Public Comment
Sthrn Delta Ag & SJR Flow
Deadline: 5/23/11 by 12 noon

The Bay Institute

American Rivers
Thriving By Nature

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LATE COMMENT

Charles Hoppin, Chair
c/o Jeanine Townsend, Clerk to the Board
State Water Resources Control Board
1001 I Street, 24th Floor
Sacramento, CA 95812-2000

RE: REVISED NOTICE OF PREPARATION FOR REVIEW OF SOUTHERN DELTA SALINITY AND SAN JOAQUIN RIVER FLOW OBJECTIVES

Dear Mr. Hoppin,

This letter is submitted as the comments of the Bay Institute and American Rivers on the Revised Notice of Preparation and Additional Scoping Meeting regarding the State Water Resources Control Board's (SWRCB) current review of the southern Delta salinity and San Joaquin River flow objectives and the program of implementation for those objectives in the 2006 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. These comments are addressed solely on issues associated with the San Joaquin River flow objectives.

We strongly agree that "*more* flow of a *more natural pattern* is needed from February through June from the San Joaquin River watershed to Vernalis to achieve the narrative San Joaquin River flow objective" (NOP, Attachment 2, p. 3; emphasis added). The scientific justification for modifying the 2006 Plan using an approach based on setting a designated percentage of unimpaired runoff for San Joaquin River inflow to the Delta to achieve a more natural runoff pattern and requiring that designated percentage to be significantly greater than the amount required under existing flow objectives is extensively documented in the SWRCB's report on public trust flow criteria for the Delta ecosystem (SWRCB, 2010).

However, we are concerned that the draft narrative objective is too imprecise and broad to ensure full protection of beneficial uses, and that beneficial uses outside of the February – June period are inadequately protected. In summary, we recommend the following changes to Table 3 and the Program of Implementation in Attachment 2 of the NOP:

- Specify that the flow rate for the February – June Vernalis objective be a designated percentage of unimpaired runoff (including an initial rate and an adaptive range).
- Specify the initial flow rate and the adaptive range based on the best available scientific information for protecting fish and wildlife beneficial uses.
- Include specific biocriteria for steelhead, Sacramento splittail, and green and white sturgeon, and additional biocriteria for fall run Chinook salmon in the narrative objective.
- Clarify the relationship between flow conditions and other measures for purposes of adaptive management of the flow rate in the objective.
- Include an objective for July – January period base flows.

<u>February – June narrative objective: enforceability</u>

The NOP proposes to require more flow of a more natural pattern by converting the existing numeric Vernalis flow objective to a narrative objective. We strongly support the proposal to link Vernalis flows to the unimpaired hydrology of the San Joaquin River basin as this will ensure that flow patterns are closer to the natural pattern in terms of their timing, duration, and frequency. Establishing a continuous-fraction-of-unimpaired flow criteria, as opposed to the current discrete, step-function regulation will also improve the reliability of fresh water flows for all beneficial uses as they will not be subject to large discontinuities associated with small changes in annual hydrology (e.g., those between year-types). Narrative objectives in a water quality control plan are legally enforceable and may be appropriate to complement numeric objectives in order to provide fuller protection of beneficial uses. We are concerned, however, that the NOP's proposed narrative objective is too broadly defined and imprecise to be practicably enforceable.

First, the narrative objective would "maintain *flow conditions*… sufficient to support and maintain the natural production of viable native San Joaquin River watershed fish populations migrating through the Delta" (NOP, Attachment 2, p. 1, emphasis added). We believe this vague objective must be made more precise by specifying the flow conditions to be achieved and complied with.. Therefore, the Vernalis flow objectives should specifically be amended from a cfs flow rate by water year type to a percentage of unimpaired runoff flow rate from the San Joaquin basin. This flow rate should be expressed as a specific designated percentage, potentially with an adaptive range around that percentage. The runoff percentage flow rate could either be directly included in the narrative objective along with biocriteria, or separately expressed as a numeric objective in the Plan whose adaptive range is linked to attainment of the narrative objective's biocriteria (see below), but it must be specifically included as part of the Vernalis flow objectives.

