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REVIEW AND ANALYSIS OF EPA PROPOSED SAN JOAQUIN RIVER SALMON SMOLT SURVIVAL CRITERIA AND STRIPED BASS SALINITY CRITERIA

Prepared for

California Urban Water Agencies
Sacramento, California

By

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The City and County of San Francisco Public Utilities Commission

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Notice

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

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This report was prepared for the California Urban Water Agencies (CUWA) as a part of a CUWA review of the Environmental Protection Agency's "Water Quality Standards for Surface Waters of the Sacramento River, San Joaquin River, and San Francisco Bay and Delta of the State of California (40 CFR Part 131). This report addresses the following questions:

- How are the criteria for salmon smolt survival and striped bass spawning in the San Joaquin River defined, and compliance measured?
- How do the proposed criteria reflect upon the biological objectives sought by EPA?
- Do the salmon smolt survival criteria consider a wide range of flow and export operations, and different Delta channel configurations?
- Have the water supply impacts associated with the proposed criteria been adequately assessed?

REVIEW AND ANALYSIS OF EPA PROPOSED SAN JOAQUIN RIVER SALMON SMOLT SURVIVAL CRITERIA AND STRIPED BASS SALINITY CRITERIA

This report discusses the proposed criteria for salmon smolt survival and striped bass spawning within the San Joaquin River portion of the Sacramento-San Joaquin River Delta. The discussion summarizes the Environmental Protection Agency's (EPA) proposed criteria, the cited basis for each criteria, and the manner by which EPA assumes that the criteria will be implemented. Comments, conclusions and recommendations are also provided regarding the proposed criteria.

PROPOSED CRITERIA

EPA is proposing two criteria that specifically focus on the hydrologic/hydraulic and biological conditions of the San Joaquin River. Proposed are criteria concerning chinook salmon smolt survival and striped bass spawning.

Proposed Salmon Smolt Survival Criteria

EPA proposes a quantitative criteria for the protection of fall-run chinook salmon smolt which is measured in terms of a numeric index.

> "Because at this time EPA has not developed an adequate scientific basis for precise temperature criteria, EPA is proposing 'smolt survival criteria' to protect the Fish Migration and Cold Fresh-Water Habitat designated uses in the Bay/Delta estuary. These criteria are based on a smolt survival index that quantifies and predicts the survival of salmon migrating through the Delta." (EPA1993, pages 68-69)

Specifically, the criteria require the achievement of the following smolt survival indices (as determined by a mathematical model).

Proposed Salmon Smolt Criteria San Joaquin River	
Water Year Type	Index Value
Wet	0.46
Above Normal	0.30
Below Normal	0.26
Dry	0.23
Critical	0.20

The smolt survival indices are to be determined by mathematical models developed and described by Kjelson et al. (1989), and the United States Fish and Wildlife Service (USFWS) (WRINT-USFWS-7)(WRINT-USFWS-9). "The San Joaquin model is based on experimental data, and

relies on the relationship between salmon smolt survival and river flows, diversions into Old River, and export rates." (EPA1993). Underlying the proposed index values is the assumption that a barrier will be in place at the head of Old River during the peak emigration season (April-May).

To compute the salmon smolt survival index on the San Joaquin River, EPA proposes the following formula:

$$SJSI = (0.341271 - 0.000025E + 0.000067F) \div 1.8$$

where

SJSI is the San Joaquin River Salmon Index value;

E is the average Central Valley Project plus State Water Project exports measured in cfs;

F is the mean daily flow in cfs in the San Joaquin River at Stockton, calculated as Old River flow subtracted from San Joaquin River flow at Mossdale. Old River flow is calculated from ratio of Brandt Bridge flow to exports.

The index is to be computed at least monthly, weighted by the proportion of smolt migrating during each month (or shorter time period) and summed to estimate survival for the water year. "Total survival for the entire fall-run migration period shall either use monitoring information collected during each water year's outmigration to determine the specific pattern of migration for the water year, or shall assume monthly migration to be 45% in April and 55% in May." (EPA1993, page 137). The criteria does not definitively state whether the San Joaquin Valley Index or the Sacramento River Basin Index will be used to establish the water year type for the salmon smolt survival index. However, the cited literature suggests that the San Joaquin Valley Index is assumed.

Cited Basis for Salmon Smolt Survival Criteria

EPA states that it developed the "goals or target index values" for its proposal primarily relying on the goal of restoring habitat conditions to those existing in the late 1960's and early 1970's (EPA1993, pages 70-71), citing consistency with the recommendations of the Interagency Statement of Principles. The historical, calculated San Joaquin River salmon smolt survival indices for various historical periods are shown below.

	Water Year Type					
	Wet	Above Normal	Below Normal	Dry	Critical	Mean of Year Types
1940 Level of Development	.58	.50	.52	.47	.39	.49
1956-70 Historical	.61	*.25	.18	.17	*.15	.27
1960-88 Historical	.43	.12	.17	.13	.12	.19
1978-90 Historical	.48	*.15	*.09	.06	.07	.17
* Interpolated: there were no water years in these categories during the relevant historical period. Source: USFWS (WRINT-USFWS-7)						

Source: (EPA1993, page 72)

EPA argues that strict adherence to the late 1960's and early 1970's target is inappropriate. Its rationale is that salmon fisheries on the San Joaquin River were already somewhat degraded during that historical period, and particularly more severe during drier years. Therefore, to protect salmon from falling to dangerously low population levels, and "more nearly mimic the natural historical response of smolts migrating through the Delta," EPA is proposing "more protective target values in drier years and less in wetter years." (EPA1993, pages 72-73)

The proposed San Joaquin River salmon smolt survival indices correspond to the recommendations of the Five Agency Chinook Salmon Committee. EPA specifically states that the criteria provides better protection than the 1956-1970 historical level, and indicate that the criteria "should provide more consistent smolt survival and help avoid situations where extraordinary measures are necessary to preserve runs..." (EPA1993, page 77)

Identified Implementation Measures

The salmon smolt survival index criteria can be met by a range of various operations. The nature of the mathematical model that determines the San Joaquin River index leaves the decision of meeting the criteria as a matter of manipulating San Joaquin River flow at Vernalis, Delta exports, and the installation of a barrier at the head of Old River. EPA states that it "expects that the State Board would implement these criteria by making appropriate revisions to operational requirements included in water rights permits issued by the State Board." (EPA1993, page 78)

