
The information in this table is preliminary and is subject to revision, as better data become available.

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Table 4-5.

Summary of Estimated Regional Economic Impacts of Crop Production in the Broadview, Panoche, San Luis, and Westlands Water Districts, 1989 through 1992

Year	Acres in Production	Total Crop Value		Regional Output Effects, Income, and Value Added, in 1992 Dollars						
		Nominal Value	In 1992 Dollars	Indirect Effects	Induced Effects	Total Output Effects	Personal Income	Total Income	Value Added	Total Jobs
		(Million Dollars)		(Million Dollars)			(Million Dollars)			
1989	604,295	830.3	943.6	314.4	732.4	1,990.2	452.1	1,046.4	1,145.2	32,640
1990	606,814	798.8	849.8	283.2	659.6	1,792.5	407.2	942.5	1,031.4	29,398
1991	511,555	712.6	734.7	244.8	570.3	1,549.7	352.0	814.8	891.7	25,414
1992	531,344	735.2	735.2	245.0	570.7	1,550.8	352.3	815.4	892.4	25,434
Comparison	**Reduction**	**Reductions**		**Losses in Regional Output, Income, Value Added, and Jobs**						
1989 vs. 1992	72,951	95.1	208.3	69.4	161.7	439.4	99.8	231.0	252.8	7,206

Source: Production data are from the Broadview Water District and the regional economic effects are calculated using economic multipliers reported in IMPLAN, USDA, Forest Service, May, 1993.

Notes: Values for personal income, total income, value added, and total jobs include the sum of direct, indirect, and induced effects.
Nominal values are converted to 1992 dollars using the consumer price index for urban consumers, published by the Bureau of Labor and Statistics.
Total jobs are calculated using the 1990 dollar values of crop production in each year.
The information in this table is preliminary and is subject to revision, as better data become available.

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Table 4-6.

Estimated Reductions in Crop Acreage and Value, for Selected Reductions in Surface Water Supply, in Four Water Districts in the San Luis and Delta-Mendota Units of the CVP, in 1992 Dollars

Assuming Limited Groundwater Availability and Limited Water Marketing Activity

Estimated Reductions In			Estimated Reductions in Regional Economic Effects						
Surface Water Supply	Crop Acres	Crop Value	Indirect Effects	Induced Effects	Total Output Effects	Personal Income	Total Income	Value Added	Total Jobs
(%)		(Million Dollars)	(Million Dollars)			(Million Dollars)			
Broadview									
25	1,741	3.4	1.1	2.6	7.1	1.6	3.7	4.1	116
50	3,481	6.7	2.2	5.2	14.2	3.2	7.4	8.2	232
75	5,304	9.6	3.2	7.4	20.2	4.6	10.6	11.6	331
Panoche									
25	6,958	8.4	2.8	6.5	17.7	4.0	9.3	10.2	290
50	13,917	16.8	5.6	13.0	35.4	8.0	18.6	20.3	580
75	17,272	21.8	7.3	16.9	46.1	10.5	24.2	26.5	755
San Luis									
25	10,412	12.6	4.2	9.8	26.6	6.0	14.0	15.3	436
50	20,825	25.2	8.4	19.5	53.1	12.1	27.9	30.6	871
75	24,513	30.2	10.1	23.5	63.8	14.5	33.5	36.7	1,046
Westlands									
25	106,129	216.7	72.2	168.2	457.0	103.8	240.3	263.0	7,495
50	212,258	433.3	144.4	336.3	914.0	207.6	480.5	525.9	14,989
75	271,557	511.3	170.3	396.8	1,078.4	244.9	567.0	620.5	17,685
All Four Districts									
25	125,240	241.0	80.3	187.1	508.3	115.5	267.3	292.5	8,336
50	250,481	482.0	160.6	374.1	1,016.6	230.9	534.5	585.0	16,673
75	318,646	572.9	190.9	444.7	1,208.4	274.5	635.3	695.3	19,818

Notes: These estimates are based on data actually observed during the years 1989 through 1993 in all four of the water districts presented here. All of the data are in constant, 1992 dollars, but the total job effects are calculated using 1990 dollars, for consistency with the job effects multiplier.

Estimates of reductions in crop acres and crop values are made according to the procedure described in the text of this report. Reductions pertain to the crop acres and values observed during 1989.

The values for personal income, total income, value added, and total jobs include the sum of direct, indirect, and induced effects.

The information in this table is preliminary and is subject to revision, as better data become available.

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SECTION 5

TECHNICAL CRITIQUE OF PROPOSED EPA BAY/DELTA WATER QUALITY STANDARDS

5.1 SUMMARY

The Authority believes a Bay/Delta salinity standard should be established, in conjunction with stronger measures to prevent introduction of foreign species, control toxic discharges and screen water diversions, to protect and improve habitat for aquatic organisms in the Delta. The Authority also believes that conservative and prudent water management indicates that, at least as an interim measure, the salinity standard should attempt to recreate Bay/Delta salinity conditions similar to those observed prior to the sharp declines in estuarine fish populations.

The analysis and supporting evidence for the salinity (X2) standard proposed as an estuarine habitat standard by EPA directly relates to the most critical water resource management problem in the state of California. Therefore, EPA's analysis must be carefully examined to see if it provides an adequate basis for water management decisions. The Authority's review of EPA's Proposed Rule and the supporting documents, as discussed below, indicates that:

- EPA has not established a firm scientific basis for the proposed X2 standard, and
- EPA's analyses do not provide an adequate means of estimating biological benefits of proposed Delta salinity standards.

Nevertheless, recognizing the need for prudence in a situation of great scientific uncertainty, The Authority supports establishment of a Delta salinity standard.

On the other hand, EPA's proposed salmon smolt survival and striped bass spawning standards are unjustified:

- As discussed below, there is no mathematical and logical basis for the proposed smolt survival standard. Furthermore, the proposed salmon smolt survival standard is not a water quality standard in that it does not specify allowable concentrations of contaminants in water, or directly specify allowable physical characteristics of Bay/Delta water. The proposed San Joaquin River smolt survival standard depends only on flow variables and the proposed Sacramento River smolt survival standard depends on flow variables and average water temperature at Freeport. Average water temperature at Freeport is mainly determined by air temperature, and cannot be precisely controlled by water project operations.

- EPA's proposed striped bass spawning standard aims to increase abundance of striped bass. Striped bass were introduced into the estuary in the late 1800s, and they prey on the threatened Delta smelt, the young of the endangered Winter-run Chinook salmon and other species of concern. Therefore, measures to increase abundance of striped bass will increase predation on protected species and species of concern, and are inconsistent with Endangered Species Act prohibitions against actions likely to harm or harass threatened and endangered species. The argument that striped bass abundance can be increased without harming Delta smelt and Winter-run salmon because they coexisted in the past is without merit. The Bay/Delta system has been changed radically in the recent past by the introduction of foreign species and increased toxic discharges so successful coexistence of the three species cannot be assumed under present conditions.

Both the salmon smolt survival and striped bass spawning standard proposals should therefore be withdrawn.

5.2 TECHNICAL CRITIQUE OF EPA'S ESTUARINE HABITAT (X2) STANDARD

The proposed EPA estuarine habitat standard aims to increase the chances for greater fish abundance by establishing upstream limits on salinity intrusion into the estuary during the spring. The estuarine habitat standard specifies the number of days from February through June that the 2 parts per thousand (2 ppt) isohaline, the line through all points where the 14 day average bottom salinity is 2 ppt, must be downstream of three locations (Roe Island, Chipps Island, and the confluence of the Sacramento and San Joaquin rivers). The distance in kilometers from the Golden Gate to the 2 ppt isohaline is designated by X2, so the estuarine habitat standard is sometimes called the X2 standard. Because average X2 is largely determined by the amount of freshwater outflow from the Delta, EPA's proposed estuarine habitat water quality standard is actually a Delta outflow standard.

There are several main difficulties with EPA's exclusive reliance on a salinity standard to protect Bay/Delta estuarine habitat:

- EPA's hopes of increasing fish abundance in the estuary by simply controlling X2 (to control salinity intrusion into the Delta and thus the extent of brackish water habitat available to fish in the springtime) depend critically on the assumption that availability of brackish water habitat is the main factor controlling and limiting abundance of estuarine fish. If so, moving X2 to values similar to those in previous years could return the ecosystem to its previous condition and increase the chance for a resurgence of the fish. However, there have been tremendous changes in the Bay/Delta estuary since estuarine fish abundances began to decline. In addition to changes in toxic discharges, flow conditions and nutrient inputs, the estuary has been permanently altered by introduction of many non-native species (including the voracious Asian clam, Potamocorbula amurensis, and fish such as inland silversides and chameleon goby). By themselves, introductions of non-native species guarantee that, even if previous flow conditions could be replicated exactly, the estuarine ecosystem can never be returned to a previous condition. So, the successive waves of invasions by introduced species mean that it is impossible to return the ecosystem to any previous condition just by recreating previous values of X2, and that changes in X2 alone are unlikely to replicate any past relationship between X2 and abundances of estuarine fish.

- EPA's data do not support the contention that changes in X2 that can be accomplished by controlling water exports will substantially affect the abundance of desired species. The most likely reason is that abundances are strongly influenced by other factors, and not just by changes in availability of brackish water habitat caused by water diversions.

- There is evidence that toxic discharges were responsible for the decline of striped bass, long acclaimed as a key "indicator" of the state of the estuary. These possible effects of toxic discharges on striped bass were neglected by EPA when setting the proposed standards. However, if toxic discharges caused the decline of striped bass, they probably also caused the decline of other species. As in other ecosystems damaged by toxic discharges, increased abundance of desirable fish species cannot occur until toxic discharges are controlled.

EPA's technical justification for their proposed salinity standard rests on correlations between X2 and eight indicators of the abundance of estuarine species, as set forth in Appendix B to the 1993 EPA San Francisco Estuary Project report "Managing Freshwater Discharge to the San Francisco Bay/Sacramento-San Joaquin Delta Estuary: The Scientific Basis for an Estuarine Standard" (the 1993 EPA report). This purported technical justification for the proposed salinity standard is scientifically inadequate for the reasons set forth in the following sections.

5.2.1 LIMITED AND INAPPROPRIATE DATA BASE

A scientifically defensible basis for a standard with consequences as far-reaching as the proposed X2 standard should rest on analysis of more than eight abundance indices. However, even within the limited number of abundance indices considered by EPA, several are misleading and unlikely to accurately represent the relationship between X2 and abundance of various species in the estuary as it exists today:

- EPA's historical data on abundance of mollusks in Grizzly Bay indicates the presence of freshwater clams when average X2 was low for a three year period and the presence of more salt-tolerant clams when average X2 was high for a three year period. However, the Asian clam Potamocorbula amurensis was introduced in 1986 and it can tolerate a very wide salinity range. Because Potamocorbula is now the dominant bottom dwelling organism in the upper estuary, historical data on mollusc abundance in Grizzly Bay do not reflect the relationship between mollusc abundance and X2 under today's conditions in the estuary. Furthermore, high abundance of Potamocorbula is probably harmful to many other estuarine species,so high mollusc abundance is not an appropriate management goal at this time.

- EPA's data on particulate organic carbon (POC) in Suisun Bay are the sum of primary production of organic carbon in the bay and organic carbon carried by river water flowing out of the Delta. A closer look at the data reveals that the upward trend in POC as outflow increases (X2 moves downstream) just shows that the rivers carry more organic carbon into Suisun Bay under the weather and upstream conditions occurring in wet years. One reason is that, in high flow years, river water is diverted from limited capacity river channels through flood control bypasses (such as the Yolo Bypass) where they flow over agricultural fields, pick up organic carbon, and carry it into Suisun Bay. Therefore, EPA's POC data do not indicate a relationship between abundance of organic carbon and changes in X2 resulting from water diversions.

- Starry flounder in the Bay/Delta system have been decimated by heavy commercial fishing in recent years. The years of low abundance resulting from over-fishing coincided with drought years of low outflow and high average values of X2. This makes any habitat-related relationship between high values of X2 and low abundance of starry flounder appear stronger than it actually is.

- Average X2 in April through July is strongly correlated with average X2 in July through November. The correlation coefficient is 0.99 for the years 1967 through 1991, when bass abundance data are available. Therefore, the two separate measures of striped bass abundance used by EPA are not independent indicators of the relationship between bass and outflow. The mid-water trawl data are probably the best indicator of bass abundance, because they indicate abundance later in the life cycle of the bass.

As a result, EPA really investigated only four independent estimates of abundance that can potentially cast light on the relationship between the average position of X2 and the abundance of estuarine species.

Finally, EPA studied the relationship between their abundance estimates and X2 in various periods throughout the year, and then jumped with no real justification to a proposed standard that controls X2 from February through June.