Assuming implementation of the Vernalis objective involves an adaptive range, then the "starting gate" or initial condition should be determined by the best available scientific evidence currently available regarding flow needs of beneficial uses and public trust resources affected by Vernalis inflows (see SWRCB 2010 and TBI 2010b). If the SWRCB considers adopting a percentage value less protective than the 2010 public trust flow criterion, then it should describe in detail the basis for doing so, specifically the balancing aspects it is taking into consideration, the anticipated impact to the Public Trust, and provide for adequate review and comment on those aspects. Similarly, moving to a lower value in the adaptive range must not allow the occurrence of flow conditions that are detrimental to beneficial uses. Some boundary conditions for setting the adaptive range floor are discussed below.

Second, the narrative objective would "maintain flow conditions…sufficient to support and maintain the *natural production of viable native San Joaquin River watershed fish populations migrating through the Delta*" (NOP, Attachment 2, p. 1, emphasis added). This broad goal (and its articulation in the third and fourth sentences of the draft objective), while sufficient as the foundation for the objective, needs to be translated into a set of specific, measurable, attainable, time-bound, and enforceable biocriteria, such as the criterion for doubling of natural (fall-run) Chinook salmon production in the second sentence. The narrative objective can and should include biocriteria for other salmonids and other species as specific as the salmon doubling criterion. More detailed recommendations for biocriteria to be included in the narrative objective are described below and the underlying analytical framework is discussed in Attachment 1.

Third, the narrative objective would "maintain flow conditions… together with *other reasonably controllable measures* in the San Joaquin River Watershed" (NOP, Attachment 2, p. 1, emphasis added). This phrase, repeated elsewhere in the draft objective, is unacceptably vague. The best available scientific evidence indicates that flow conditions are the single most important driver of ecological conditions in the estuary (IEP 2010; DFG 2010; USDOI 2010; SWRCB 2010, TBI 2010a-d *and sources cited therein*), but there exist multiple stressors other than hydrologic alteration that do or may affect protection of beneficial uses in the Bay-Delta system. Other stressors include low dissolved oxygen in the Stockton Deepwater Ship Channel; loading of selenium, pesticides, and other contaminants from agricultural and muncipal run-off; and lack of available shallow channel or floodplain habitats. Given the dire status of fish and wildlife resources in the estuary, both the SWRCB and other responsible parties should take actions to reduce or eliminate the effects of these other stressors, even when evidence of those effects is limited. However, the relationship between improving flow conditions and relying on other measures in implementing this objective is extremely unclear and may make it more difficult to achieve.

The narrative objective should properly focus on flow conditions alone, but should explicitly state that the best scientific information will be used to evaluate the relative effect of implementing these flow rates against the relative effect of other reasonably controllable measures in the San Joaquin River Watershed in achieving the biocriteria identified in the objectives in order to adjust the flow rate within the adaptive management range in the future. The program of implementation should describe the process by which the SWRCB will collect and evaluate this information, and how it will be used to modify the flow rate within the adaptive range. In evaluating these non-flow measures, it is critical to develop very clear linkages between the measures, the stressors they are designed to alleviate and the projected outcomes of the measure (e.g. how much of a contribution are they expected to make towards reduction of a stressor). Applying the logic chain framework described in Attachment 1 to the SWRCB's evaluation of flow and non-measures will provide a clear articulation of how actions are intended to result in attainment of goals and objectives. Because flow objectives address many stressors simultaneously, it is extremely important to demonstrate the efficacy of other measures to provide the full range of benefits associated with flow conditions before assuming that flow rates can be modified in exchange for physical habitat or water quality improvements. Attachment 1 provides some guidance for evaluating the relative effects of different actions and their potential interchangeability.

