United States Department of the Interior
Statement Before the State Water Resources Control Board
Review of 1995 Delta Water Quality Control Plan
Topic #5: Delta Outflow
January 12, 2005

A decade ago, the State Water Resources Control Board (SWRCB) adopted the Delta outflow objectives, commonly known as the X2 standard, to protect beneficial uses of Delta waters by the State's fishery resources. The Delta outflow objectives formed the foundation for one of the major new concepts in the 1995 Delta Water Quality Control Plan (1995 WQCP). Over the last 10 years, these objectives generally have improved environmental conditions for a number of fish species, particularly those listed as threatened or endangered pursuant to the federal Endangered Species Act (ESA).

During the past 10 years and particularly during the recent drier years, Department of the Interior (Interior) agencies have observed that achieving Delta outflow objectives have created conflicts with other operational objectives and other water quality parameters. These conflicts have been documented by actual operations in the last several years and from long-term operation studies. In some years, the X2 standards require substantial releases of water from upstream reservoirs. These releases and lowered reservoir levels have affected temperature objectives for anadromous fish, including threatened or endangered salmon species.

Interior has identified conflicts in the past and recognizes that in the future there may be competing needs between upstream and downstream (Delta) fishery objectives. Interior proposes to implement the Delta outflow objective in a flexible manner, as necessary, using real-time analyses and consultation and communication among all five agencies (the Bureau of Reclamation, the Department of Water Resources, the Fish & Wildlife Service, NOAA Fisheries, and the Department of Fish and Game), with the goal of balancing the competing demands of fishery objectives.

Background

The purpose of the 1995 WQCP's X2 Delta outflow standard is to provide fish protection in the Delta by ensuring the existence of appropriate habitat, as defined by conditions of outflow and salinity. The standard calls for meeting a 2-part-per-thousand (ppt) salinity requirement at certain locations in the Delta for specified periods based on hydrologic conditions. The standard is met by a "three ways to win" concept. The standard can be met through 14-day mean salinity, single day salinity, or 3-day average outflow surrogates. The surrogate outflow level to meet the X2 standard at Port Chicago/Roe Island is 29,200 cfs, Chipps Island is 11,400 cfs, and Collinsville/Confluence is 7,100 cfs.

Biological Basis. Given the profound alteration of natural flows in the Sacramento-San Joaquin Estuary, the WQCP's X2 standards help control the degree to which salinity is allowed to penetrate up the Estuary. While the X2 standard provides for the needs of a range of fish species, Interior has a legal responsibility for protecting the delta smelt, which has been listed as

threatened under both the Federal and State ESA. The Delta outflow objective (X2 standard) is incorporated into the Bureau of Reclamation's new OCAP project description and associated Biological Assessment and the Fish and Wildlife Service's OCAP Biological Opinion. Over the last 20 years, the delta smelt population has experienced a significant decline in numbers, and since 1982, has remained at extremely low levels. Interior remains concerned that the delta smelt population is at risk of extinction. Recent population abundance indices confirm that the species has not sustained any significant signs of recovery (FWS 5-Year Review, March 2004). This analysis therefore focuses on delta smelt.

Delta smelt have exhibited the lowest fall mid-water trawl ever in 2004. The only new information concerning the delta smelt's population size and extinction probability indicates that the population is at risk of falling below an effective population size and therefore in danger of becoming extinct (USFWS biological opinion, pg.116). A WQCP Delta outflow objective (X2 standard) that successfully protects habitat upon which listed delta smelt depend is essential to achieving species recovery.