5.2.2 INAPPROPRIATE DATA ANALYSIS

The species abundance data used by EPA to support their conclusions about the importance of X2 have not been made readily available. However, fall mid-water trawl data for longfin smelt and striped bass juveniles were obtained, and detailed review of these data reveals several inadequacies in EPA's analysis:

a. Unjustified omissions of data

EPA did not consider the 1967 midwater trawl data, and no justification is given for omission of these data. In addition, the 1983 longfin smelt abundance data were omitted. Appendix B to the 1993 EPA report says that the observation corresponding to 1983 flows was eliminated because "...a significant portion of the population may have been seaward of the sampling stations, causing an underestimate of the annual abundance." However, examination of the 1983 longfin smelt catch data in Appendix A shows that the distribution of catch by area in 1983 was similar to that in 1982. Therefore, there is no justification for eliminating the 1983 data. Including 1983 data substantially changes the relationship between X2 and longfin smelt abundance, as will be discussed below.

b. Inadequate treatment of uncertainty in the data

The abundance index EPA used for the midwater trawl data is the sum of abundance estimates for the months of September, October, November and December. In other words, EPA's index is 4 times the average abundance in the months sampled. The four sampled values can be used to estimate the standard deviation of the average abundance. The standard deviation of the total index is then 4 times the standard deviation of the average value, and the variance is the square of the standard deviation. EPA assumed that:

- variance of the striped bass abundance data is constant, independent of the value of the abundance index; and
- variance of the longfin smelt abundance data is proportional to the value of the abundance index.

However, the variances for striped bass and longfin smelt mid-water trawl data are roughly proportional to the square of the abundance index. This is demonstrated by the plots in Appendix A showing that the standard deviation of the average value of the monthly abundance is roughly proportional to the average value of the monthly abundance.

Adequate regression analysis of the abundance data must properly account for the uncertainty in the data, and EPA did not do this. The generalized linear model analysis described in Appendix B to the 1993 EPA report was redone by:

- including all years of abundance data from the midwater trawl survey;
- taking proper account of uncertainty in the data; and
- focusing on the relationship between abundance and average X2 from February through June, the period when X2 would be controlled by the proposed EPA standard.

The results of this reanalysis, as shown in Appendix A, are as follows:

- Correlations between predicted and observed abundances are substantially weaker than reported by EPA. The percentage of variation of striped bass abundance explained by changes in X2 drops from the 71% claimed in the 1993 EPA report to 50%, and the percentage of variation in longfin smelt abundance explained by changes in X2 drops from the 74% claimed in the 1993 EPA report to 27%.
- As shown by the wide error bars on the longfin smelt and striped bass regression equations in Appendix A that predict abundance from February-June X2, there is great uncertainty in the predicted values of abundance. Therefore, shifts in the predicted abundance values for striped bass and longfin smelt resulting from changes in the average X2 value in February through June X2 that might result from limitations on exports may not even be detectable.

5.2.3 INAPPROPRIATE STANDARD AT ROE ISLAND

Roe Island is not an appropriate location for a 2 ppt salinity standard, and the proposed requirement for maintaining X2 downstream of Roe Island for a specified number of days in February through June is unjustified. EPA's Proposed Rule on Bay/Delta Standards emphasizes the importance of locating the entrapment zone, hypothesized to exist between locations where the average salinity is between 2 ppt and 10 ppt, adjacent to the shallows in Suisun Bay. However, holding X2 at or below Roe Island will move the entrapment zone too far downstream towards Carquinez Strait (10 km below Roe Island), reducing or eliminating the hypothesized benefits of setting X2 at Roe Island.

Taking the threatened Delta smelt as an important example, the regression analysis in Appendix B shows that there is no statistically significant relationship between Delta smelt abundance and the number of days X2 is downstream of Roe Island (64 km from the Golden Gate Bridge). Furthermore, abundance data for Delta smelt shown in Appendix C clearly indicate that Delta smelt abundance declines when the average position of X2 in February through June is downstream of Roe Island.

Finally, setting X2 at Roe Island would result in significant reductions of carryover water storage in upstream reservoirs, adversely affecting the endangered Winter-run salmon, and other salmon species of concern. The Authority contends that no standard should be established at Roe Island to avoid the detrimental environmental effects of such a standard.

5.2.4 INAPPROPRIATE DETERMINATION OF COMPLIANCE REQUIREMENTS

EPA used calculated Delta outflow (DAYFLOW) data and the Kimmerer-Monismith regression equation in Appendix A to the 1993 EPA report to estimate X2 during the period 1940-1975. EPA then took the average number of days in each water year type that X2 was downstream of Roe Island, Chipps Island and the confluence of the Sacramento and San Joaquin Rivers and used this as the X2 standard. This does not replicate 1940-1975 conditions because low flow conditions are not replicated. Furthermore, using the 1940-1975 period as the basis for the standard does not accurately represent conditions in the late 1960s and early 1970s because the early years in the 1940-1975 period were years with little or no exports, and were generally wetter than average. Basing the standard on water year types introduces unrealistic discontinuous jumps at the outflow conditions on the boundary between water year types. Finally, establishing the 14 day average X2 as the standard implies that prudent operations for compliance require maintaining flows larger than those estimated to be necessary for compliance to allow for a margin of error.

The Authority contends that salinity standards should use a sliding scale based on the Four River Index to avoid discontinuous jumps in the standard. This standard should allow for several ways to achieve compliance, eliminating the need for costly water releases to maintain an unnecessary and detrimental buffer, or margin of safety, for compliance.

5.3 TECHNICAL CRITIQUE OF EPA'S SALMON SMOLT SURVIVAL STANDARD

EPA's proposed salmon smolt survival standard must be withdrawn because, as explained in the following sections, it has no technical justification whatsoever.

5.3.1 PROBLEMS WITH THE SMOLT SURVIVAL ESTIMATES

The proposed salmon smolt survival standard is based on a completely inadequate analysis of data from release and recapture of hatchery-raised salmon smolts. Tagged smolts were released at various times and locations upstream of Chipps and recaptured at Chipps Island. If every live smolt from a particular release that reached Chipps Island could be counted, smolt survival for that release would be known. It would obviously be some number less than 1.0 (100% survival). Because a complete count is clearly not feasible, the number of surviving smolts must be estimated by sampling. EPA assumed that:

- smolts were distributed evenly across the cross-section of the river when passing Chipps Island, and
- the smolts from a given release were evenly spread out in time when passing Chipps Island during the sampling period.

Then sample catches from a short period in part of the channel can be scaled up to estimate the total number R of tagged smolts reaching Chipps Island. Estimated survival for a release is R divided by the number of smolts released.

Even if the assumed homogeneous distribution of smolts in time and across the cross-section of the river were correct, some errors in the survival estimates would be expected because of random variations from the assumed even distribution of smolts in space and time. Some catch estimates might be larger than the release, if the sampling net happened to hit a large number of fish. However, survival estimates for a given group of releases should be normally distributed around the average value, which is the best estimate of smolt survival for that group of releases. This is what was observed.

Because the raw survival estimates described above often turned out to be larger than one, EPA calls the raw survival estimates "survival indices". In Appendix III to EPA's 12/15/93 Proposed Rule on Bay/Delta Standards, EPA says "...estimates of total tagged fish in the river cross-section (based on trawl mouth size and time fished) yielded a maximum survival index of nearly 1.8 (180%), and the frequency distribution plot of survival indices indicated an approximately normal distribution with a median near 1.0..." This indicates that the sampling program resulted in an estimate of salmon smolt survival averaged over all of the releases of 1.0 (100%) with a normal distribution of measurement error, as expected.

If salmon smolt survival is believed to be different for different release conditions, the best estimate of survival for some release conditions must have been greater than 1.0 to balance lower survival under other conditions and give a composite survival estimate of 1.0 for all releases. This alone shows that there are fundamental errors in the estimation of smolt survival, above and beyond random errors of measurement, because salmon smolt survival can never exceed 1.0 (100% survival).

Investigating hypothesized differences in smolt survival under different release conditions would require analyzing the frequency distribution plots of raw survival estimates for different release conditions separately, to see if:

a. the mean survival estimates are significantly different from 1.0 (the average over all release conditions), and

b. the mean survival estimates are significantly different from each other.

This analysis might result in survival estimates greater than 1.0 for some release conditions. That would have to be the case if there is a significant difference between survival under different release conditions and the average survival for all releases is 1.0. Then, before proceeding with any further analyses, data for those release conditions indicating survival greater than 1.0 must be carefully examined to uncover and correct the mistakes in sampling and analysis responsible for this nonsensical result. EPA did not do this.

5.3.2 UNJUSTIFIED SCALING OF THE RAW SURVIVAL DATA

EPA says that smolt survival "...indices were divided by 1.8 to provide biologically meaningful survival rates." In other words, EPA assumed that, because the highest raw survival estimate was at least 80% too high, all of the raw survival estimates were exactly 80% too high. There is absolutely no scientific or statistical justification for this assumption.

When the raw salmon smolt survival estimates are "corrected" by arbitrarily dividing them by 1.8, there is no justification for treating the resulting numbers as survival probabilities. Therefore, the "corrected" survival estimates cannot appropriately be used in the regressions, or in the Ricker equation involving multiplication of survival probabilities, that were used to develop the proposed smolt survival standards. So, the entire technical basis for the smolt survival standard falls apart completely.

5.3.3 OTHER ERRORS

EPA omitted some of the smolt survival data from their analysis. For example, the estimated San Joaquin smolt survival of 1.0 in 1979 was dropped from consideration without justification by EPA. Inclusion of these unjustifiably neglected data is likely to substantially influence the results.

EPA also failed to correct for the following effects on survival of tagged salmon smolts released in the Sacramento-San Joaquin system:

- effects related to tidal conditions at the time of the release (Note that

USFWS report WQCP-USFWS-1 demonstrates that water temperature does not account for a significant portion of the residual variation in smolt mortality after mortality due to tidal effects has been removed.);

- differences in survival of smolts from different hatcheries;
- effects of thermal shock arising from the difference in water temperature between the hatchery truck and the receiving water; and
- variation in activity of predators over the range of temperatures when releases occurred.

Finally, effects of different sampling effort during daylight and nighttime hours on the resulting survival estimates were not addressed in detail.

SECTION 5
Appendix A

Longfin Data
Bass Data
& Regressions

Table 5A-1

LONGFIN SMELT FALL MIDWATER TRAWL ABUNDANCE

		AREA																	
YEAR	MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1967	9	623.70		7051.20	1274.00				740.00			1840.00	3080.00	592.94	270.00	12.00	0.00	0.00	15483.8
	10	6318.00		937.90	65.00				13616.00		172.80	14512.00	8113.78	4962.32	1077.86	0.00	0.00	0.00	49775.6
	11	24.30		1310.80	390.00				0.00		187.20	480.00	2280.44	2267.05	675.00	36.00	5.60	0.00	7656.4
	12	413.10		1126.23					296.00			0.00	1690.89	4032.00	881.88	117.60	229.60	28.57	8815.8
		7379.10	0.00	10426.13	1729.00	0.00	0.00	0.00	14652.00	0.00	360.00	16832.00	15165.11	11854.31	2904.73	165.60	235.20	28.57	81731.7
1968	9	48.60		0.00	0.00			0.00	0.00			0.00	222.44	1039.26	118.57	0.00	0.00	0.00	1428.8
	10	0.00		0.00	0.00			0.00	0.00			0.00	3.11	496.42	259.38	13.20	0.00	0.00	772.1
	11	0.00		26.37	0.00			0.00	0.00			80.00	32.67	267.16	25.00	15.60	6.53	0.00	453.3
	12	0.00		33.90	0.00			0.00	0.00			0.00	119.78	310.74	83.75	37.20	57.87	20.00	663.2
		48.60	0.00	60.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	80.00	378.00	2113.58	486.70	66.00	64.40	20.00	3317.5
1969	9	0.00	0.00	15026.23	52.00	0.00		6.80	2682.50	4.50		9344.00	6527.11	1265.68	139.38	1.33	0.00	0.00	35048.5
	10	0.00	2.80	493.43	0.00	134.20		0.00	425.50	130.50		112.00	5475.56	1896.63	954.38	4.50	0.93	0.00	9630.4
	11		*data missing*																8148.2
	12	32.40	207.20	862.57	61.75	24.40		40.80	536.50	219.00	4.80	1360.00	1367.33	1340.53	427.50	67.20	100.80	13.33	6666.1
		32.40	210.00	16381.23	113.75	158.60	0.00	47.60	3644.50	354.00	4.80	10816.00	13370.00	4502.84	1521.25	73.03	101.73	13.33	59493.3
1970	9	16.20	0.00	42.38	61.75	2.44		0.00	148.00		0.00	96.00	352.80	169.20	0.00	0.00	0.00	0.00	888.7
	10	2.70	0.00	0.00	0.00	0.00	0.00	0.00	4.63		4.80	4.57	257.60	122.40	13.75	0.00	0.00	0.00	410.4
	11	0.00	0.00	1.88	2.17	24.40	8.85	8.16	0.00	1.50	24.00	178.67	526.40	208.80	80.00	0.00	2.00	0.00	1066.8
	12	238.95	0.00	30.13	541.67	492.07	0.00	132.60	29.07	9.00	2020.80	450.67	126.00	37.64	40.00	6.00	14.00	0.00	4168.5
		257.85	0.00	74.39	605.58	518.91	8.85	140.76	181.70	10.50	2049.60	729.90	1262.80	538.04	133.75	6.00	16.00	0.00	6534.6
1971	9	8.10	0.00	137.86	2.17	4.07	0.00	0.00	166.50	54.00	0.00	571.43	1321.60	135.00	41.25	0.00	0.00	0.00	2441.9
	10	87.08	0.00	111.12	10.83	8.13	0.00	0.00	302.94	0.00	86.40	365.71	2511.60	1776.60	461.25	0.00	0.00	0.00	5721.6
	11	643.95	0.00	97.93	45.50	46.77	2.95	47.60	48.56	0.00	163.20	539.43	400.40	2734.20	245.00	2.40	4.00	0.00	6021.6
	12	285.53	0.00	47.08	136.50	26.84		40.80	9.25	27.00	196.80	224.00	495.60	1038.60	172.50	74.40	14.00	12.00	2800.9
		1024.65	0.00	393.99	195.00	85.81	2.95	88.40	527.25	81.00	446.40	1700.57	4729.20	5684.40	920.00	76.80	18.00	12.00	15966.4