To achieve the criteria, EPA cites that "the USFWS recommended a series of implementation measures (based on the Five Agency Chinook Salmon Committee proposals) to achieve the smolt survival indices..." The measures for the San Joaquin River were:

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

- Total water exports would be curtailed to a range from 6,000 cfs in wet years to 2,000 cfs in critically dry years from April 15 to May 15. (EPA1993, pages 78-79)

Proposed Fish Spawning Criteria

EPA has proposed to establish water quality criteria to protect the historic spawning range of striped bass on the lower San Joaquin River. The proposed criteria are stated to "reflec[t] the natural variability in salinity levels in different water year types." (EPA1993, page 87). Specifically, the criteria are stated as follows:

> "The 14-day running average of the mean daily EC shall not be more than 0.44 mmhos/cm for the period April 1 to May 31 in wet, above normal, and below normal years at the following stations: Jersey Point, San Andreas Landing, Prisoners Point, Buckley Cove, Rough and Ready Island, Brandt Bridge, Mossdale, and Vernalis. In dry and critical water years, the criteria are required only in the reach between Jersey Point and Prisoners Point, as measured at Jersey Point, San Andreas Landing, and Prisoners Point." (EPA1993, page 87)

Cited Basis for Spawning Criteria

EPA states that its objective is to protect spawning in both the Sacramento and San Joaquin river systems to "ensure the genetic diversity of the population as well as increase the size of the overall striped bass population." (EPA1993, page 83). EPA cites literature that states that adults spawn by migrating upstream, with the location and time of spawning apparently controlled by temperature and salinity conditions. The literature was cited to state that "striped bass spawn successfully only in freshwater with electrical conductivity less than 0.44 mmhos per centimeter electroconductivity (mmhos/cm EC), and prefer to spawn in waters with conductivities below 0.33 mmhos/cm. Conductivities greater than 0.55 mmhos/cm appear to block the upstream migration of adult spawners." (EPA1993, page 83)

EPA cites the work of others and summizes that in the San Joaquin River the earlier occurrence of warm temperatures cause the spawning period to occur earlier than in the Sacramento River, with the San Joaquin spawning peak occurring in April or May. EPA recognizes that migrating bass seeking warmer waters encounter excessive upstream salinity caused primarily by runoff, with the migration potentially blocked by salinity. Subsequent mortality of eggs is stated to also occur due to high salinity.

Identified Implementation Measures

The criteria are stated as specific quantitative salinity requirements. EPA expects that the State Board will implement the criteria by making appropriate revisions to the operational requirements included in water rights permits issued by the State Board.

COMMENTS

Salmon Smolt Survival Criteria

The basic development of the San Joaquin River salmon smolt survival index equation was developed by integrating several approaches and adjustments. The mixed approach was due to apparent limitations of experimental data over a diverse range of operating conditions. For instance, the proposed equation (assuming a barrier exists at Old River) is based on limited coded wire tagged data (8 data points) and is extended from several theories that are not currently verified by experimental data. Figure 1 below illustrates the flow, export and survival relationship developed by USFWS for a barrier-in condition. To relate the graphical depiction to the proposed survival index, the results for survival shown in the graphic must be divided by a factor of 1.8.

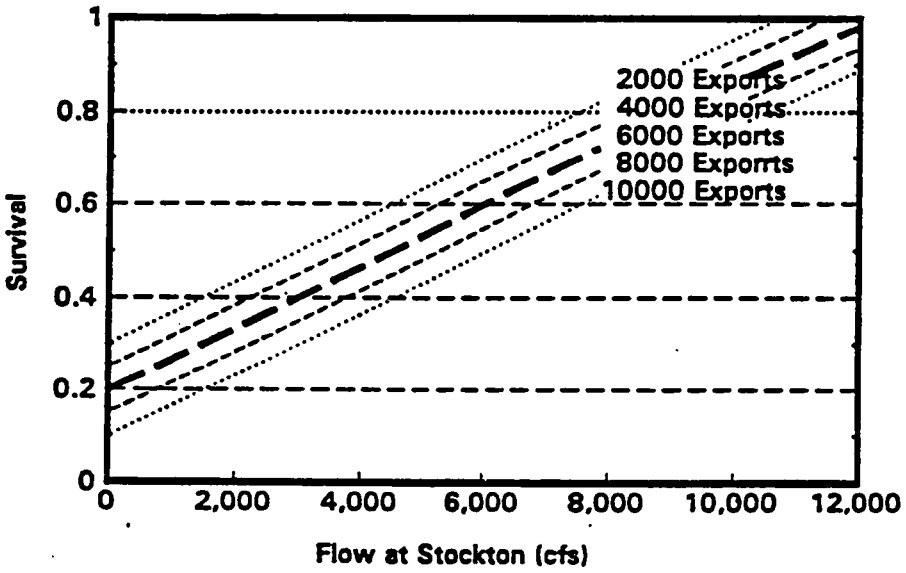


Figure 1
Barrier-in Condition
(Source: WRINT-USFWS-7)

USFWS describes in WRINT-USFWS-7 the numerous steps it used to develop a predictive tool for smolt survival assuming a barrier at Old River. USFWS states that including exports in the regression analysis did not improve the equation; however, exports were added to the equation based on the opinion of USFWS that the effect of exports on smolt survival under a no-barrier configuration would have similar effects under a barrier-in condition. A family of lines was developed that relates smolt survival, flow and exports. USFWS indicated reservation with its relationship based on the "relatively high survival it provides at very low flow." (WRINT-USFWS-7, page 54)

The foundation of the equation and its supporting theories appear questionable. Achievement of the proposed criteria by simply manipulating the flows within the Delta will likely not guarantee the biological response intended by the criteria. On face value, the proposed

equation suggests that with zero exports, a Stockton flow of only 280 cfs will result in a survival index of 0.20 (critical year required index). The historical data will not support the calculated result. Additional research and experimentation must be performed to refine and validate a relationship for smolt survival.