The X2 standards were intended to provide adequate downstream flows to allow delta smelt to move away from the influence of the CVP/SWP water diversion facilities into low-salinity rearing habitat in Suisun Bay and the lower Sacramento River. Placement of X2 downstream from the Confluence and Chipps and Roe Islands provides delta smelt with necessary low-salinity habitat in Suisun Bay and protection from entrainment at the export facilities, allowing for productive rearing habitat that increases both smelt abundance and distribution (FWS BO pg 118). Delta smelt rear in the near-landward area of the low-salinity zone. Maximizing this low-salinity habitat by placing X2 in Suisun Bay is significantly correlated with adult abundance (Unger 1994). This is based on previous research showing the longitudinal distribution of delta smelt during its larval and juvenile stages is related to flow magnitude and its correlate, X2 position (Sweetnam and Stevens 1993, Dege and Brown 2004). Therefore, during the larval and juvenile phases, river flows of sufficient magnitude and duration facilitate down-estuary movement from spawning habitats in the Delta to rearing habitats (FWS BO pg 134).

A review of the scientific literature on delta smelt reveals the need to maintain a broad mixing, low-salinity zone. The underlying causal X2 mechanisms for delta smelt are complex and not necessarily amenable to simple statistical analyses. See the attachment for references that provide supporting information for X2 mechanisms affecting delta smelt. The X2 objectives also were developed to provide good quality habitat in the Delta for other native and anadromous fish, including listed winter run and spring run Chinook salmon. X2 affects transport through its effect on migratory cues or hydrologic residence time (IEP/EET 1997).

Peer-reviewed research has indicated that X2, as an indicator of the position of the low-salinity zone, is correlated with positive habitat values for many species in the Delta. For delta smelt these include increases in available spawning habitat, increased co-occurrence with food organisms, increased shallow water habitat for rearing, reduced predation, and higher food production, which promotes good growth and improved survival. Some believe that the X2 standard has inconclusive links with the protection of Delta species, noting that existing data has not established a clear connection between X2 position and population-level effects to listed

species. As mentioned above, although the underlying causal X2 mechanisms for delta smelt are complex and not necessarily amenable to simple regression analyses, there is substantial evidence that X2 is an ecologically critical indicator and a meaningful management tool for delta smelt and other Delta species (see 1997 IEP Technical Report 52 and the attached references).

As to ESA-listed salmonids, which are under the jurisdiction of NOAA Fisheries, certain salmon species enjoy benefits from X2, but require other protections as well. The NOAA Fisheries biological opinion on the Long-Term Central Valley Project and State Water Project Operation, Criteria, and Plan (OCAP) under the Endangered Species Act for protection of listed salmonids below project facilities includes temperature targets for steelhead habitat in the American River. The NOAA Fisheries OCAP opinion also includes temperature targets for winter-run Chinook salmon habitat in the upper Sacramento River. In the event these temperatures are not met, the Sacramento River Temperature Task Group will meet to determine if additional actions can be taken to protect listed salmon. If the temperature targets are not met, then re-initiation of consultation may be required. There are instances when the timing of flows must favor one species more than the other, suggesting there are periods when outflow requirements could be temporarily modified to improve upstream temperatures.

Operational Challenges. Meeting the X2 standard can require the projects to make significant storage releases or to bypass flows that would otherwise be diverted to storage. Such releases or bypasses can be of a magnitude that result in lower springtime storage levels in project reservoirs. The result of such lower storage levels is a smaller pool of coldwater resources for later in the year to meet temperature requirements in the rivers below project reservoirs. Releases from project reservoirs to meet large X2 standard flows, such as the Roe Island requirement, can also cause significant river level fluctuations in the rivers below project facilities at times that such fluctuations are sensitive to anadromous fishery resources below those facilities.

Operational conflicts between meeting upstream requirements and meeting the X2 standard do not occur in all years. There are some "technical problems" associated with the Roe Island X2 standard regarding salinity conditions at the end of the month and the determination of the flows for the X2 standard for the following month, that can create an immediate need for a project operations response, much sooner than what might otherwise be expected. This is discussed in the next section.