Table 5A-2

LONGFIN SMELT FALL MIDWATER TRAWL ABUNDANCE

		AREA																	
YEAR	MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1972	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.14	86.80	34.20	7.50	0.00	0.00	0.00	137.64
	10	0.00	0.00	0.00	0.00	0.00	0.00	5.10	0.00	0.00	0.00	34.67	25.20	52.00	1.25	0.00	0.00	0.00	118.22
	11	0.00	0.00	0.00	3.25	0.00	0.00	0.00	0.00	0.00	0.00	9.14	8.40	54.00	31.25	0.00	0.00	0.00	106.04
	12	4.05	0.00	1.88	0.00	0.00			0.00	0.00	14.40	74.67	168.00	102.60	10.00	16.00	6.00	0.00	397.60
		4.05	0.00	1.88	3.25	0.00	0.00	5.10	0.00	0.00	14.40	127.62	288.40	242.80	50.00	16.00	6.00	0.00	759.50
1973	9	10.80		0.00	48.75	73.20			111.00		0.00	69.33	927.11	1340.00	212.14	2.00	0.00	0.00	2794.34
	10	8.10		0.00	35.75	0.00			4.63		0.00	74.67	301.78	716.82	95.00	0.00	0.00		1236.74
	11	62.78		24.86	0.00	0.00			0.00		0.00	109.33	435.40	140.63	35.00	0.00	0.00		807.99
	12	229.50		113.00	9.75	24.40					278.40	72.00	186.67	108.00	13.33	15.00	7.00		1057.05
		311.18	0.00	137.86	94.25	97.60	0.00	0.00	115.63	0.00	278.40	326.33	1850.96	2305.45	355.48	17.00	7.00	0.00	5896.12
1975	9	6.08		40.68	6.50	0.00			2.31		4.80	13.33	147.00	91.13	5.71	0.00	0.00	0.00	317.54
	10	4.05		0.00	0.00	0.00			2.31		0.00	5.33	337.40	200.25	48.57	0.00	0.00		597.92
	11	85.05		2.26	0.00	12.20			0.00		28.80	93.71	379.40	443.25	132.86	16.00	4.67		1198.20
	12	46.58		0.00	0.00	12.20					28.80	41.14	340.20	146.25	38.57	36.00	5.25		694.99
		141.75	0.00	42.94	6.50	24.40	0.00	0.00	4.63	0.00	62.40	153.52	1204.00	880.88	225.71	52.00	9.92	0.00	2808.64
1976	9	*data missing*																	11.00
	10	0.00	0.00	0.00	2.17	0.00			0.00		0.00	2.67	0.00	4.50	2.86	0.00	0.00	0.00	12.19
	11	6.08	0.00	0.00	0.00	0.00			0.00		0.00	0.00	2.80	20.57	1.43	58.00	1.27	0.00	90.15
	12	*data missing*																	540.62
		6.08	0.00	0.00	2.17	0.00	0.00	0.00	0.00	0.00	0.00	2.67	2.80	25.07	4.29	58.00	1.27	0.00	653.96
1977	9	0.00	0.00	0.00	2.17	4.07	0.00	0.00	0.00		0.00	0.00	0.00	6.00	0.00	16.36	0.00	0.00	28.60
	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	1.20	0.00	14.18	1.27	0.00	16.65
	11	0.00	0.00	0.00	0.00	0.00		0.00	2.31		0.00	0.00	0.00	3.38	2.86	56.73	10.18	2.22	77.68
	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	2.67	4.67	2.57	0.71	63.27	2.55	5.00	81.44
		0.00	0.00	0.00	2.17	4.07	0.00	0.00	2.31	0.00	0.00	2.67	4.67	13.15	3.57	150.55	14.00	7.22	204.36
1978	9	176.18	2.80	310.75	47.67	75.23	53.10	98.60	25.44		57.60	56.00	142.80	691.20	55.00	7.64	0.00	0.00	1800.00
	10	32.40	0.00	0.00	0.00	8.13	0.00	2.55	0.00		4.80	80.00	296.80	650.25	97.14	1.09	0.00	0.00	1173.17
	11	37.80	0.00	9.42	0.00	12.20	0.00	10.20	62.44		28.80	61.33	174.00	779.29	92.86	144.00	37.80	0.00	1450.14
	12	205.20	0.00	137.86	107.25	8.13		0.00	0.00		105.60	275.20	579.60	601.71	110.00	93.60	21.00	6.67	2251.82
		451.58	2.80	458.03	154.92	103.70	53.10	111.35	87.88	0.00	196.80	472.53	1193.20	2722.46	355.00	246.33	58.80	6.67	6675.13

Table 5A-3

LONGFIN SMELT FALL MIDWATER TRAWL ABUNDANCE

YEAR	MONTH	AREA 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1980	9	1215.00		508.50	866.67	0.00		612.00	7402.64		0.00	181.33	1442.00	1918.29	426.43	375.00	253.56	0.00	15201.4
	10	21.60		24.86	2.17	24.40		5.10	0.00		4.80	373.33	1505.00	2599.71	1205.71	182.67	121.33	0.00	6070.6
	11	0.00		0.00	6.50	0.00		0.00	0.00		24.00	41.60	570.89	1437.75	597.14	801.33	47.25	0.00	3526.4
	12	2430.00		11.30	97.50	183.00		20.40	61.67		48.00	220.80	1369.20	1498.80	190.00	124.00	99.56	0.00	6354.2
		3666.60	0.00	544.66	972.83	207.40	0.00	637.50	7464.31	0.00	76.80	817.07	4887.09	7454.55	2419.29	1483.00	521.69	0.00	31152.7
1981	9	0.00		0.00	0.00	0.00		5.10	0.00		0.00	5.33	49.00	111.38	32.50	18.67	0.00	0.00	221.9
	10	4.05		0.00	2.17	0.00		0.00	3.08		0.00	0.00	4.20	84.71	16.67	278.67	4.67	0.00	398.21
	11	2.70		0.00	6.50			0.00	0.00		4.80	9.14	19.60	86.40	10.00	39.60	0.00	0.00	178.7
	12	0.00		13.56	16.25	0.00		0.00	0.00		4.80	373.33	677.60	240.75	43.33	17.14	10.89	5.00	1402.6
		6.75	0.00	13.56	24.92	0.00	0.00	5.10	3.08	0.00	9.60	387.81	750.40	523.23	102.50	354.08	15.56	5.00	2201.5
1982	9	542.70		203.40	1421.33	292.80		2284.80	6.17		0.00	400.00	1909.60	668.12	169.17	0.00	0.00	0.00	7898.0
	10	731.03		418.10	450.67	414.80		10.20	1504.67		9.60	2610.29	2804.20	3611.65	1347.86	44.40	3.82	0.00	13961.27
	11	20.25		571.78	2.17	732.00		0.00	5.29		105.60	7474.67	11289.60	6511.76	1405.00	70.67	1.27	0.00	28190.0
	12	3086.10		25.43	17.33	0.00		81.60	373.70		4.80	2730.67	5798.80	536.82	153.57	38.67	21.00	6.67	12875.1
		4380.08	0.00	1218.71	1891.50	1439.60	0.00	2376.60	1889.82	0.00	120.00	13215.62	21802.20	11328.35	3075.60	153.73	26.09	6.67	62924.5
1983	9	12.15		0.00	0.00	0.00		0.00	0.00		33.60	11.43	82.60	10.59	1.43	0.00	0.00	0.00	151.8
	10	133.65		49.72	0.00	0.00		0.00	5.29		1377.60	240.00	1290.80	6.75	0.71	1.20	0.00	0.00	3105.7
	11	803.93		92.66	162.50	280.60		5.10	7.93		748.80	681.14	1841.00	586.13	193.57	3.60	0.00	0.00	5406.9
	12	95.18	5.60	248.60	184.17	105.73	5.90	8.16	743.08		19.20	1245.33	439.60	15.60	78.57	15.43	0.00		3210.1
		1044.90	5.60	390.98	346.67	386.33	5.90	13.26	756.30	0.00	2179.20	2177.90	3654.00	619.06	274.29	20.23	0.00	0.00	11874.6
1984	9	0.00		0.00	4.33	0.00		0.00	0.00		14.40	66.67	168.00	64.59	7.86	2.40	0.00	0.00	328.2
	10	127.58		0.00	296.83	1043.10		0.00	0.00		28.80	240.00	424.20	317.25	61.43	65.33	7.00		2611.5
	11	70.88	0.00	76.84	21.67	22.37	50.16	6.12	0.00	0.00	24.00	184.00	760.20	1022.63	77.86	234.67	50.00		2601.3
	12	40.50		2.26	2.17	14.23	0.00	0.00	92.50		446.40	157.33	691.60	277.88	106.43	26.67	58.80		1916.7
		238.95	0.00	79.10	325.00	1079.70	50.16	6.12	92.50	0.00	513.60	648.00	2044.00	1682.34	253.57	329.07	115.80	0.00	7457.9
1985	9	0.00		0.00	0.00	0.00		0.00	0.00		0.00	4.57	4.20	6.35	2.14	2.40	0.00	0.00	19.6
	10	0.00		0.00	0.00	0.00		0.00	0.00		0.00	0.00	2.80	4.24	0.00	24.00	0.00	0.00	31.0
	11	0.00		0.00	0.00	0.00		0.00	15.86		0.00	11.43	7.00	3.38	10.00	168.00	3.82		219.4
	12	6.08		0.00	0.00	0.00		0.00	5.29		0.00	102.86	93.80	298.80	22.86	171.60	20.22		721.5
		6.08	0.00	0.00	0.00	0.00	0.00	0.00	21.14	0.00	0.00	118.86	107.80	312.76	35.00	366.00	24.04	0.00	991.6
1986	9	30.38		4.52	36.83	73.20		0.00	7.93		0.00	16.00	289.33	397.06	95.71	15.60	5.09	0.00	971.6
	10	34.43		27.12	19.50	48.80		15.30	224.64		4.80	22.86	698.60	227.65	172.86	37.33	8.91	0.00	1542.7
	11	208.58		74.58	30.33	97.60		0.00	9.25		24.00	54.86	450.80	438.35	151.43	301.20	14.00	2.00	1856.9
	12	184.28		20.34	4.33	0.00		0.00	49.33		0.00	155.43	285.60	558.00	235.71	217.20	78.00		1788.2
		457.65	0.00	126.56	91.00	219.60	0.00	15.30	291.15	0.00	28.80	249.14	1724.33	1621.06	655.71	571.33	106.00	2.00	6159.6