February – June narrative objective: biocriteria

As previously noted above, the proposed narrative objective should be anchored in clear and measurable biocriteria. In this section, we propose an expanded set of biocriteria using the "logic chain" framework developed by TBI and American Rivers for use in other planning processes (see TBI Attachment 1), and address how the SWRCB could develop additional criteria.

Problem Statement: Numerous fish and wildlife elements of the public trust have been in serious decline over the period in which accurate records have been kept, including a particularly steep decline to record low levels in recent years. In addition, ecosystem processes (transport of nutrients and food items from the San Joaquin River basin to the Delta; provision of migratory corridors for various fish species; loss of spawning and rearing habitat; contaminant flushing) have been compromised within the lower San Joaquin River and south Delta.

Goals

- Re-establish viable populations of native fish species (including some that have been completely eliminated in recent times, i.e., spring run Chinook salmon and green sturgeon) to the San Joaquin basin. Viable populations are those that have sufficient abundance, spatial distribution, life history diversity, and productivity to withstand natural (uncontrollable) environmental variability and still support public trust values.
- Restore ecosystem processes that support viable populations and provide the functions associated with an ecosystem that serves the public trust, such as transporting food and nutrients to downstream habitats in a way that enhances productivity of the estuarine ecosystem, etc.

Fall run Chinook salmon objectives (biocriteria) – The CVPIA doubling goal for fall run Chinook salmon serves as a central objective linked to the goal of reestablishing populations of native fish species to the San Joaquin drainage. Abundance is one of four key attributes of viability identified by NMFS for assessing the conservation status of salmonid fishes (McElhaney et al 2000; Lindley et al. 2007) and is therefore relevant to the goal of establishing viable populations of native fishes; the target of production equal to or greater than twice the average seen during the 1967-1991 period is appropriate as it is specific, easily measured, established in existing policy, and attainable even in recent times (Figure 1).