One particularly challenging aspect of the X2 standard is the effect of the late spring Collinsville/Confluence flows for X2 and its potential impact on CVP and SWP reservoir storage during prolonged droughts. The Collinsville X2 standard is expressed as a minimum outflow level to be in place from February through June. Unlike the Chipps Island and Roe Island requirements, this standard is not hydrologically tied to the previous month's 8-River Index. While reservoir storage of cold water may recover in some years, continued dry conditions may reduce the projects' ability to ensure cold water in rivers downstream from reservoirs during the fall.

The X2 standard at Collinsville does have a relaxation provision that applies in May and June if the forecasted Sacramento River Index is below 8.1 MAF, which is a relatively low

threshold. In five of the "critical" years during the 20th century's two 6-year droughts, the Sacramento River Index did not drop low enough to qualify for relaxation of Collinsville X2 standard, based on interpretation of the provision used for CALSIM modeling. There were a total of twelve critical Sacramento Valley Index years during the period 1922-1994. Currently, the existing Collinsville relaxation provision would apply to seven of those twelve years, per the CALSIM modeling.

Reclamation's estimate of the effect during the 1928-34 drought on project storage for this requirement is a cumulative reduction of 550,000 acre-feet, during three critical years (1929, 1933 and 1934). The cumulative reduction in storage for the 1986-92 drought is 382,000 acre-feet, during the two critical years (1988 and 1992). By the final year of either of these six-year droughts, reservoir and river conditions are adverse. In some instances, the river conditions have been adverse for several consecutive years, and are capable of providing only minimal temperature protection.

These examples illustrate how meeting the X2 standard can create a situation where there are competing needs between upstream water resources, and associated coldwater resources, and downstream fishery protection. This situation can occur when there are important ESA concerns in both the upstream and downstream (Delta) environments.

Operational Experience. Actual hydrologic conditions do not always match well with the standards. Large precipitation events in one month can trigger Roe Island standard, but the foreseeable hydrologic conditions is uncertain. Sometimes additional rain events help to meet regulatory requirements and sometimes no significant rain events occur and the regulatory requirement must be operationally addressed. Reclamation has to increase releases that cause flow fluctuations in the upstream during the time the standard is triggered. This also contributes to reduced reservoirs later in the season. Below are some examples of operational challenges that have occurred between fishery objectives that were discussed and coordinated by the five management and project agencies. It should be noted, however, that FWS and NOAA Fisheries issued new Biological Opinions in 2004. These Biological Opinions have not been implemented through an entire year. Although these examples pertain to past experiences under the previous Biological Opinions, we anticipate that there will be times when we have competing needs in the future.

Pursuant to the 1995 WQCP the projects have been achieving the Delta outflow objectives. In April/May 2000, projects released more than 450,000 acre-feet of water to fulfill the Delta outflow standard at Roe Island (CVP - over 150,000 acre-feet from Shasta and about 100,000 acre-feet from Folsom, SWP - over 200,000 acre-feet from Oroville). There were upstream issues with the cold-water pools in CVP reservoirs and, during that summer, Reclamation had to consult with NOAA Fisheries to move temperature compliance points continually upstream.

In February 2003, the projects released more than 350,000 acre-feet of water to fulfill the Delta outflow standard (CVP - about 160,000 acre-feet from Shasta and just under 30,000 acre-feet from Folsom, SWP - over 200,000 acre-feet from Oroville). This effort to meet the Roe Island standard caused flow fluctuations in the rivers below project reservoirs creating a conflict

because, at that same time, Reclamation also was trying to minimize flow fluctuations to aid and protect spawning steelhead..

In April 2004, the projects released more than 400,000 acre-feet of water (CVP - over 140,000 acre-feet from Shasta and over 80,000 acre-feet from Folsom, SWP - over 200,000 from Oroville) to fulfill the Delta outflow standard at Roe Island. Later in the year, Reclamation had difficulties with upstream temperature control, and after nearly exhausting the cold-water pool, had to consult with NOAA Fisheries to move the temperature compliance point for winter-run Chinook salmon..