Table 5A-4

LONGFIN SMELT FALL MIDWATER TRAWL ABUNDANCE

YEAR	MONTH	AREA 1	3	4	5	7	8	10	11	12	13	14	15	16	17	Total
1987	9	2.03	9.04	2.17	0.00	0.00	2.64	0.00	6.86	5.60	5.29	0.71	99.60	0.00	0.00	133.94
	10	10.13	0.00	0.00	0.00	5.10	7.93	0.00	9.14	8.40	10.13	0.00	19.20	0.00	0.00	70.02
	11	6.08	9.04	0.00	0.00	15.30	13.21	0.00	54.86	32.20	73.06	0.71	174.00	5.83	0.00	384.29
	12	81.00	65.54	45.50	36.60	0.00	208.79	33.60	77.71	95.20	95.29	7.14	151.20	11.67	10.00	919.24
		99.23	83.62	47.67	36.60	20.40	232.57	33.60	148.57	141.40	183.77	8.57	444.00	17.50	10.00	1507.50
1988	9	0.00	0.00	0.00	0.00	5.10	0.00	0.00	0.00	0.00	2.12	0.71	8.40	0.00	0.00	16.33
	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.29	7.00	7.41	0.71	0.00	0.00	0.00	17.41
	11	0.00	0.00	4.33	0.00	5.10	0.00	0.00	2.29	11.20	11.65	0.00	151.20	3.50	0.00	189.27
	12	52.65	13.56	8.67	42.70	61.20	24.67	14.40	22.86	109.20	66.00	5.71	76.00	22.00		519.61
		52.65	13.56	13.00	42.70	71.40	24.67	14.40	27.43	127.40	87.18	7.14	235.60	25.50	0.00	742.62
1989	9	0.00	0.00	0.00	0.00		0.00	0.00	2.29	4.20	3.18	0.00	1.20	0.00	0.00	10.86
	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.12	0.00	30.00	0.00	0.00	32.12
	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.71	7.00	6.35	0.00	7.20	2.55	0.00	36.81
	12	16.20	2.26	2.17	0.00	0.00	15.86	0.00	38.86	56.00	22.24	1.43	212.40	8.91	0.00	376.31
		16.20	2.26	2.17	0.00	0.00	15.86	0.00	54.86	67.20	33.88	1.43	250.80	11.45	0.00	456.11
1990	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.40	3.18	0.71	4.80	0.00	0.00	10.0
	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.43	0.00	0.00	0.00	1.4
	11	4.05	2.26	4.33	0.00	0.00	3.08	0.00	4.57	2.80	3.18	1.43	45.60	5.83	0.00	77.1
	12	12.15	11.30	4.33	6.10	0.00	7.93	0.00	13.71	9.80	20.12	2.86	60.00	2.33	0.00	150.6
		16.20	13.56	8.67	6.10	0.00	11.01	0.00	18.29	14.00	26.47	6.43	110.40	8.17	0.00	239.2
1991	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.18	0.00	4.80	0.00	0.00	7.9
	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.40	2.12	2.14	1.20	0.00	0.00	6.8
	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.60	8.47	0.71	12.00	0.00	0.00	26.7
	12	2.03	0.00	4.33	0.00	0.00	7.93	0.00	25.14	16.80	9.53	2.86	19.20	4.67	0.00	92.4
		2.03	0.00	4.33	0.00	0.00	7.93	0.00	25.14	23.80	23.29	5.71	37.20	4.67	0.00	134.1
1992	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.80	0.00	0.00	0.00	0.00	0.00	2.
	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.
	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.29	1.40	4.24	0.00	3.60	0.00	0.00	11.
	12	8.10	2.83	4.33	0.00	5.10	0.00	0.00	4.00	12.60	7.41	0.71	14.40	0.00	0.00	59.
		8.10	2.83	4.33	0.00	5.10	0.00	0.00	6.29	16.80	11.65	0.71	18.00	0.00	0.00	73.

Table 5A-5

STRIPED BASS FALL MIDWATER TRAWL ABUNDANCE

YEAR	MONTH	AREA 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1967	9	16.20		0.00	0.00				0.00			768.00	2557.80	5376.71	2340.63	474.00	505.87	71.43	12110.63
	10	0.00		7.53	0.00				0.00		0.00	16.00	1003.33	1589.68	1367.14	301.20	237.07	50.00	4571.96
	11	8.10		7.53	13.00				0.00		72.00	144.00	855.56	161.05	625.63	63.60	204.40	50.00	2204.87
	12	16.20		3.77					18.50			112.00	854.00	831.79	201.25	66.00	87.73	2.86	2194.10
		40.50	0.00	18.83	13.00	0.00	0.00	0.00	18.50	0.00	72.00	1040.00	5270.69	7959.23	4534.64	904.80	1035.07	174.29	21081.58
1968	9	0.00		0.00	0.00			0.00	0.00			0.00	7.78	994.74	100.71	339.60	226.80	30.77	1700.40
	10	0.00		0.00	0.00			0.00	0.00			0.00	7.78	101.37	106.88	646.80	564.67	15.71	1443.20
	11	0.00		0.00	0.00			0.00	0.00			16.00	65.33	126.00	93.13	153.60	173.60	7.69	635.35
	12	0.00		0.00	0.00			0.00	0.00			16.00	63.78	79.58	27.50	52.80	92.40	6.67	338.72
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	144.67	1301.68	328.21	1192.80	1057.47	60.84	4117.67
1969	9	0.00	2.80	0.00	6.50	0.00		13.60	0.00	0.00		16.00	175.78	2156.21	936.88	104.00	303.33	250.77	3965.87
	10	0.00	5.60	3.77	52.00	0.00		10.20	0.00	0.00		32.00	496.22	228.32	434.38	115.50	227.73	40.00	1645.71
	11		*data missing*																1486.24
	12	0.00	36.40	90.40	19.50	6.10		0.00	0.00	21.00	33.60	112.00	612.89	65.37	147.50	99.60	45.73	36.67	1326.76
		0.00	44.80	94.17	78.00	6.10	0.00	23.80	0.00	21.00	33.60	160.00	1284.89	2449.89	1518.75	319.10	576.80	327.44	8424.57
1970	9	0.00	11.20	0.00	94.25	19.52		0.00	0.00		4.80	4.57	70.00	468.00	707.50	436.00	428.00	45.71	2289.56
	10	0.00	5.60	2.26	437.67	20.33	0.00	0.00	0.00		19.20	25.14	128.80	145.80	805.00	72.00	158.00	2.86	1822.66
	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	81.60	1290.67	988.40	109.80	196.25	26.40	32.00	25.71	2750.83
	12	0.00	0.00	5.65	32.50	8.13	0.00	5.10	7.93	0.00	62.40	864.00	196.00	24.55	53.75	3.00	146.00	25.71	1434.72
		0.00	16.80	7.91	564.42	47.99	0.00	5.10	7.93	0.00	168.00	2184.38	1383.20	748.15	1762.50	537.40	764.00	100.00	8297.77
1971	9	0.00	5.60	20.34	2.17	0.00	5.90	0.00	0.00	0.00	0.00	93.71	1414.00	1446.00	643.75	84.00	174.00	80.00	3969.47
	10	0.00	0.00	0.00	0.00	2.03	17.70	0.00	0.00	0.00	4.80	153.14	215.60	702.00	446.25	26.00	282.00	5.71	1855.24
	11	36.45	0.00	1.88	34.67	0.00	2.95	0.00	0.00	0.00	28.80	114.29	336.00	376.20	336.25	24.00	46.00	16.00	1353.49
	12	26.33	0.00	3.77	257.83	0.00		10.20	0.00	0.00	542.40	389.33	571.20	201.60	168.75	96.00	28.00	0.00	2296.41
		62.78	5.60	25.99	294.67	2.03	26.55	10.20	0.00	0.00	576.00	750.48	2536.80	2725.80	1595.00	230.00	530.00	101.71	9473.61

Table 5A-6

STRIPED BASS FALL MIDWATER TRAWL ABUNDANCE

		AREA																	
YEAR	MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1972	9	0.00	0.00	5.65	0.00	0.00	11.80	0.00	0.00	0.00	0.00	96.00	1229.20	1094.40	293.75	150.00	262.00	27.50	3170.30
	10	0.00	0.00	0.00	0.00	10.17	2.95	0.00	0.00	0.00	0.00	5.33	154.00	324.00	143.75	80.00	250.00	7.50	977.70
	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.80	22.86	210.00	745.20	265.00	34.00	60.00	11.43	1377.29
	12	4.05	0.00	0.00	6.50	0.00			0.00	0.00	33.60	61.33	117.60	306.00	16.25	4.00	54.00	0.00	603.33
		4.05	0.00	5.65	6.50	10.17	14.75	0.00	0.00	0.00	62.40	185.52	1710.80	2469.60	718.75	268.00	626.00	46.43	6128.62
1973	9	0.00		0.00	100.75	61.00			0.00		0.00	77.33	34.22	446.00	417.14	270.00	80.00	30.00	1516.45
	10	0.00		0.00	3.25	0.00			0.00		9.60	26.67	45.11	75.18	207.86	40.00	30.80		438.46
	11	18.23		20.34	0.00	0.00			0.00		57.60	122.67	502.60	114.75	85.71	44.00	39.67		1005.56
	12	642.60		79.10	3.25	12.20					148.80	240.00	85.56	64.29	31.67	0.00	16.33		1323.79
		660.83	0.00	99.44	107.25	73.20	0.00	0.00	0.00	0.00	216.00	466.67	667.49	700.21	742.38	354.00	166.80	30.00	4284.26
1975	9	2.03		0.00	3.25	0.00			0.00		19.20	8.00	441.00	430.88	553.57	110.00	176.91	27.50	1772.33
	10	8.10		2.26	0.00	0.00			0.00		14.40	0.00	418.60	41.63	157.86	0.00	37.80		680.64
	11	24.30		4.52	3.25	0.00			0.00		158.40	203.43	425.60	214.88	187.86	24.00	37.33		1283.56
	12	0.00		0.00	0.00	0.00					0.00	6.86	680.40	56.25	54.29	6.00	7.00		810.79
		34.43	0.00	6.78	6.50	0.00	0.00	0.00	0.00	0.00	192.00	218.29	1965.60	743.63	953.57	140.00	259.04	27.50	4547.33
1976	9		*data missing*																223.56
	10	16.20	0.00	0.00	13.00	4.07			0.00		4.80	2.67	2.80	5.63	7.14	42.00	5.09	12.50	115.89
	11	0.00	0.00	0.00	0.00	0.00			0.00		0.00	2.67	23.80	72.00	33.57	66.00	30.55	13.33	241.92
	12		*data missing*																176.11
		16.20	0.00	0.00	13.00	4.07	0.00	0.00	0.00	0.00	4.80	5.33	26.60	77.63	40.71	108.00	35.64	25.83	757.48
1977	9	0.00	0.00	0.00	4.33	4.07	0.00	0.00	0.00		0.00	0.00	4.20	10.80	17.14	244.36	2.55	20.00	307.45
	10	0.00	0.00	0.00	0.00	2.03	0.00	0.00	0.00		0.00	0.00	2.80	15.60	14.29	132.00	14.00	22.86	203.58
	11	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	0.00	4.20	11.25	3.57	128.73	25.45	6.67	179.87
	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	1.56	14.14	16.43	106.91	39.45	15.00	193.49
		0.00	0.00	0.00	4.33	6.10	0.00	0.00	0.00	0.00	0.00	0.00	12.76	51.79	51.43	612.00	81.45	64.52	884.39
1978	9	0.00	0.00	3.77	4.33	0.00	2.95	0.00	0.00		0.00	74.67	134.40	388.80	232.14	115.64	126.00	37.50	1120.20
	10	5.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00		4.80	34.67	46.20	85.50	187.86	94.91	66.18	25.00	550.51
	11	2.70	2.80	0.00	0.00	0.00	0.00	0.00	0.00		28.80	10.67	14.00	60.35	34.29	156.00	23.60	6.67	340.07
	12	8.10	0.00	0.00	55.25	0.00		0.00	0.00		0.00	12.80	100.80	169.71	27.86	212.40	2.80	0.00	589.72
		16.20	2.80	3.77	59.58	0.00	2.95	0.00	0.00	0.00	33.60	132.80	295.40	704.37	482.14	578.95	218.78	69.17	2600.50