As a question of complying with the EPA proposed criteria, additional information must be provided by EPA concerning the calculation of the salmon smolt survival index. The equation proposed by EPA currently includes a variable for flow at Stockton. Flow at Stockton is not measured, and reportedly is determined by a San Joaquin River flow and Delta export relationship. No specific criteria (equation) was provided by EPA to determine the flow at Stockton which is necessary to determine the salmon smolt survival index in a barrier-in condition.

The EPA criteria were cited to the proposal of Alternative D described in WRINT-USFWS-7. In order to achieve the proposed San Joaquin River smolt survival criteria the following operational measures were assumed (additional operational assumptions were assumed that affect the Sacramento River smolt survival index):

Year Type	Close Cross Channel	Close Georgiana	Max Total Exports	Full Barrier Old River	Minimum Vernalis	Salmon Survival Index
			4/15 - 5/15		4/15 - 5/15	
Wet	April 1 - June 30	April 15 - June 15	6,000 cfs	April - May	10,000 cfs	0.46
Ab Norm	all years	all years	5,000 cfs	&	8,000 cfs	0.30
Bl Norm			4,000 cfs	Sept - Nov	6,000 cfs	0.26
Dry			3,000 cfs	all years	4,000 cfs	0.23
Critical			2,000 cfs		2,000 cfs	0.20

Although the nature of the smolt survival index allows the achievement of the criteria through variance of Vernalis (Stockton) flow and/or exports, the manipulation of the parameters of this equation to achieve the proposed survival index will not necessarily provide the desired biological response.

Paramount to achieving the criteria is the assumption that the barrier at Old River will be installed. Due to concerns that the barrier could adversely impact the use of the water coarse for other needs, there is no certainty that a barrier will be installed during the period anticipated by EPA. If an equation is to be used to surrogate smolt survival, then additional compliance measurement criteria must be included to capture the array of physical channel configurations within the Delta that may occur. The equation proposed in the EPA criteria is only associated with a barrier-in condition.

USFWS has previously described its methodology to determine smolt survival under a no-barrier configuration. (WRINT-USFWS-7) Questions again arise regarding the validity of the USFWS index equation for the no-barrier configuration. USFWS states that due to the lack of coded wire tagged data, the relationship relied in part on adult fall-run salmon escapement data. Figure 2 below illustrates the flow, export and survival relationship previously developed by USFWS for a no-barrier condition. Assuming consistency between the graphical depiction of the barrier-in

survival relationship and the no-barrier survival relationship, the survival values shown in Figure 2 would be divided by a factor of 1.8 to relate to the EPA proposed criteria.

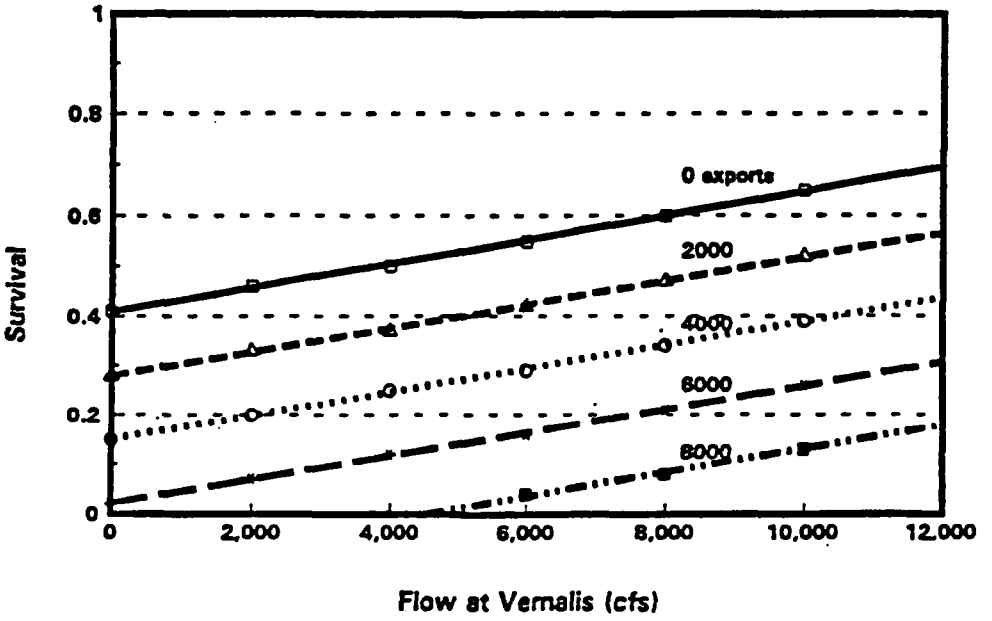


Figure 2
No-Barrier Condition
(Source: WRINT-USFWS-7)

To compute the salmon smolt survival on the San Joaquin River in a no-barrier condition, USFWS suggests (WRINT-USFWS-9, page 50) the following equation:

$$Y = (4.90106 + 0.000286F - 0.000774E) \div 12$$

where

Y is the San Joaquin River salmon survival;

F is the mean daily flow at Vernalis; and,

E is the average Central Valley Project plus State Water Project exports measured in cfs.

Consistent with the methodology suggested by USFWS for the barrier-in condition, the results of the above equation would be divided by a factor of 1.8 to result in the San Joaquin River salmon smolt survival index (see WRINT-USFWS-9, page 72).

Similar to the barrier-in equation, this equation suggests that significant survival can occur with minimal, if not zero flow at Vernalis if exports are reduced to zero. Recent, past year survival data indicate that the no-barrier index relationship is far from accurate. Therefore, a biological response is not necessarily guaranteed by simply complying to EPA's proposed criteria.

The Department of Water Resources (DWR) has attempted to model water supply impacts associated with compliance to the several EPA proposed criteria. Concerning compliance to the San Joaquin River smolt survival criteria, DWR appears to be assuming compliance is met through the implementation of the following operation:

> "Total exports not above 1500 cfs for 4 weeks, April 15 - May 15. Total exports for the rest of April through June not above 4000 cfs. Minimum flows at Vernalis for four weeks (April 15 - May 15) as follows: W 10,000 cfs; AN 8,000 cfs; BN 6,000 cfs; D 4,000 cfs; C 2,000 cfs." (by direction of EPA by letter dated August 12, 1993 from Susan Hatfield to George Barnes, DWR1993)

The operation conditions suggested by EPA, and the proposed rule itself, suggest that the water supply impact modeling has been performed assuming a barrier-in condition. Therefore, the water supply impact analysis completed thus far by DWR does not include an assessment for the cost of water supply associated with the San Joaquin River salmon smolt survival index criteria under other potential physical configurations, particularly the no-barrier condition.