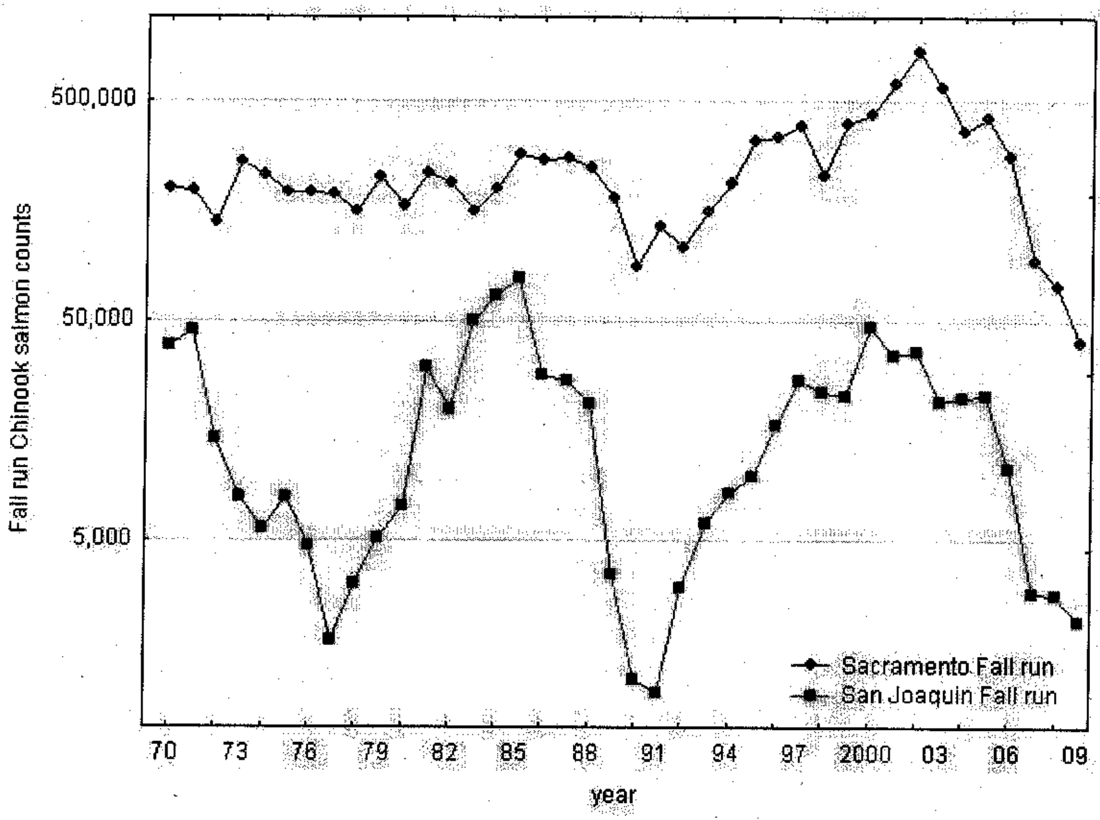

Figure 1: Fall run Chinook escapement for Sacramento and San Joaquin systems, 1970-2009. Escapement is less than production. The CVPIA calls for a doubling of 1967-1991 production. This corresponds to a production objective for SJR fall run Chinook salmon of 78,000 fish/yr

The NOP states that full compliance with the narrative objective will be achieved by the completion of the FERC proceedings on the Merced and Tuolumne Rivers, or no later than 2020. This statement should be applied not only to full compliance with the objective's flow conditions, but also to the salmon doubling biocriterion.

There are other biocriteria that should be considered for fall run. For instance, maintaining or improving the spatial diversity of fall run Chinook salmon in the Central Valley is critical to maintaining the viability of this population (and thus its public trust value). Although the fall run Chinook salmon currently spawn in the San Joaquin, maintaining and increasing this population in the San Joaquin is important to maintaining the population's viability in the Central Valley as a whole because it insulates this economically important population from catastrophic events that may occur in the breeding, rearing and migration areas of the Sacramento River basin. Given the threats posed to Central Valley salmonids by global climate change and the ability of the San Joaquin watershed to serve as a refuge for these fish during warmer periods (due to longer retention of snowpack in the southern Sierra Nevada range), restoration and maintenance of Chinook salmon spawning, rearing, and migration conditions in the San Joaquin will contribute to maintenance of the spatial extent characteristic of viable populations – and is therefore, an essential component of the larger effort to maintain the Central Valley's public trust values.

Furthermore, to fully protect the SJR fall run of Chinook salmon, the State Board must identify actions that will support or improve natural patterns of life history diversity among these fish and critical thresholds of population productivity. Maintenance and expansion of suitable migration periods towards historical norms for the fall run Chinook salmon are vital to restoring the life history diversity of this migratory fish. When salmonid migrations are constrained to a narrow window of time (and particularly, when that narrow window occurs on the same calendar dates year after year), natural variation that supports salmonid population viability is also constrained. Chinook salmon success in the Central Valley probably depends on maintenance of a wide range of migration timing and size at migration to ensure that migrants (upstream and downstream) encounter conditions suitable for supporting the next life stage (e.g. Miller et al. 2010; Williams 2006; Quinn 2005). Also, the State Board should establish conditions that maintain Chinook salmon productivity in the San Joaquin River basin so that these fish can capitalize on good environmental conditions and recover from periods of poor environmental conditions. Conditions that encourage population growth and a minimum frequency with which those conditions recur can be defined in addition to ultimate population abundance targets.

Biocriteria for other species --The narrative objective should also, to the extent possible, identify biocriteria associated with (at a minimum) the maintenance of population viability for other fish and wildlife species that use, or historically used, the lower San Joaquin River as either a spawning ground, rearing habitat, migration corridor or a combination of these. Such species include steelhead, Sacramento splittail, and both green and white sturgeon. By specifying the viability requirements of these species within the Central Valley as a whole and the San Joaquin in particular, the SWRCB may identify additional periods, magnitudes, frequencies, and durations of freshwater flow and/or other controllable actions that are necessary to fully protect the public trust. The same applies to attributes of ecosystem function.