Table 5A-7

STRIPED BASS FALL MIDWATER TRAWL ABUNDANCE

		AREA																	
YEAR	MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1980	9	0.00		0.00	2.17	0.00		0.00	2.64		0.00	5.33	7.00	99.00	37.14	262.50	205.33	90.00	711.12
	10	0.00		0.00	0.00	12.20		0.00	0.00		28.80	0.00	26.25	20.57	25.00	109.33	135.33	25.00	382.49
	11	0.00		0.00	0.00	0.00		0.00	0.00		4.80	0.00	10.89	20.25	42.86	12.00	8.75	2.50	102.05
	12	0.00		0.00	2.17	0.00		0.00	0.00		4.80	3.20	56.00	104.40	8.57	68.00	17.11	2.50	266.75
		0.00	0.00	0.00	4.33	12.20	0.00	0.00	2.64	0.00	38.40	8.53	100.14	244.22	113.57	451.83	366.53	120.00	1462.40
1981	9	0.00		0.00	9.75	12.20		0.00	0.00		14.40	96.00	72.80	133.88	84.17	76.00	59.11	26.00	584.30
	10	16.20		9.04	10.83	12.20		0.00	3.08		124.80	93.71	64.40	177.88	27.50	268.00	71.56	37.50	916.71
	11	8.10		11.30	41.17			0.00	0.00		57.60	112.00	67.20	225.60	55.83	248.40	99.56	110.00	1036.76
	12	4.05		149.16	6.50	24.40		0.00	0.00		4.80	805.33	739.20	166.50	57.50	6.86	20.22	10.00	1994.52
		28.35	0.00	169.50	68.25	48.80	0.00	0.00	3.08	0.00	201.60	1107.05	943.60	703.86	225.00	599.26	250.44	183.50	4532.29
1982	9	2.70		13.56	0.00	0.00		0.00	0.00		273.60	43.43	95.20	451.06	214.17	171.60	189.00	22.00	1476.31
	10	14.18		38.42	84.50	195.20		0.00	3.08		19.20	32.00	28.00	315.53	142.86	40.80	14.00	10.00	937.76
	11	6.08		0.00	26.00	73.20		5.10	0.00		33.60	106.67	201.60	271.06	165.71	20.00	25.45	6.00	940.47
	12	111.38		0.00	0.00	0.00		0.00	7.40		9.60	426.67	418.60	26.47	83.57	6.67	22.40	0.00	1112.75
		134.33	0.00	51.98	110.50	268.40	0.00	5.10	10.48	0.00	336.00	608.76	743.40	1064.12	606.31	239.07	250.85	38.00	4467.30
1983	9	6.08		29.38	28.17	689.30		15.30	5.29		0.00	34.29	532.00	204.35	312.14	54.00	28.00	2.00	1940.29
	10	194.40		24.86	30.33	933.30		35.70	2.64		4.80	82.29	18.20	159.75	430.00	34.80	28.00	9.00	1988.16
	11	380.70		289.28	403.00	1409.10		10.20	177.07		14.40	475.43	1533.00	328.50	195.00	43.20	11.45	14.29	5284.62
	12	471.83	0.00	226.00	132.17	109.80	2.95	6.12	64.76		201.60	1682.67	278.60	36.00	64.29	0.00	6.00		3282.76
		1053.00	0.00	569.52	593.67	3141.50	2.95	67.32	249.76	0.00	220.80	2274.67	2361.80	728.60	1001.43	132.00	73.45	25.38	12495.84
1984	9	2.03		0.00	69.33	201.30		0.00	0.00		9.60	48.00	81.20	568.59	100.00	121.20	31.82	56.36	1289.43
	10	204.53		2.26	65.00	103.70		5.10	1609.50		4.80	168.00	91.00	168.75	72.86	148.00	29.40		2672.89
	11	68.85	0.00	15.82	2.17	0.00	0.00	0.00	348.86	0.00	57.60	125.33	200.20	270.00	98.57	140.00	56.00		1383.40
	12	2.03		0.00	0.00	0.00	0.00	0.00	3.08		201.60	112.00	749.00	85.50	46.43	1.33	54.60		1255.57
		277.43	0.00	18.08	136.50	305.00	0.00	5.10	1961.44	0.00	273.60	453.33	1121.40	1092.84	317.86	410.53	171.82	56.36	6601.29
1985	9	0.00		0.00	2.17	0.00		0.00	0.00		0.00	6.86	23.80	15.88	34.29	34.80	3.82	4.00	125.61
	10	0.00		0.00	0.00	0.00		0.00	0.00		0.00	2.29	98.00	271.06	429.29	9.60	10.18	4.44	824.86
	11	0.00		0.00	0.00	0.00		0.00	0.00		0.00	11.43	9.80	5.63	11.43	16.00	3.82		58.10
	12	0.00		0.00	0.00	0.00		0.00	0.00		0.00	9.14	92.40	264.00	20.71	219.60	144.67		750.52
		0.00	0.00	0.00	2.17	0.00	0.00	0.00	0.00	0.00	0.00	29.71	224.00	556.57	495.71	280.00	162.48	8.44	1759.09
1986	9	4.05		9.04	23.83	262.30		0.00	0.00		0.00	2.29	597.33	126.00	111.43	978.00	519.27	72.00	2705.54
	10	0.00		4.52	13.00	0.00		0.00	0.00		4.80	4.57	50.40	57.18	67.14	216.00	91.64	24.00	533.25
	11	4.05		0.00	28.17	0.00		0.00	0.00		81.60	73.14	46.20	29.65	11.43	148.80	71.27	14.00	508.31
	12	22.28		2.26	0.00	0.00		0.00	0.00		33.60	27.43	56.00	19.06	2.86	19.20	14.00		196.68
		30.38	0.00	15.82	65.00	262.30	0.00	0.00	0.00	0.00	120.00	107.43	749.93	231.88	192.86	1362.00	696.18	110.00	3943.78

Table 5A-8
STRIPED BASS FALL MIDWATER TRAWL ABUNDANCE

		AREA (note 2, 6, 9 missing)														
YEAR	MONTH	1	3	4	5	7	8	10	11	12	13	14	15	16	17	Total
1987	9	2.03	47.46	2.17	6.10	0.00	0.00	0.00	4.57	7.00	30.71	66.43	405.60	10.18	22.00	604.24
	10	8.10	13.56	4.33	18.30	0.00	0.00	14.40	4.57	4.20	15.75	9.29	37.20	26.83	12.00	168.53
	11	38.48	6.78	0.00	6.10	0.00	2.64	0.00	9.14	25.20	13.76	0.00	72.00	30.33	2.00	206.44
	12	38.48	18.08	43.33	6.10	5.10	5.29	9.60	32.00	65.80	6.35	1.43	103.20	29.17	8.00	371.92
		87.08	85.88	49.83	36.60	5.10	7.93	24.00	50.29	102.20	66.57	77.14	618.00	96.52	44.00	1351.13
1988	9	2.03	18.08	0.00	0.00	0.00	0.00	0.00	4.57	0.00	9.53	12.14	43.20	12.83	4.00	106.38
	10	0.00	2.26	0.00	0.00	0.00	0.00	0.00	0.00	9.80	4.24	19.29	46.80	11.67	4.00	98.05
	11	0.00	0.00	2.17	0.00	5.10	0.00	0.00	6.86	14.00	14.82	0.71	66.00	7.00	12.00	128.66
	12	0.00	0.00	0.00	0.00	0.00	3.08	0.00	25.14	72.80	26.40	2.86	1.33	12.00		143.62
		2.03	20.34	2.17	0.00	5.10	3.08	0.00	36.57	96.60	54.99	35.00	157.33	43.50	20.00	476.71
1989	9	0.00	0.00	0.00	0.00		0.00	0.00	20.57	11.20	3.18	8.57	62.40	33.83	14.00	153.75
	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.06	0.00	123.60	7.00	20.00	151.66
	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.57	7.00	6.35	2.14	37.20	16.55	2.00	75.81
	12	2.03	0.00	0.00	0.00	0.00	0.00	0.00	4.57	36.40	8.47	2.14	2.40	1.27	2.22	59.50
		2.03	0.00	0.00	0.00	0.00	0.00	0.00	29.71	54.60	19.06	12.86	225.60	58.65	38.22	440.73
1990	9	0.00	0.00	0.00	6.10	0.00	0.00	4.80	0.00	15.40	8.47	9.29	88.80	71.27	28.00	232.13
	10	28.35	0.00	0.00	0.00	0.00	0.00	9.60	22.86	0.00	2.12	3.57	102.00	58.33	8.00	234.83
	11	4.05	9.04	0.00	0.00	0.00	0.00	14.40	38.86	96.60	73.06	17.14	126.00	16.33	2.00	397.48
	12	42.53	20.34	32.50	12.20	0.00	0.00	0.00	61.71	203.00	56.12	8.57	10.80	4.67	2.00	454.44
		74.93	29.38	32.50	18.30	0.00	0.00	28.80	123.43	315.00	139.76	38.57	327.60	150.61	40.00	1318.88
1991	9	4.05	2.26	4.33	12.20	0.00	0.00	0.00	27.43	0.00	24.35	12.86	90.00	54.83	27.14	259.46
	10	0.00	0.00	4.33	12.20	0.00	2.64	0.00	2.29	1.40	7.41	2.14	69.60	21.00	4.29	127.30
	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.86	5.60	21.18	2.86	18.00	40.83	18.57	113.90
	12	10.13	0.00	0.00	6.10	0.00	0.00	0.00	194.29	131.60	47.65	5.00	46.80	3.50	0.00	445.06
		14.18	2.26	8.67	30.50	0.00	2.64	0.00	230.86	138.60	100.59	22.86	224.40	120.17	50.00	945.71
1992	9	64.80	15.82	8.67	152.50	15.30	10.57	19.20	38.86	32.20	32.82	25.00	115.20	46.67	34.29	611.89
	10	0.00	2.26	13.00	85.40	0.00	0.00	4.80	20.57	18.20	22.24	0.71	60.00	5.83	12.31	245.32
	11	30.38	15.82	15.17	24.40	15.30	5.29	0.00	80.00	120.40	52.94	16.43	126.00	40.83	1.43	544.38
	12	18.23	2.83	28.17	12.20	5.10	64.75	52.80	118.00	121.80	142.94	10.00	25.20	11.67	2.86	616.53
		113.40	36.73	65.00	274.50	35.70	80.61	76.80	257.43	292.60	250.94	52.14	326.40	105.00	50.88	2018.12