Regardless of the validity of the objectives associated with the absolute index values incorporated in the criteria, additional water supply costs will occur if the proposed criteria are applied to a no-barrier configuration. This consequence has not been recognized by proposed rule or the RIA. To maintain the same water supply impacts between a barrier-in and no-barrier configuration would require a relaxation of the absolute smolt survival values.

As a closing comment on the salmon smolt survival index, the proposed criteria are explicitly tied to two flow quantities - flow in the San Joaquin River and exports from the Delta. Neither of these two hydrologic factors are directly relatable to water quality requirements of salmon smolt - the criteria are flow requirements.

Fish Spawning Criteria

EPA states that it disapproved earlier State Board salinity objectives for various reasons. Cited were the State Board's 1991 Bay/Delta Plan that established 1.5 mmhos/cm EC at Antioch and 0.44 mmhos/cm EC at Prisoners Point in April and May. EPA states that it disapproved these objectives, in part, because they were considered inadequate to protect spawning habitat in the upper reach of the San Joaquin River between Prisoners Point and Vernalis.

During the development of the 1991 Bay/Delta Plan, the State Board framed several alternative water quality standards that could have extended the protection of the spawning conditions upstream of Prisoners Point. EPA states that the State Board chose not to adopt such standards upstream of Prisoners Point "... apparently because of concern that improved spawning conditions would lead to greater losses of young to entrainment at the State and Federal pumping plants." (EPA1993, page 85) EPA also states that it disapproved the proposed State Board standards because they were not based on sound science. EPA's concern apparently was founded on the issue of the State Board attempting to provide protection to an upstream location through the

establishment of a salinity standard downstream (e.g., establish a 1.5 mmhos/cm EC standard at Antioch to protect conditions at Jersey Point).

The State Board addressed EPA's recommendation to maintain spawning conditions in the entire stream reach between Jersey Point and Vernalis. (SWRCB1993) In its draft Decision 1630, the State Board stated:

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

While EPA has proposed a rule that is now cognizant of "dry" and "critical" year conditions (i.e., the proposed rule does not require the spawning criteria for the upper reach of the San Joaquin River during dry and critical years), meeting the criteria during better years is not certain without the potential of significant water supply impacts. Whether proposing an "all years" rule or not for the reach, EPA has not adequately addressed the causes of salinity degradation in the southern Delta, and has instead set an objective which causes compliance through "dilution" measures rather than through source correction.

The State Board stated in draft Decision 1630:

> "Salinity between Vernalis and Prisoners Point is influenced primarily by discharges of salty agricultural return flows, not by intruding ocean salinity (footnote omitted). Thus, water supplied to dilute the salinity in this reach would primarily be used to dilute pollutants. If the State Water Board is to assure the maximum beneficial use of the State's water supplies, it should not require releases of water supply for the purpose of diluting pollutants except when those water quality standards cannot be achieved solely by controlling waste discharges. To protect spawning habitat during the spawning period, the appropriate way to regulate salinity caused by agricultural discharges in this reach is by regulating the discharges." (SWRCB1993, pp. 44-45)

When considering EPA's proposed rule for salmon smolt survival and Suisun Bay salinity, in combination with the State Board's Decision 1485, EPA's proposed rule for spawning conditions may incidentally be met much of the time.

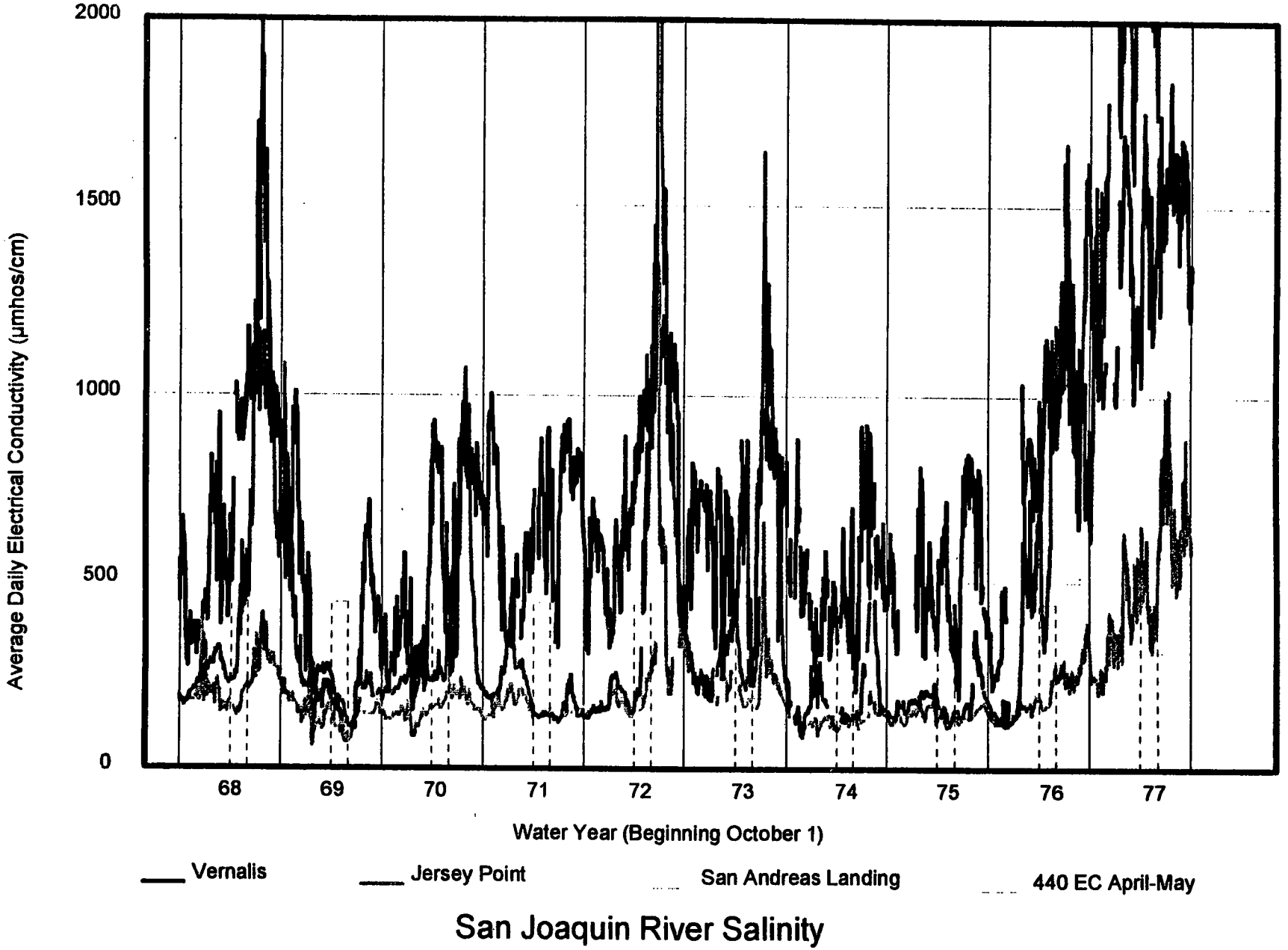
By eliminating the Prisoners Point to Vernalis criteria, the proposed EPA rule will effectively result in the striped bass spawning criteria proposed by draft Decision 1630. Exceptions to this comparison are that draft Decision 1630: (1) allowed a relaxation of the Prisoners Point salinity requirement to 0.55 mmhos/cm EC during periods when Antioch spawning criteria were relaxed; and, (2) Jersey Point to Prisoners Point criteria are not specifically stated for spawning, but instead occur incidentally to other criteria. These other criteria are assumed to be less stringent than the proposed EPA Suisun Bay salinity criteria.