Steelhead – Central Valley Steelhead are federally listed as endangered; the species has historically supported an important sport fishery in the Central Valley. These fish were previously numerous throughout the Central Valley, but development of impassable dams eliminated access to most of their historic spawning habitats (McEwan 2001; Lindley et al. 2006; NMFS 2009). Restoring viable populations of steelhead to the San Joaquin basin would simultaneously increase the abundance and spatial extent of this species within the Central Valley (Lindley et al. 2006; NMFS 2009). Steelhead life histories are notoriously responsive to environmental conditions (Quinn 2005); it is likely that providing reliable habitat for steelhead throughout most of their migration period would also support maintenance of life history diversity in this species. Provision of flows and other improvements to the San Joaquin River in support of steelhead migrations would make a major contribution to the conservation and recovery of this valuable species.

Therefore, flow conditions should be maintained to support an abundance target of 10,000 in the San Joaquin basin; to support distribution of spawning steelhead in the upper San Joaquin River and at least two of its major tributaries (Lindley et al. 2006; NMFS 2009), with a minimum population of 2,500 adults/year in these tributaries and to ensure that steelhead adults and juveniles are able to migrate to/from spawning and rearing habitats through the lower San Joaquin River throughout all or most of their historic migration season (January-June, for juveniles; late August-November, for spawning adults). These objectives are quite achievable as McEwan (2001) estimated that the Central Valley population historically numbered between 1-2 million steelhead annually and that returns were as high as 40,000 fish as recently as the 1960s. These fish were distributed in numerous populations throughout the San Joaquin River valley (Lindley et al. 2006; NMFS 2009) – remnant steelhead are still detected in a variety of waterways within the San Joaquin drainage (McEwan 2001).

Sacramento Splittail – An important recreational fishery relies on Sacramento splittail (Moyle 2002). These fish are also an important prey item for piscivorous fish; increased production of Sacramento splittail would be expected to bolster the food web that supports predatory game and non-game fish in the Delta (Kratville 2008). Splittail objectives for the lower San Joaquin River should include the frequency of years in which successful spawning and migration occurs in the lower San Joaquin River. Such actions will contribute to the abundance, productivity, and spatial distribution of Sacramento splittail in the Central Valley.

Therefore, flow conditions should be maintained to support significant and successful spawning of Sacramento splittail in the San Joaquin basin at least once every three years, on average, including successful emigration of juveniles and adults from spawning grounds in the San Joaquin River to the lower Estuary. Here "significant and successful spawning" means spawning on a floodplain (as opposed to limited spawning that may occur in channel margin habitats) as evidenced by detection of large numbers of emigrating Sacramento splittail juveniles in the lower San Joaquin River over the course of more than one week.. Sacramento splittail typically produce extremely large numbers of offspring (in the millions) when conditions suitable to spawning exist on an inundated floodplain. The fish and wildlife trustee agencies (CDFG and USFWS) should be tasked with defining a performance metric that can discriminate between a significant and successful spawning event and the more limited spawning that periodically occurs in channel edge habitats, The former kind of spawning event is critical to recover and then sustain a viable spawning population of Sacramento splittail in the lower San Joaquin River and is the type of event that the State Board's flow regulations should seek to promote.

Green and white sturgeon – Both the green and white sturgeon have supported recreational fisheries in the recent past. Providing migration access to the San Joaquin River for these species will contribute to their viability through increases in their spatial extent, abundance, and potentially, to maintenance of their life history diversity in the Central Valley. It is believed that both native species of sturgeon spawned in the San Joaquin basin historically; certainly, there is no known reason why sturgeon would not utilize habitats in the basin that are similar to those they are known to use in the Sacramento Basin (Israel and Klimley 2008; Israel et al. 2009). With respect to white sturgeon, the DRERIP life history conceptual model stated:

> "…It is strongly suspected that the San Joaquin River supported a larger spawning population [of white sturgeon] than at present, prior to the upstream diversion of its flow for agricultural irrigation (Schaffter 1997). In the San Joaquin River, spawning adults have been captured between Mossdale and the Merced River confluence in late winter and early spring (Kohlhorst 1976) [Israel et al. 2009:10].