Recommendation

Compliance with Delta outflow objectives can create both operational challenges and ESA conflicts, however FWS believes the Delta outflow objectives remain important protections for the Delta's fishery resources. It contributes to maintenance of Delta habitat and increased smelt abundance and distribution. Interior therefore supports implementation of the Delta outflow objectives (X2 standards) as part of the Delta's WQCP with the following recommendation, that such implementation of the X2 standard would be flexible to allow real-time changes to address competing needs between upstream and downstream fishery objectives. We propose that, when such conflicts arise, the Bureau of Reclamation, the Department of Water Resources, the Fish & Wildlife Service, NOAA Fisheries, and the Department of Fish and Game, which already have regularly scheduled meetings regarding water operations and fishery management, address these competing needs and develop specific operational recommendations in response to the real-time situation.

In order to address the operational challenges and related ESA species concerns, Interior recommends that the five agencies would assess existing conditions, including:

- effect of meeting the X2 requirement on coldwater storage in project reservoirs and the ability of the projects to meet temperature requirements in Central Valley rivers
- effect to sensitive life stages of anadromous fish, especially ESA- listed species, of the flow fluctuations associated with meeting the X2 requirement
- effect of meeting the X2 requirement on the projects' ability to meet water quality standards in the Delta
- monitoring of real-time data for abundance and distribution of migrating listed fish species, using the salmonid and delta smelt decision processes to determine the level of risk to upstream and in-Delta species
- water quality at monitoring stations throughout the Delta
- forecasts of hydrological and meteorological conditions;
- comments from the Delta Smelt Working Group and/or the Sacramento River Temperature Task Group

In order to implement flexibility, the five agencies would need to coordinate and consult on a course of action. Shortly thereafter, the project agencies, with consensus from the fishery agencies, would submit their plan to the SWRCB, begin implementation, and provide an annual

report to the SWRCB, explaining the rational basis for their decisions and the outcome of implementation of any flexibility in that year. Although the goal of the five agencies is to achieve consensus on decisions, the agencies retain their authorized roles and responsibilities.

A crucial advantage of this proposal is timeliness. The five agencies need to respond to rapidly changing biological and hydrological conditions as quickly as possible. Now, ten years after the WQCP was adopted, these agencies enjoy much greater access to real-time monitoring data from the Delta and upstream rivers. As either biological or hydrological data show changes, the agencies need to be able to adapt the Delta outflow standards to the competing needs of fishery resources.

Providing such flexibility to the implementation of the Delta outflow objectives would ensure the most effective protection of the Delta's diverse fishery resources while also protecting upstream fishery resources. It also allows for resolution of any conflicts between the fish needs of the Delta and upstream habitat, which arises on occasion in particularly dry years. The proposed flexibility to implement the Delta outflow standard is consistent with the adaptive management process currently described in the project Biological Opinions and will facilitate quick response to resource issues in a collaborative manner.

Attachment - January 12, 2005
Relevance of X2 Objectives to Delta Smelt

Given the profound alteration of natural flows in the Sacramento-San Joaquin Estuary, the X2 objectives of the 1995 Bay Delta Plan help to control the degree to which salinity is allowed to penetrate up-estuary. A review of the scientific literature on delta smelt reveals the need to maintain a broad mixing, low salinity, zone for this threatened species. Although the underlying causal X2 mechanisms for delta smelt are complex and not necessarily amenable to simple regression analyses, there is substantial evidence that X2 is an ecologically meaningful management tool for delta smelt. The following references provide supporting information for X2 mechanisms affecting delta smelt.

Moyle and Herbold (1989). They reported that the cumulative number of days of reverse flows in the San Joaquin River during spring was always associated with low abundance of delta smelt in Siusun Bay in the fall. They further reported that low frequency of exports in spring not always resulted in high abundance of delta smelt the following fall. Thus, other cumulative factors could explain the low abundance of delta smelt in those years.