In evaluating its proposal concerning maintenance of the EPA-recommended salinity level of 0.44 mmhos/cm EC between Vernalis and Jersey Point, the State Board found:

> "[t]he decision (draft Decision 1630) will protect striped bass spawning at the EPA-recommended salinity level of 0.44 mmhos/cm EC in the reach from Vernalis to Jersey Point during a substantial part of the spawning period in wet, above normal, and below normal water years. During some parts of the spawning period this salinity will not be met in the entire reach. In dry years Vernalis salinity will probably be on average slightly higher, at 0.46 during the pulse flow, and somewhat higher yet during the rest of the spawning period. The dry year regime likely will not significantly impair spawning success. In critically dry years, 0.44 mmhos/cm EC is not expected to be met between Prisoners Point and Vernalis. While the entire spawning reach will not be protected during the entire spawning period each year, this decision will substantially improve spawning habitat over the levels that could occur under D-1485. This decision will provide water quality in the reach between Vernalis and Jersey Point which is comparable to or better than the levels which existed in or before 1975, the base date for the antidegradation policy under the federal Clean Water Act." (SWRCB1993, page 105)

State Board staff has specifically commented on the proposed EPA criteria for striped bass spawning (SWRCB1993a). Interpretation of their analysis and findings leads to a conclusion that EPA's proposed criteria for the striped bass would be establishing a water quality condition in the San Joaquin River which greatly exceeds the condition that existed during the period 1964 to 1976, which is stated to be EPA's assumption for antidegradation regulation.

Figure 3 through Figure 5 illustrate historical average daily salinity levels within the San Joaquin River during the period water year 1968 through water year 1992. The data are provided for three locations: Vernalis, San Andreas Landing and Jersey Point. Also depicted in the figures is the proposed .44 mmhos/cm EC salinity requirement for the April through May period. Readily observed in the figures is the frequency of high salinity levels at Vernalis. The frequency of which the proposed EPA criteria would have been met incidentally by historical operations is summarized by Table 1. It is assumed that non-compliance occurs if the criteria is not met on any day during the April through May period.