Therefore, flow conditions should be maintained to promote successful spawning by green sturgeon and white sturgeon in the San Joaquin basin at least three times (three different years) within the each twenty year period. Spawning success may be determined by presence of YOY sturgeon in traditional fish sampling programs in the San Joaquin drainage or through analysis of bone (e.g. otolith) microchemistry/isotopes (e.g. Weber et al. 2002) that identify the San Joaquin or its tributaries as the natal stream for older juvenile or mature sturgeon.

February – June narrative objective: starting gate (initial flow rate)

The "starting gate" or initial condition should be determined by the best available current scientific evidence regarding flow needs of beneficial uses and public trust resources affected by Vernalis inflows (see SWRCB 2010 and TBI 2010b). In this section we summarize the most relevant information for setting the initial percentage of unimpaired runoff flow rate. For more detailed discussion see SWRCB 2010, TBI 2010, DFG 2010; and USDOI 2010.

Fall-run Chinook salmon

Productivity – To attain the San Joaquin fall-run Chinook salmon doubling biocriterion, the fall-run population must grow substantially. In TBI 2010b, we identified flows that had resulted in population growth (measured as a Cohort Replacement Rate (CRR) >1.0) in the past. March-June Vernalis flows of approximately 4600 cfs corresponded to an equal probability for positive population growth (CRR>1.0) or negative population growth (CRR<1.0). Detailed review of CRR data showed that in 84% of years with average March-June flows greater than or equal to 5000 cfs, the CRR was greater than 1.0 (positive population growth), while in 66% of years with average March-June flows less than 5000 cfs, the CRR was less than 1.0, indicating a population decline. Springtime flows of approximately 5000 cfs appear to represent an important minimum threshold for success of salmon in the San Joaquin Basin. In order to achieve the doubling goal within any reasonable time frame, population growth must occur in each generation. As a result, the absolute minimum initial flow rate should be set at a level that supports positive population growth_in every year (i.e. flows ≥5000cfs in all weeks of April and May) until the abundance target is met. These minimum, base migration flows, will be supplemented in most years by additional pulse flows (of shorter duration) that provide additional migration and rearing benefits and are generally necessary to support the larger populations envisioned by the CVPIA and SWRCB.

Abundance—The Anadromous Fish Restoration Program identifies San Joaquin River basin production of 78,000 fall-run Chinook salmon/year[1] as doubling of production in that occurred in the period 1967-1991 (AFRP 200; Final Restoration Plan, Appendix B-1). In order to attain this threshold, the initial flow rate should include adequate spring outmigration flows during the fall-run juvenile migration period (March – June). In our previous analysis (TBI 2010b), we found that springtime flows >10,000cfs corresponded to historic population abundances similar to those anticipated by the doubling objective. Flows >10,000 cfs that occur for at least two weeks during the juvenile migration period in at least 80% of years are likely to be the minimum necessary to support the abundance target identified by CVPIA and the State Board. The duration of such flows should increase progressively under wetter conditions (TBI 2010b; Table 1).

In addition, because fall-run Chinook salmon benefit substantially from residence on inundated floodplains, the initial flow rate should include flows that frequently inundate San Joaquin floodplains during the fall run juvenile migration period, specifically, flows that exceed 25,000cfs for at least two weeks in 60% of years (and for longer periods during wetter years).

Table 1 (from TBI 2010b) summarizes the flow needs that should be addressed in developing an initial percentage of unimpaired runoff flow rate.

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[1] Production includes losses in the ocean and sport fisheries; in any year where fishing occurs, production is greater than "escapement" which measures the number of fish that return to the spawning grounds.