Table 5A-9

Longfin Smelt

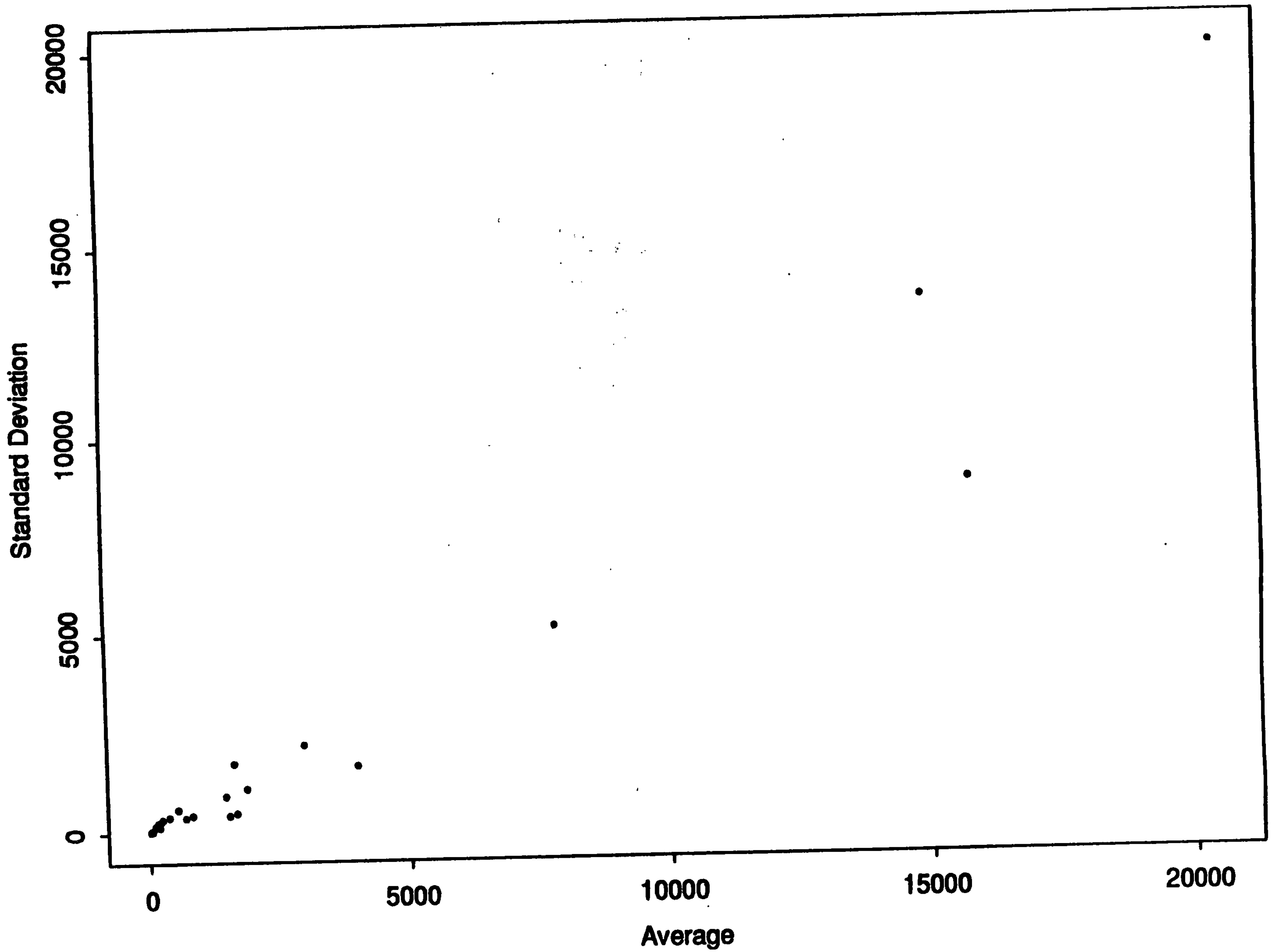


Table 5A-10

Striped Bass

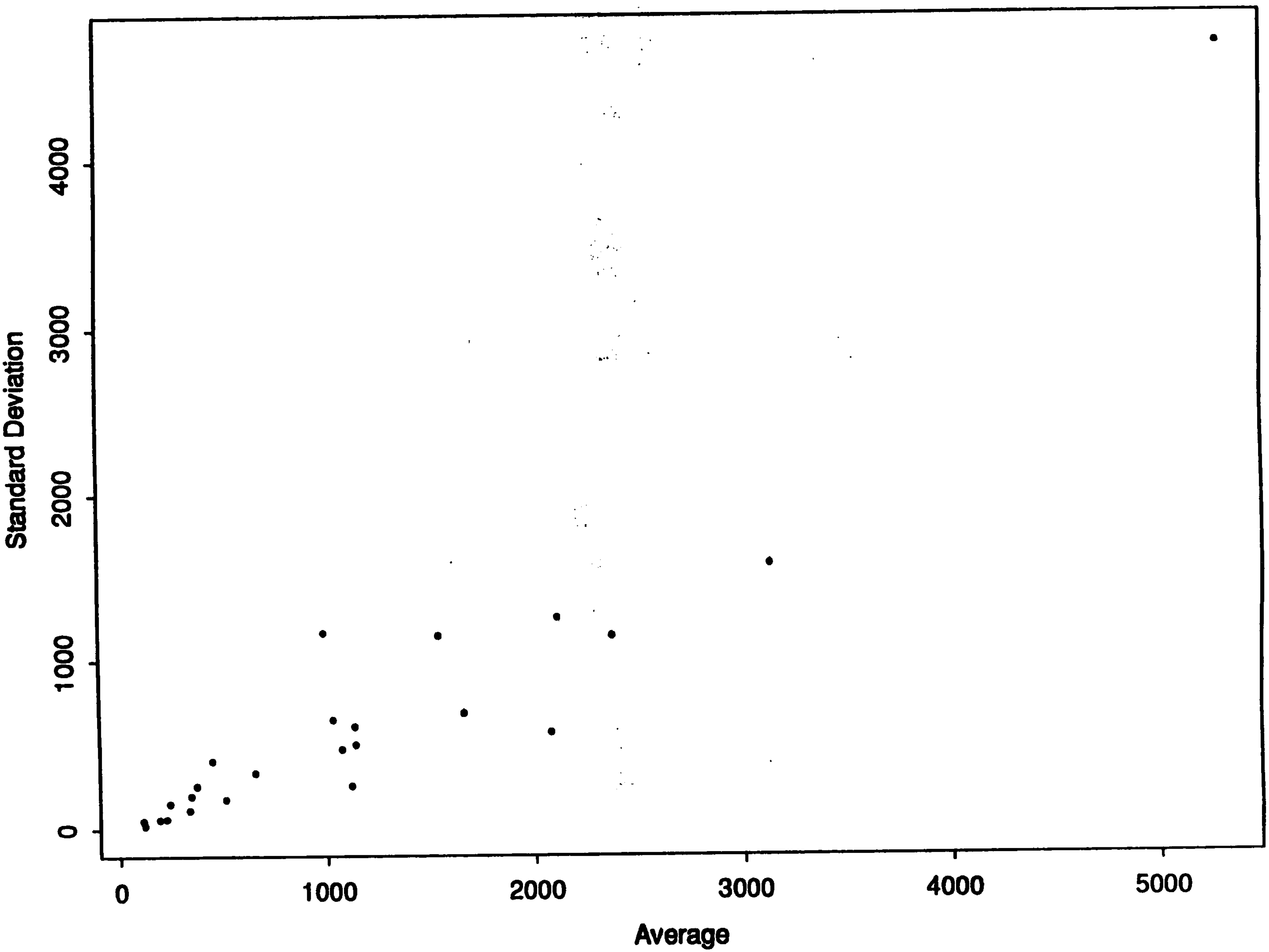
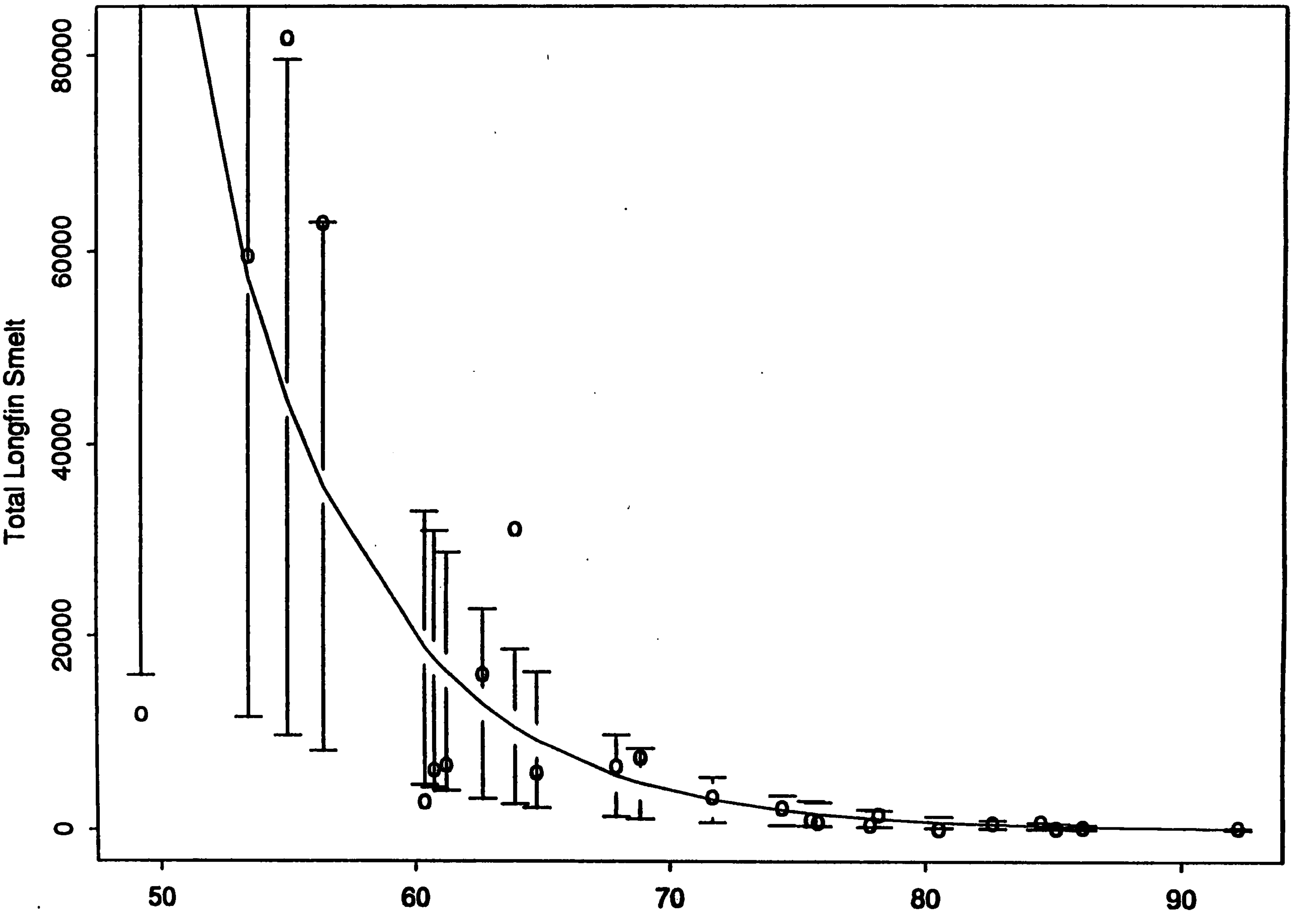


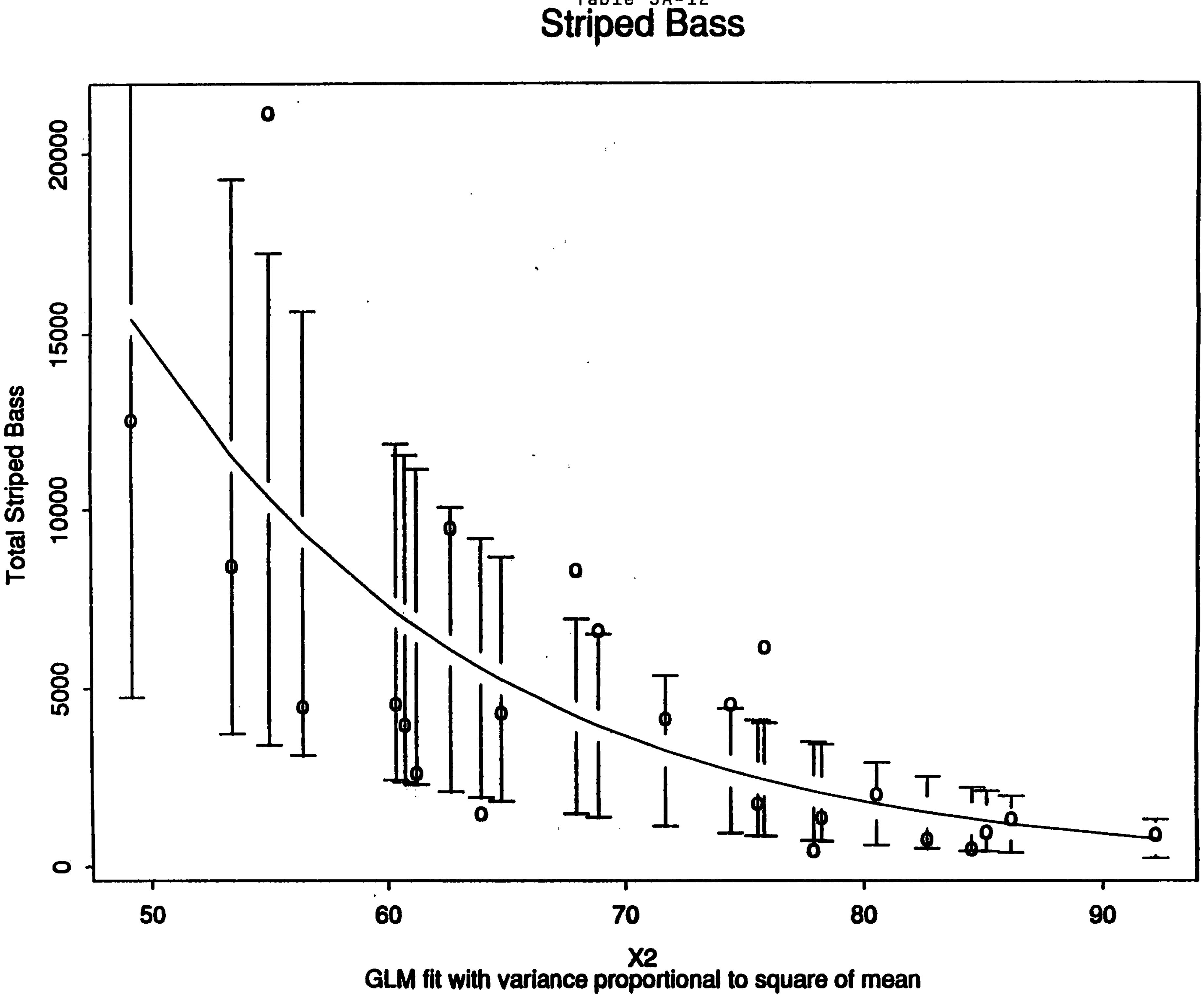
Table 5A-11

Longfin Smelt



GLM fit with variance proportional to square of mean

Table 5A-12


Striped Bass
Total Striped Bass
0
5000
10000
15000
20000
50
60
70
80
90
X2
GLM fit with variance proportional to square of mean

```
sepred _ sqrt(pd$se.fit^2 + .530*pd$fit^2)
error.bar(X2, pd$fit, sepred, sepred, add =T)
title(main="Longfin Smelt", sub="GLM fit with variance proportional to square of m
> cor(LongfAv, pd$fit)
[1] 0.5153967

> (73.4 - 15.2)/73.4
[1] 0.7929155 - proportion of deviance explained
```

TOTAL LONGFIN SMELT FIT ACCORDING TO GLM AND NATURAL SPLINE WITH ONE INTERIOR KNOT

```
ft _ glm(Longfin ~ ns(X2,2), family=quasi(link=log, variance=mu^2))
pd _  predict(ft, type="response", se.fit=T)


> summary(ft)

Call: glm(formula = Longfin ~ ns(X2, 2), family = quasi(link = log, variance = mu^2
Deviance Residuals:
       Min        1Q     Median        3Q       Max
 -1.697612 -0.788257 0.05659376 0.3638015 1.313015

Coefficients:
                Value Std. Error   t value
(Intercept)  11.640971  0.4573274  25.454347
 ns(X2, 2)1  -8.009802  0.9938378  -8.059466
 ns(X2, 2)2  -5.266840  0.5660804  -9.304050

(Dispersion Parameter for Quasi-likelihood family taken to be 0.5299603 )

    Null Deviance: 73.40382 on 23 degrees of freedom

Residual Deviance: 15.21805 on 21 degrees of freedom

Number of Fisher Scoring Iterations: 4

Correlation of Coefficients:
             (Intercept) ns(X2, 2)1
ns(X2, 2)1 -0.9454555
ns(X2, 2)2  0.0165254   0.0069822

> cor(Longfin, pd$fit)      JASSAY
[1] 0.5153967                .86
   R² = .27                  .74
 plot(X2, Longfin, pch="o", xlab= "X2", ylab=" Total Longfin Smelt")
lines(X2[ss], pd$fit[ss])
sepred _ sqrt(pd$se.fit^2 + .530*pd$fit^2)
error.bar(X2, pd$fit, sepred, sepred, add =T)
title(main="Longfin Smelt", sub="GLM fit with variance proportional to square of m
```