Moyle et al. (1992). They reported that delta smelt eggs are demersal and adhesive, sticking to substrates in the fresh water portion of the western delta. Thus, the implications are that the vulnerable egg stage could be adversely affected by sudden salinity changes if X2 standards were to be relaxed. Moreover, delta smelt larvae and juveniles are known to rear in and near the low salinity zone (LSZ 0.5 – 6 psu) feeding on copepods and other small zooplankton. They concluded that the decline of delta smelt coincided with an increase in the diversion of inflowing water during a period of drought. Such conditions restricted the mixing zone to a relatively small area of deep river channels. Restoration of delta smelt to a sustainable population size could require maintenance of the mixing zone in Siusun Bay and maintenance of a net seaward flow in the lower San Joaquin River during the period when larvae are present.

Unger (1994). He reported that the overall surface area of habitat bounded by 0.3-1.8 psu was maximized with X2 positioned in Siusun Bay, when this habitat measure was weighted by the average monthly occurrence of larval and juvenile smelt; he found a significant correlation with adult abundance.

Jassby et al (1995). They reported that the location of X2 in the Sacramento-San Joaquin Estuary has both physical and ecological meaning, a property not shared with other near-bottom isohaline positions. Although a delta smelt abundance index based on the fall mid water trawl did not exhibit a statistical verifiable relation with X2, an effect of X2 position on the abundance of delta smelt cannot be ruled out by the authors. X2 role may simply be masked by the

effect of additional mechanisms or delta smelt respond to other function of X2, rather than the April-July averaging period used. Jassby et al. also concluded that delta smelt distribution is determined by X2.

Estuarine Ecology Team (1997). They reported that the effect of X2 on delta smelt entrainment losses are very well documented. In low outflow years, delta smelt may exhibit a higher probability of entrainment mortality of larvae, juveniles and adults at SWP, CVP, PG&E and agricultural diversions. They reported other less well documented, yet presumably important effects of X2 on delta smelt, including:

- Increase spawning habitat. The amount of flooded vegetation increases with increasing outflow.
- Increased co-occurrence of young delta smelt with food organisms. There is a significant relationship between delta smelt year-class strength and the amount of time during spring X2 is located in Siusun Bay. Other factors may be operating in some years as well.
- More suitable habitat for larvae and juveniles may occur when X2 is located downstream in Siusun Bay, which supplies substantially more shallow water habitat than the river channels upstream.
- Reduced probability of encounter with predators. Annual delta smelt year classes exhibit a significant negative association with the abundance of the non-native predator inland silverside in years when X2 is located upstream during spring.
- Entrapment zone (EZ) residence time. Overall, food for larval and juvenile delta smelt is higher near the upstream end of the EZ. When X2 is positioned in Siusun Bay, a higher proportion of the larval population occurs in the EZ.
- Delta smelt may also reside longer in Siusun Bay if they are transported there earlier by higher flows.
- Higher production of food. The abundance of many food organisms for delta smelt larvae and juveniles is affected by mean X2 during spring. Thus, overall growth and condition of delta smelt may be better in higher outflow years.

Kimmerer (2002). He reported a positive relationship between X2 and a delta smelt abundance index based on the summer tow net survey over the period 1959 to1981. He also reported a non-significant relation from 1982 to 2000. It must be pointed out that by the early 1980s, a significant population collapse had been observed in all existing abundance indices of delta smelt (Sweetnam and Stevens 1993). Thus, the effect of X2 on delta smelt abundance should still influence the population along with other factors that have driven delta smelt to critically low population sizes.

Bennett (2004). He reported that adult abundance of delta smelt is always low when X2 is located in the lower Sacramento and San Joaquin rivers. He concluded that maintaining low salinity habitat in Siusun Bay during spring can be beneficial for delta smelt. This does not guarantee recruitment success, but may increase the potential for high abundance.

References

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