Table 1. Schedule of springtime Delta inflows from the San Joaquin River recommended to protect public trust resources.

Frequency (% of years)	**July-February kcfs**	**March kcfs** (cells show 1st and 2nd parts of month)		**April kcfs** (cells show 1st and 2nd parts of month)		**May kcfs** (cells show 1st and 2nd parts of month)		**June kcfs** (cells show 1st and 2nd parts of month)		**Duration enhanced outmigration flow period (days)**	**Average flow during enhanced outmigration flow period**
	Recommended Flow (kcfs)										
100% (all years)	2	2	2	5	5	5	5	2	2	31	5
80% (dry years)	2	2	2	5	10	7	5	2	2	45	7
60% (below normal years)	2	2	2	20	10	7	5	2	2	60	11
40% (above normal years)	2	2	5	20	20	7	7	2	2	75	12
20% (wet years)	2	2	5	20	20	20	7	7	2	90	13

Sacramento splittail

The upper extension of the Sacramento spllittail range in the San Joaquin is to Mud Slough (river kilometer 201; Kratville 2008). The timing of migration of juveniles to downstream habitats varies from year to year (depending on when spawning occurred and other environmental conditions) but generally lasts into July. Specific attributes and thresholds of suitable habitat for riverine stages of Sacramento splittail are documented in papers summarized by the life history conceptual model developed for CDFG's Delta Regional Ecosystem Restoration Implementation Program (DRERIP; Kratville 2008).

The Vernalis objectives should include flows to support Sacramento splittail spawning, rearing, and migration to/from spawning habitats in the lower San Joaquin River. This would include requiring sufficient flows to inundate critical spawning and rearing habitats for a minimum of 30-45 days during the spawning period (Sommer et al. 2002; Feyrer et al. 2006), and flows sufficient to maintain a migration corridor in the lower San Joaquin River for juvenile and adult splittail that return to downstream habitats. As splittail are relatively long-lived, it is not necessary (or practicable) for flows of this magnitude to occur every year, but the flow objectives should ensure the frequency for flow events of this magnitude such that a significant splittail spawning event (i.e., one associated with sufficient inundation of a floodplain) occurs in the San Joaquin River basin least once every Sacramento splittail generation (i.e. ~3 years; Kratville 2008).

Sacramento splittail migrate to potential spawning habitats (floodplains or channel margins) starting in late November. Spawning is highly dependent on the presence of high flows that inundate shallow habitat; it may begin as early as February and usually ends by April (Kratville 2008). Year class success is strongly associated with the duration and extent of floodplain inundation during the spring (Moyle 2002; Sommer et al. 2002; Moyle et al. 2004; Feyrer et al. 2006). Spawning currently occurs in the San Joaquin River when flows are sufficient to inundate relict floodplains. TBI (2010b) identified flows expected to produce inundation of floodplains and other spawning habitats in the lower San Joaquin River:

> For floodplain inundation, we found that, under existing channel conditions, flows of approximately 20,000-25,000 cfs at Vernalis were necessary to trigger substantial floodplain inundation. A review of the stage discharge curve at the Vernalis gauge combined with an evaluation of topographic maps adjacent to the river indicated that a flow of a minimum of 20,000 cfs and as much as 25,000 cfs is necessary to achieve broad scale inundation of floodplain along the San Joaquin River between Vernalis and Mossdale. [TBI 2010b; p.18]

Inundation and connectivity to the river environment must be maintained for at least ~30 days in order for benefits to Sacramento splittail to develop; therefore, we recommended flows that produce inundations that would last at least 30 – 45 days of functional floodplain habitat. Also, river inflows must not only overtop riverbanks but also be sufficient to maintain desired flow conditions within the area of inundated floodplain for 1 – 3 months.