San Joaquin River Salinity

Figure 3

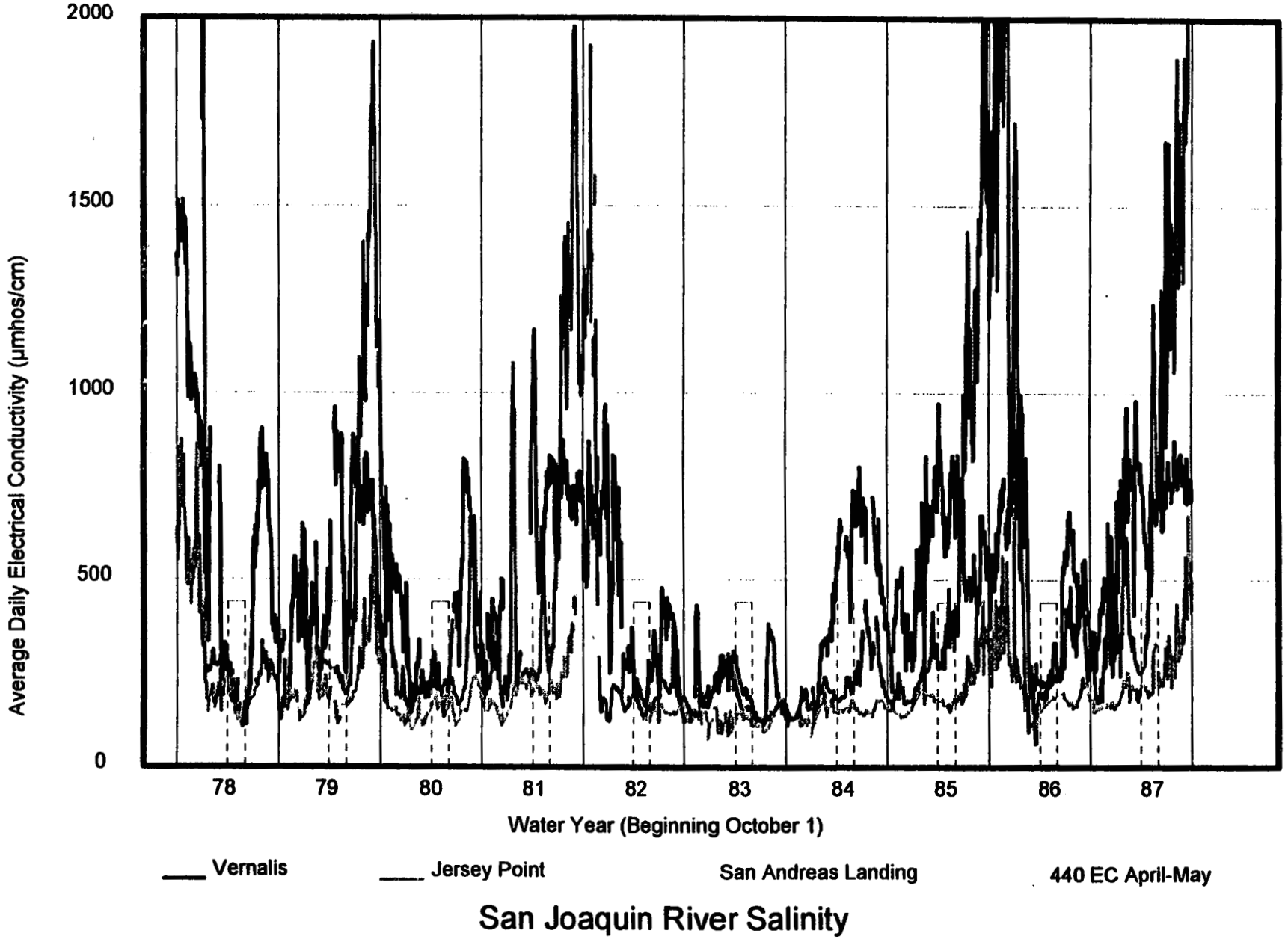
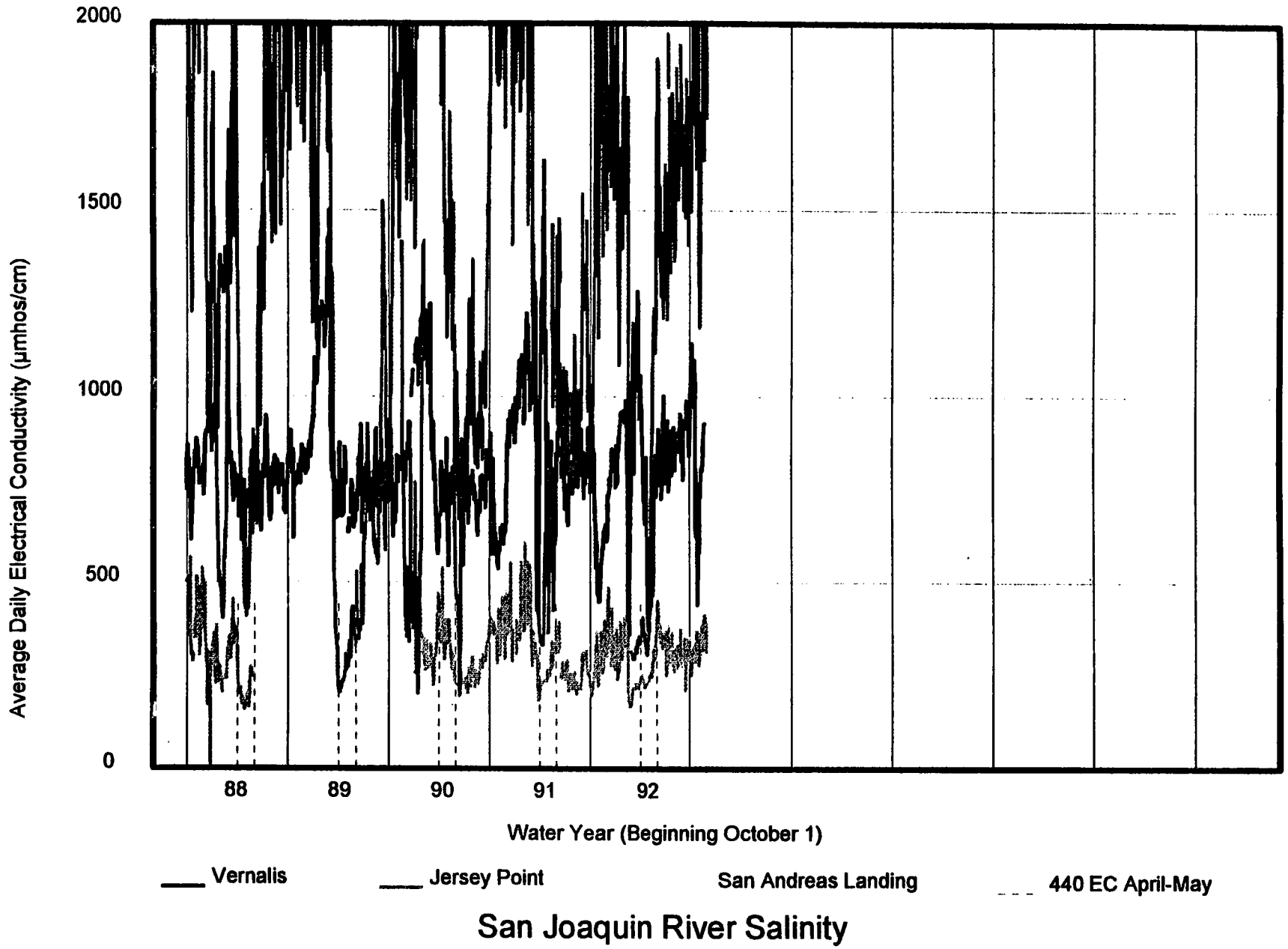


Figure 4



San Joaquin River Salinity

Figure 5

Table 1
Compliance to Proposed EPA Striped Bass Criteria at Selected Locations Incidentally to Historical Operations

Water Year	Year Type	Jersey Point	San Andreas Landing	Vernalis	Water Year	Year Type	Jersey Point	San Andreas Landing	Vernalis
1968	D	NO	YES	NR	1981	D	NO	YES	NR
1969	W	YES	YES	YES	1982	W	YES	YES	YES
1970	AN	YES	YES	NO	1983	W	YES	YES	YES
1971	BN	YES	YES	NO	1984	AN	YES	YES	NO
1972	D	NO	YES	NR	1985	D	NO	YES	NR
1973	AN	YES	YES	NO	1986	W	YES	YES	YES
1974	W	YES	YES	NO	1987	C	NO	YES	NR
1975	W	YES	YES	NO	1988	C	NO	YES	NR
1976	C	NO	YES	NR	1989	C	YES	YES	NR
1977	C	NO	NO	NR	1990	C	NO	YES	NR
1978	W	YES	YES	YES	1991	C	NO	YES	NR
1979	AN	YES	YES	NO	1992	C	NO	YES	NR
1980	W	YES	YES	YES	1993	W	YES	YES	NO

NR means the criteria are not required during this year type.