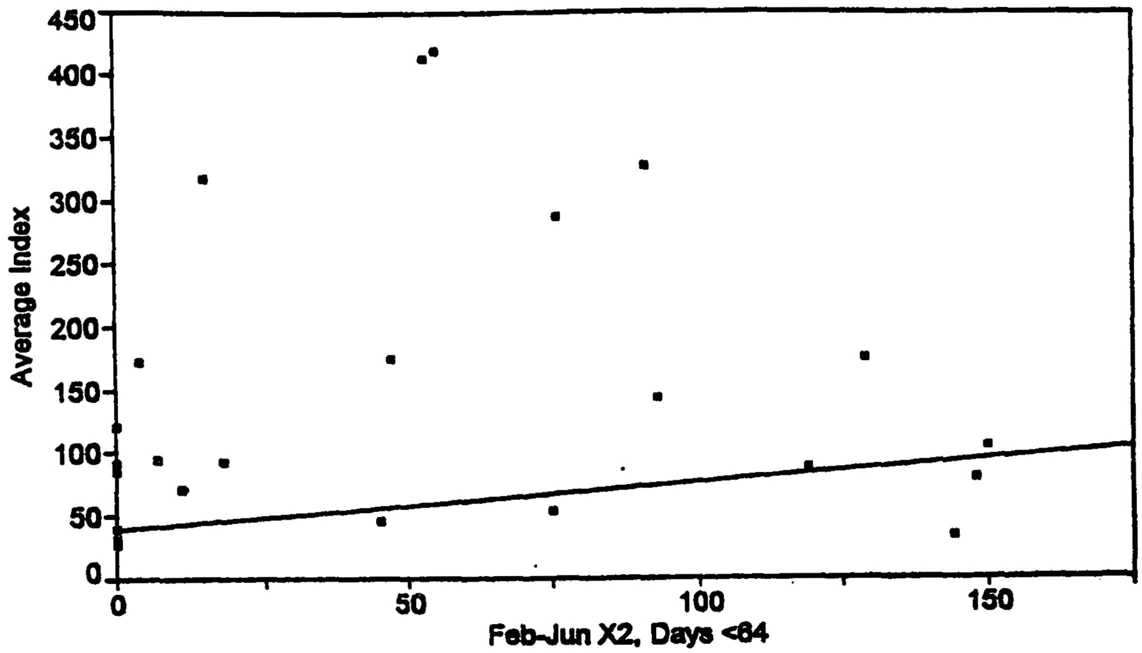
Table 5A-14

3

```
sepred _ sqrt(pd$se.fit^2 + (2*SBassSD^2))
error.bar(X2, pd$fit, sepred, sepred, add =T)
title(main="Striped Bass", sub="weighted according to standard deviations")

> cor(SBass, pd$fit)        JASSBY
[1] 0.7026184               .84
r² = .49                    .71
--------------------------------------------------------------------------------

ft _ glm(SBass ~ X2, family=quasi(link=log, variance=mu^2))
pd _  predict(ft, type="response", se.fit=T)

> summary(ft)

Call: glm(formula = SBass ~ X2, family = quasi(link = log, variance = mu^2))
Deviance Residuals:
      Min         1Q     Median        3Q      Max
 -1.243989 -0.5421673 -0.2430861 0.3067858 1.091208

Coefficients:
                   Value  Std. Error    t value
(Intercept)  13.06971294 0.80595676  16.216395
         X2  -0.06956345 0.01130172  -6.155121

(Dispersion Parameter for Quasi-likelihood family taken to be 0.4049444 )

    Null Deviance: 22.72025 on 23 degrees of freedom

Residual Deviance: 9.373418 on 22 degrees of freedom

Number of Fisher Scoring Iterations: 4

Correlation of Coefficients:
   (Intercept)
X2 -0.9869269

 plot(X2, SBass, pch="o", xlab= "X2", ylab="Total Striped Bass")
lines(X2[ss], pd$fit[ss])
sepred _ sqrt(pd$se.fit^2 + .405*pd$fit^2)
error.bar(X2, pd$fit, sepred, sepred, add =T)
title(main="Striped Bass", sub="GLM fit with variance proportional to square of mea

> cor(SBass, pd$fit)
[1] 0.7048019

--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
```

SECTION 5
Appendix B

Delta Smelt
Regression
vs
February - June X2 Days
Downstream of Roe Island



Rank 68 Eqn 1 y=a+bx

r^2 Coef Det	DF Adj r^2	Fit Std Err	F-value
0.1271978014	0.0440737825	40.080540927	3.2081693186 < 3.47 (NOT SIGNIFICANT AT 5% LEVEL)

Parm	Value	Std Error	t-value	95% Confidence Limits	
a	38.57765731	9.170585080	4.206682683	19.55205801	57.60325661
b	0.369166023	0.206171436	1.790577929	-0.05856499	0.796897039

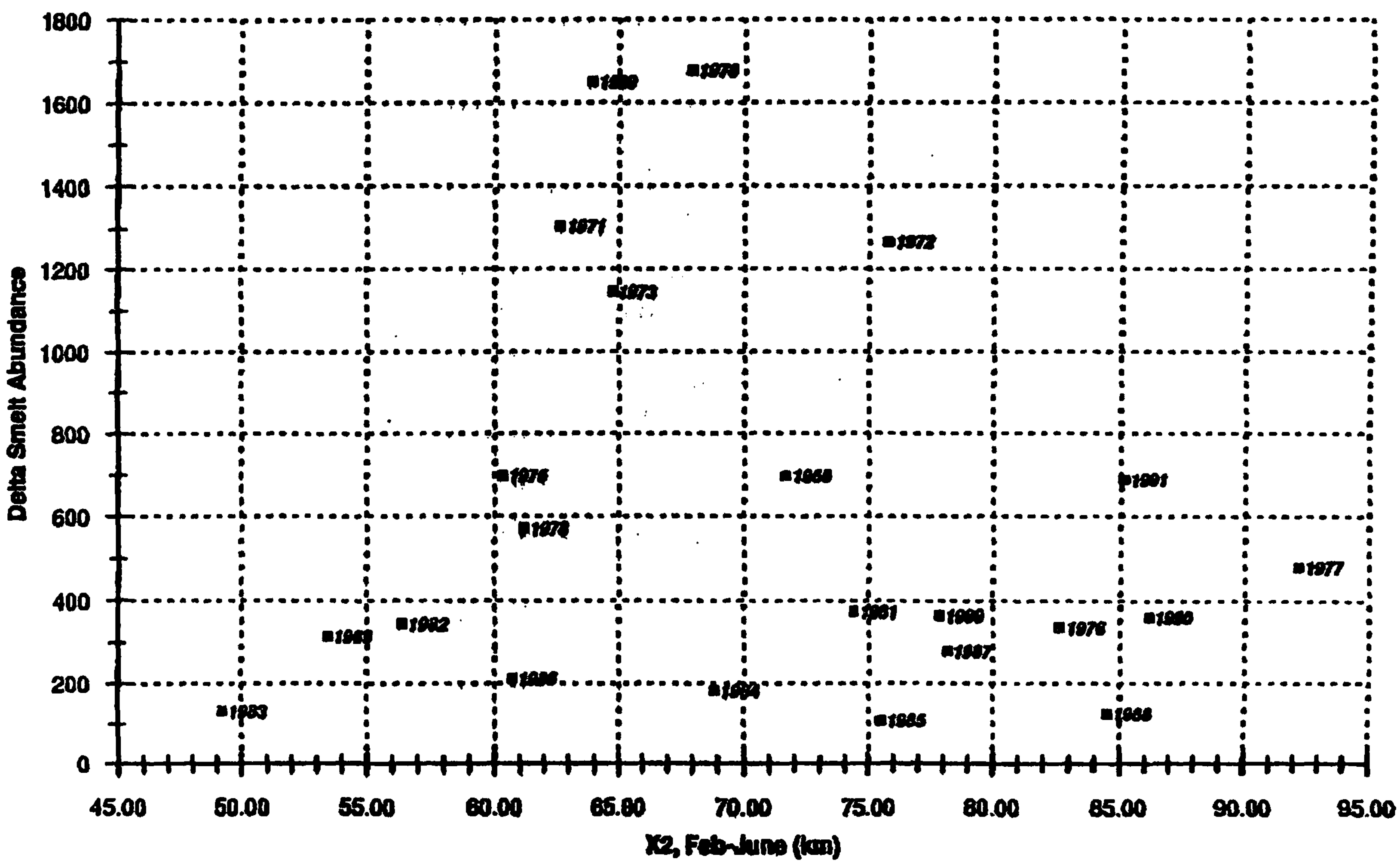
Date	Time	File Source
Feb 14, 1994	8:24:01 PM	c:\tcwin\x284-74.xls

Table 5B-1

SECTION 5
Appendix C

Delta Smelt
Abundance vs
Average February - June X2

Table 5C-1


Delta Smelt Abundance
1800
1600
1400
1200
1000
800
600
400
200
0
45.00
50.00
55.00
60.00
65.00
70.00
75.00
80.00
85.00
90.00
95.00
X2, Feb-June (km)
1979
1971
1972
1973
1977
1983
1982
1976
1987
1984
1985

SECTION 6

RESPONSE TO EPA'S "SPECIFIC ISSUES FOR COMMENTERS TO ADDRESS"

Section H ("Specific Issues for Commenters to Address") in EPA's December 15, 1993 "Proposed Rule on Bay/Delta Standards" requests comments on seventeen issues related to the salinity, salmon smolt survival and striped bass spawning standards proposed by EPA. The responses of the San Luis & Delta-Mendota Water Authority (SLDMWA) to the specific issues EPA raised for comment are as follows:

1. Basing the X2 salinity standard on the Sacramento River Index

The number of days X2 must be downstream of the locations specified by the Estuarine Habitat standard should be calculated from the Sacramento River Index, instead of specified by water year type. The standard as proposed is based on the five conventional water year types. There are two serious problems with this approach:

- Use of the average number of days as the standard for the 2 ppt salinity line to be downstream of each of the three control points is analogous to making "C," the average for a classroom, a failing grade. The water cost of compliance with such a standard is very large for the drier years of each year type. For the Roe Island control point, the water cost is especially high because at this downstream location, the natural variation of X2 from its mean value is larger. Therefore, compliance with the mean location would take very large amounts of Delta outflow to force the upstream variations in the 2 ppt line downstream to the mean value. This is the primary reason that compliance with the Roe Island standard would cost so much water.

- Use of the conventional five year types means that a small change in runoff, one that causes a shift from one year type to another, can cause a large change in the number of days required for compliance. It is possible that the timing of the change could be such that the number of days required is greater than the number of days remaining in the compliance period.

A sliding scale would correct these problems. The Authority is aware of several different versions of a sliding scale. These versions have not been compared in detail to determine which is the most representative and the most practical for use. The Authority recommends that over the next several months there should be an organized technical analysis of the various methods to reach consensus on the most appropriate sliding scale.

2. **Averaging period for salinity standard**

The San Luis & Delta-Mendota Water Authority proposes that issues related to the averaging period for the Delta salinity standard be addressed by allowing for three ways to comply with the standard, as follows:

CCWD has proposed three criteria, any of which would suffice to allow credit for counting a day towards the total number of days required for compliance. The Authority concurs with this recommendation. The three criteria are as follows:

- The daily average salinity is below 2 ppt, OR
- The 14-day running average salinity is below 2 ppt, OR
- The net Delta outflow index is greater than the 2 ppt equivalent net Delta outflow index without regard to antecedent conditions (because these are essentially considered in the first two criteria).

Note that this recommendation, specifically the third criterion, amounts to converting the X2 standard back into a flow standard as suggested by EPA.

3. **The need for a confidence interval in meeting the salinity standard**

The San Luis & Delta-Mendota Water Authority proposes that issues related to the need for a confidence interval in meeting the Delta salinity standard be addressed by allowing for three ways to comply with the standard, as follows:

CCWD has proposed three criteria, any of which would suffice to allow credit for counting a day towards the total number of days required for compliance. The Authority concurs with this recommendation. The three criteria are as follows:

- The daily average salinity is below 2 ppt, OR
- The 14-day running average salinity is below 2 ppt, OR
- The net Delta outflow index is greater than the 2 ppt equivalent net Delta outflow index without regard to antecedent conditions (because these are essentially considered in the first two criteria).

Note that this recommendation, specifically the third criterion, amounts to converting the X2 standard back into a flow standard as suggested by EPA.