In correspondence between EPA and the Department of Water Resources (DWR1993) it has been recognized that no attempt has yet been made to quantify the operations required to fully comply with the proposed criteria during dry and critical years. Given this knowledge, EPA still has proposed the criteria therefore making the results of the RIA incomplete. Further, there has not yet been adequate review of the modeling results prepared by EPA and the Department of Water Resources to verify the compliance of the proposed criteria during below normal, above normal, and wet years for the reach between Prisoners Point and Vernalis.

The proposed criteria may at times be incidentally met during wet, above normal and below normal years due to the proposed salmon smolt survival criteria for a portion of the April - May period; however, the salmon smolt survival criteria may only incidentally meet the spawning criteria approximately one half of the period during which the spawning criteria apply. For dry and critical years, DWR has noted that a flow versus salinity relationship does not currently exist for Prisoners Point; therefore, the additional water cost associated with the spawning criteria have not yet been fully determined.

A review of recent 1993 operations of the San Joaquin River and its tributaries further illustrates the potential difficulty in meeting the proposed spawning criteria, even in a year classified as wet. Figure 6 and Figure 7 depict several flow and water quality conditions in the San Joaquin River basin during the spring of 1993. Figure 6 depicts the water quality in the San Joaquin River at

Vernalis, San Andreas Landing, Jersey Point and the Stanislaus River at Ripon. Also illustrated in Figure 6 is the proposed .44 mmhos/cm EC requirement during April and May for 1993 (classified as a wet year). Figure 7 depicts the flow operations for the San Joaquin River and its tributaries during the same period. These operations included water releases for water quality (Stanislaus River) and pulse flows (Stanislaus, Tuolumne and Merced rivers) for migration of salmon smolt. Supplemental releases during this period amounted to over 100,000 acre-feet.

Figure 6 illustrates that water quality at Vernalis during the primary period of the pulse flows improved to a level that would comply with EPA's wet year criteria at Vernalis. However, both prior and after the pulse flow period the proposed criteria at Vernalis were not met. The amount of additional supplemental water that would have been required to comply with the proposed criteria at Vernalis during 1993 was estimated to exceed 150,000 acre-feet. This type of additional water supply impact is not currently included in DWR's water supply impact analysis or the RIA.

The objective of increasing the population of striped bass could be contrary to the goal of providing recovery to endangered and threatened species. Two separate adverse consequences occur by enhancing the environment associated with striped bass: (1) improvement of the striped bass population will increase predation of endangered and threatened species and competition for food and environment; and (2) water supplies required to comply with the spawning criteria will be in direct competition with the supplies that are necessary to comply with other objectives for the other species.

CONCLUSIONS

The proposed criteria and method of compliance measurement for salmon smolt survival are based on mathematical relationships that appear to be invalid for a wide range of potential export and flow operations.

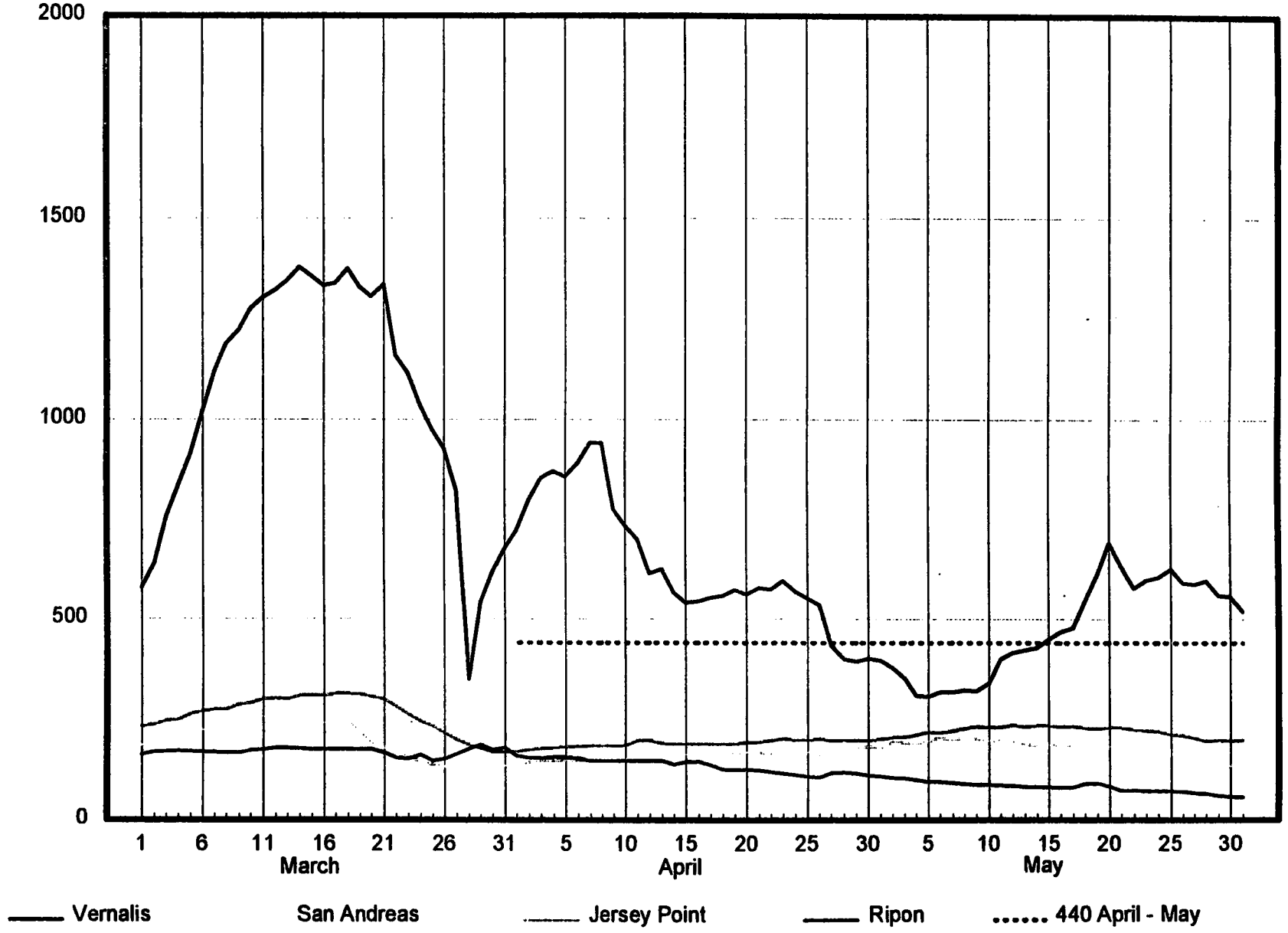
The proposed criteria does not provide sufficient guidance as to the calculation of the salmon smolt survival index; specifically, the quantification of flow at Stockton is not defined.