As long as the standard is based on actual salinity measurements, a margin of safety or "confidence interval" will probably be necessary to insure that enough water is released to guarantee compliance. EPA's assurance that a confidence interval is unnecessary is correct if the final standard states that achieving the requisite outflow specified by the flow/salinity equation will satisfy the standard.

4. Should standards be stricter in wet years?

The San Luis & Delta-Mendota Water Authority proposes that salinity standards in wet years should be determined from the Sacramento River Index. The standard as proposed is based on the five conventional water year types. There are two serious problems with this approach:

- Use of the average number of days as the standard for the 2 ppt salinity line to be downstream of each of the three control points is analogous to making "C," the average for a classroom, a failing grade. The water cost of compliance with such a standard is very large for the drier years of each year type. For the Roe Island control point, the water cost is especially high because at this downstream location, the natural variation of X2 from its mean value is larger. Therefore, compliance with the mean location would take very large amounts of Delta outflow to force the upstream variations in the 2 ppt line downstream to the mean value. This is the primary reason that compliance with the Roe Island standard would cost so much water.

- Use of the conventional five year types means that a small change in runoff, one that causes a shift from one year type to another, can cause a large change in the number of days required for compliance. It is possible that the timing of the change could be such that the number of days required is greater than the number of days remaining in the compliance period.

A sliding scale would correct these problems. The Authority is aware of several different versions of a sliding scale. These versions have not been compared in detail to determine which is the most representative and the most practical for use. The Authority recommends that over the next several months there should be an organized technical analysis of the various methods to reach consensus on the most appropriate sliding scale.

5. Selecting the period of hydrologic record and establishing standards for critical years.

The San Luis & Delta-Mendota Water Authority proposes that the salinity standard for critical years should be determined from the Sacramento River Index.

EPA proposed the period 1968-1975 as the historical basis for the standard. However, three independent analyses, one by the Department of Water Resources, one by the State Water Resources Control Board, and one by the Contra Costa Water District all show that the proposed standard reflects salinity conditions typical of periods much earlier than 1968 - 1975.

The Authority does not concur with the historical basis of 1968 - 1975. Setting aside the Authority's concerns, if a standard is to be based on the historical period 1968-1975, the standard should accurately reflect salinity conditions in the western Delta as of that period.

6. Conditions for triggering the Roe Island standard

The Authority recommends that the Roe Island part of the standards should be eliminated. This part would establish conditions adverse to Delta smelt, a threatened species. The 2 ppt salinity is pushed downstream of Roe Island largely by unregulated flows. Compliance with the Roe Island standard requires larger outflows than can reasonably be provided by the water projects.

7. Salinity standards during droughts.

The San Luis & Delta-Mendota Water Authority proposes that salinity standards during droughts should be determined from the Sacramento River Index, based on conditions during the 1968-1975 period and following the analysis by the Contra Costa Water District, as follows:

The Authority recommends a three-year total number of days standard to allow for some relaxation of the required number of days in drier years. The water cost of compliance with critically dry or dry year standards could be very high. In addition, estuarine species have evolved to withstand single dry or critically dry years, provided there is not a succession of such years.

The Authority analyzed the total number of days that the 2 ppt salinity line was downstream of Chipps Island and the confluence in successive three-year periods from 1930 through 1975. Obviously, the lowest three-year total would not provide adequate protection because even though estuarine species survived that total, it occurred in the past when other factors may not have been adversely affecting those species. Therefore, the value representing the lower ten percentile was chosen. For Chipps Island this value was 150 days. For the confluence it was 223 days. This analysis used EPA's X2/outflow equation, although the Contra Costs Water District equation could also have been used and would change the numbers slightly.

The rebound of estuarine fish such as Delta smelt after the recent prolonged drought demonstrates that Delta fish can withstanding habitat limitations significantly more stringent than those envisioned in the proposed standards.

8. Protection of tidal wetlands

As EPA states, there are insufficient scientific data to support numerical water quality criteria for tidal wetlands. Furthermore, there are no reliable data indicating a need for further protection for tidal wetlands beyond that achieved by a salinity standard aimed at replicating conditions in the late 1960's and early 1970's, as proposed by SLDMWA. The present status of tidal wetlands is uncertain because of drastic changes caused by recently introduced species, and there are potentially conflicting salinity requirements between protected species like the California clapper rail, the Salt Marsh Harvest House and other species preferring lower salinity habitat. Furthermore, the area of relatively salt intolerant plants in brackish water marshes may already have been artificially increased by increased outflows from water projects in summer months to prevent salinity intrusion into the Delta.

9. Need to maintain X2 in Suisun Bay in June and July if Delta smelt spawn late

Any such provision is completely unnecessary, because there is no correlation between the position of X2 and the abundance of Delta smelt (Biological Assessment - Effects of the Central Valley Project and the State Water Project on Delta Smelt, California Department of Water Resources and U.S. Bureau of Reclamation October 1993). Furthermore, Herbold's analysis ("Habitat Requirements of Delta Smelt", Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Winter 1994 Newsletter) shows that there is no relationship between Delta smelt abundance and the number of days that X2 is in Suisun Bay in June or July. Finally, imposition of a standard that requires X2 to be maintained in Suisun Bay during June and July is likely to conflict with carryover water storage requirements imposed to protect the endangered Winter-run salmon and impact instream flows necessary to protect other chinook species of concern.

10. Smolt Survival Criteria;

The question is too limiting to fully address the issue of salmon smolt survival, because a large number of factors, (estimated by National Marine Fisheries Service to be over 200 in the case of winter run chinook), affect smolt survival and stock recruitment. Temperature is only one of these factors, and the others include:

- over fishing and by-catch losses from commercial, sport and illegal fishing activities both in the estuary and the ocean.
- effects of point source and nonpoint source toxic discharges in, and

tributary to, the estuary.

- losses associated with unscreened and improperly screened diversions in and tributary to, the estuary, and
- impacts of flood control and related, or similar, projects in and tributary to the estuary.

Various proposed temperature requirements have been put forth. One which is often proposed is 61° F at Sacramento or Freeport. Numerous modeling studies, and observation of actual operational data have shown that such a condition is impossible to achieve in all but the wettest years involving heavy snow packs with significant carryover storage in northern reservoirs. Further, data suggests that even in a "no projects" condition, such conditions could rarely be achieved.

A salmon smolt survival criteria based only temperature fails to take into account the numerous non-temperature related factors, would not account for the natural conditions and would be impractical from a management standpoint over the expected range of hydrologic conditions.

11. Georgiana Slough Closure

The question as posed is too narrowly framed. The inclusion of sound barriers is obviously an after thought given that the entire balance of the question assumes a physical barrier. The question also focuses on salmon smolts which is only one life stage of one species. Several others, either listed, proposed or of concern under ESA, migrate at various life stages, in both directions, through Georgiana Slough.

Losses/mortality of salmon smolts under older United States Fish & Wildlife Service (USFWS) studies (Kjelson et. al.) were indicated to be 50% greater than smolts emigrating through the Sacramento River. Data presented at the 1994 Programmatic Environmental Impact Statement workshop in Asilomar indicated that mortality may be significantly greater than even the United States Fish & Wildlife Service estimates, possibly two to three times higher.

Studies by Hanson et. al. (1993 unpublished) indicate that the hypothesis that fish (chinook in this case) move proportional to flow may be in error at Georgiana Slough. This appears to be due to a combination of cross sectional distribution of fish and site hydraulics at least during the period of fall run emigration. Therefore, the importance of the Georgiana Slough barrier (physical, sound or other alternative technology) may be greater for stock recruitment then previously thought.

Chinook salmon are in a virtually continuous state of immigration and emigration in the Sacramento River system. There is substantial overlap in the timing of migration. In all but late fall months, one species of smolts is migrating down stream while another species is migrating upstream. This poses particular concern in the context of a physical barrier at Georgiana Slough and the Delta Cross Channel since both are, or can be, used as upstream migration routes for adult chinook. Similar concerns have been expressed by the USFWS (pine et. al.) for Delta smelt, Splittail, Green Sturgeon and Longfin Smelt. The same concerns have been expressed by California Department of Fish & Game (Stevens et. al.) for striped bass (an introduced predatory species). Therefore, physical closure of Georgiana Slough is probably inconsistent with ESA. Because Georgiana Slough is used by migrating Delta smelt and splittail, physical closure during the 9-10 months per year necessary to protect all chinook species would cause significant harm, both economic and other, to recreational boating and related activities in addition to exacerbating central delta water quality problems.

There are several potential alternatives to a physical closure physical barrier at Georgiana Slough. Several alternative technologies exist that could provide a significant reduction in the number of chinook smolts entering the central Delta via Georgiana Slough, the Cross Channel and Three Mile Slough while not impeding the immigration of adults. These same technologies could also be useful in guiding salmon smolts into biologically safer routes such as Steamboat Slough, through which fall run chinook have been shown to have lower mortality then the Sacramento River (USFWS/Kjelson et. al.).

Studies by Hanson et. al. (Nov. 1993) provided encouraging results on the use of a hydroacoustic (underwater sound) barrier at Georgiana Slough. Additional studies, with extensive laboratory and field research, are scheduled for Spring and Fall of 1994. If effective, an acoustic barrier could significantly reduce mortality of chinook smolts while not impeding the migration of other species or life stages of chinook.

It is agreed that increased flows in the San Joaquin River would be beneficial to chinook. However, it is beyond the capability of the Central Valley Project to provide reasonably necessary San Joaquin River flows (at Vernalis) to provide for San Joaquin River chinook migration in either direction.

Finally, the proposed survival index has no basis in even best case historical fact. Studies by Department of Water Resources, Department of Fish & Game and others indicate that a more appropriate, reasonable and achievable index, even under historically good conditions is approximately 0.18 to 0.22. This recognizes the ongoing excessive fishing take, estimated by various studies to be 10-20% in excess of sustainable yield.

12. San Joaquin River Smolt Survival

(A) The smolt survival index is unrealistic based upon historical data described above, unless non-water project related actions are fully implemented.

(B) See A and #11 comments.

13. Export Limits

Entrainments in the State Water Project and Central Valley Project export facilities are but one of a host of problems effecting emigrating San Joaquin River chinook smolts and immigrating adults. These other problems have been previously described. It has also been clearly established that San Joaquin River chinook are significantly affected by loss of up-river spawning habitat, waste water discharges and other factors. Action on these items is necessary if species jeopardy is to be avoided, even if fish alternative fish guidance technologies are found to be effective and applied delta wide.

14. Central Valley Project Improvement Act Fish Doubling vs. EPA

The question is too narrow and ignores other factors. While the proposed EPA criteria may support the goals of the Central Valley Project Improvement Act fish doubling plan, the doubling plan is itself inconsistent with the proposed recovery requirements of several species listed under ESA. As example, at the 1994 Programmatic Environmental Impact Statement workshop, the National Marine Fisheries Service representative stated that the criteria for recovery of the Winter run chinook would be a stable population of 10,000 females. This would translate into about 16,000 to 19,000 total adult returns. As specified, the doubling plan would require a returning adult population of about 25,000 to 40,000.

Another consideration is that the proposed standards have been shown through modeling studies to produce flow, temperature and reservoir storage conditions within the Central Valley Project and State Water Project which conflict with salmon requirements. In about 3 years in 10, the flow standards, if imposed on only the Central Valley Project and State Water Project, yield conditions which lead to poor flow and overall habitat conditions for other runs of chinook and other ESA listed species and estuary species of concern. Therefore, the proposed standards is in direct conflict with the ESA listed species, species of concern and the efforts/intents of the Central Valley Project Improvement Act.

15. Should Kimmerer's model be used to set EPA's salmon smolt survival standard?

The San Luis & Delta-Mendota Water Authority has not had an opportunity to review Dr. Kimmerer's salmon population model (CPOP) in detail. However, any use of the model in attempting to develop an adequate salmon smolt survival standard should:

- avoid scaling raw smolt survival data with the technique used in developing the completely inadequate smolt survival standard presently proposed by EPA;

- employ all of the available data; and
- take explicit account of all potential sources of bias, including tidal conditions at the time of release, differences in survival between smolts from different hatcheries, effects of thermal shock on released smolts, differences in daytime and nighttime sampling effort, and temperature effects on the activity of predators.

16. Should EPA extend their standards to the period July through January?

Available data do not suffice to scientifically justify and X2 standard for the February through June period, and there is no reliable evidence that additional salinity standards are needed in the months of July through January. Water project operations have either increased Delta outflow, or left it unchanged in these months. Other aspects of estuarine habitat protection, such as stronger measures to prevent introduction of foreign species and to control toxic discharges and unscreened diversions, are much more likely to benefit the Bay/Delta system than additional salinity standards in July through January.

17. Unforeseen effects of the proposed standards and measures of the effectiveness of the standards.

The San Luis & Delta-Mendota Water Authority proposes that the salinity standards be reconsidered if future studies indicate that exports were not a dominant factor in the decline and continued low abundance of estuarine fish.