The proposed criteria does not include a compliance measurement tool for delta channel configurations other than a barrier-in condition for Old River.

Water supply impacts have not been determined assuming any delta channel configuration other than a barrier-in condition.

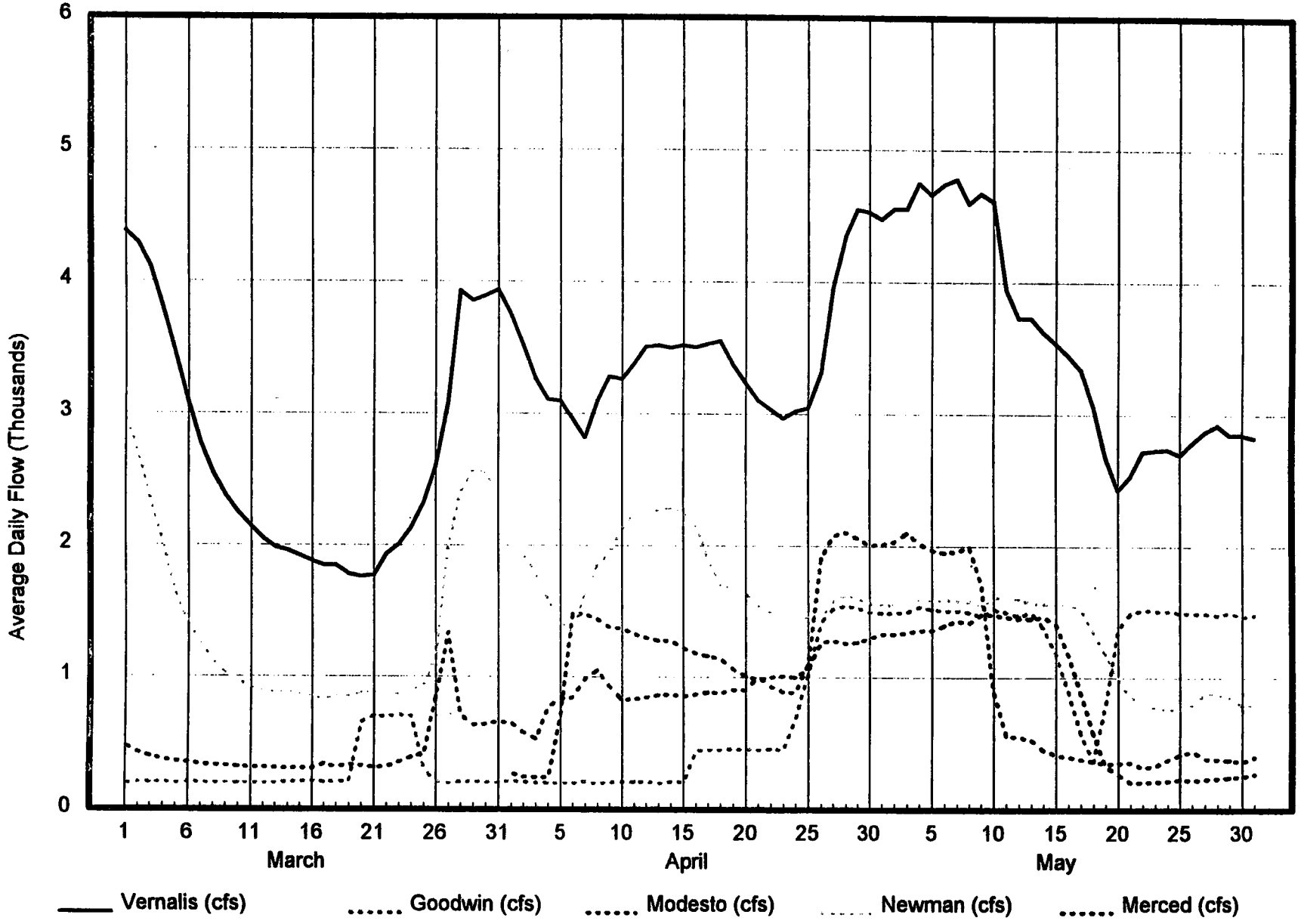
The salmon smolt survival index criteria is a flow requirement.

The striped bass spawning criteria will provide quality which exceeds the level of quality which occurred in the San Joaquin River during the 1964-1976 period.



San Joaquin River and Tributary Water Quality - 1993

Figure 6



San Joaquin River and Tributary Flows - 1993

Figure 7

Releases of water for the spawning criteria will actually be diluting agricultural drainage flows of the San Joaquin River.

Incidentally to the other criteria proposed by EPA, or criteria which already currently exists, the striped bass spawning criteria will be substantially met much of the time.

The full water supply impacts of the proposed spawning criteria have knowingly not been assessed and incorporated into the proposed rule or RIA.

Provision of flows for the spawning criteria could at times be in competition for flows which are necessary to protect endangered and threatened species.

Citations

Environmental Protection Agency. Proposed Rule on Bay/Delta Standards. December 15, 1993. (EPA1993)

United States Fish and Wildlife Service. Measures to Improve the Protection of Chinook Salmon in the Sacramento/San Joaquin River Delta. July 6, 1992. (WRINT-USFWS-7)

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