Green and white sturgeon

Productivity – The productivity of both sturgeon populations is positively correlated with river flows (DFG 2010; Israel and Klimley 2008; Israel et al. 2009 *and sources cited therein*). Both species are believed to have spawned in the San Joaquin River Valley historically. Regarding green sturgeon Israel and Klimley (2008) wrote:

> Southern DPS green sturgeon likely spawned in the Sacramento, Feather, and San Joaquin rivers, judged upon the characteristics of the local habitats (Adams et al. 2007). Historic flows in these rivers during the upstream migration period occurring from March through July included increasing flows during winter rainstorms and spring melting of the snowpack. These flow increases enabled green sturgeon to migrate into the upper portions of these rivers with reaches characterized by high velocity flows and coarse river bed surfaces. Current flow management may inhibit the return of green sturgeon to the Sacramento River and Bay-Delta estuary by restricting seasonal flow necessary as cues for spawning and misdirection of juveniles during their outmigration. [Israel and Klimley 2008: 16].

White sturgeon adults begin their spawning migrations as early as November and spawn between February and May (Israel et al. 2009) and the green sturgeon migration period also begins in February though it may extend through July (Israel and Klimley 2008). The DRERIP conceptual models for green and white sturgeon suggest that flows near their spawning grounds in the neighborhood of ~20,000 cfs are the minimum necessary to produce strong recruitment of age-0 sturgeon in the Sacramento River drainage. This implies a relatively high level of flow must occur downstream in order to attract sturgeon to migrate upstream to spawn. River flows reportedly cue spawning, as no spawning was detected at Sacramento River flows <180 m^3/s (≈ 6,400 cfs) near Colusa). In addition, white sturgeon stopped their upstream migration and drifted downstream when Sacramento River flows dropped below 150 m^3/s (≈ 5,300 cfs) near Colusa (Schaffter 1997, cited in DFG 2010 and Israel et al. 2009). Because sturgeon are iteroparous (spawn in multiple years) and facultative spawners, it is highly unlikely that these fish would initiate spawning migrations in response to flows significantly less than those required upstream for spawning.

During the November – May period, fresh water flows in excess of 6400 cfs (180 m^3/s) should be provided for at least one month to stimulate sturgeon spawning migrations in the San Joaquin River. In years where these sturgeon attraction flows occur, flows that support spawning (>20,000 cfs) should be provided for at least one month between April and June following provision of the attraction flows. Sturgeon are very long-lived and do not reach sexual maturity until ~14 years of age. These sturgeon migration and spawning flows should occur at least once every 7 years (twice a generation). This frequency will assure that Central Valley sturgeon populations are represented by several age classes in the wild and insulate them from environmental conditions that may cause the failure of any one year-class.

February – June narrative objective: limits to adaptive range

We support the concept of an approach based on requiring a percentage of unimpaired runoff to provide more flow using more natural flow patterns, and the concept of an adaptive management range, but recognize that there are biological thresholds that must always be met to prevent mortality, impassable barriers to fish migration, consistent negative population growth, and other problems. Below we identify numerous flow-related life history requirements of fish and wildlife species that must be exceeded under all conditions. The lower limits of the adaptive range must always exceed these flow requirements.

Fall-run Chinook salmon

Productivity - To provide adequate temperatures in the lower San Joaquin River/southern Delta that avoid lethal effects and increase outmigration success of juvenile Chinook salmon and steelhead, the State Board should provide flows sufficient to provide average daily water temperatures of 65°F (18.3°C) or lower on all days from April 1 through May 31 in the lower San Joaquin River in all years. In our analyses (TBI 2010b) we found that flows ≥5000 cfs were likely to provide these conditions.

Spatial extent -- Persistent low DO conditions in the lower San Joaquin River produce migration barriers that limit the spatial extent of fall run Chinook salmon and other migratory fish in this system. Inflows of less than 2,000 cfs contribute significantly to low DO concentrations in the lower San Joaquin River (Van Nieuwenhuyse 2002; see Figure 2 below). Although management of other variables in addition to flow will be necessary to completely alleviate this problem, Jassby and Van Nieuwenhuyse (2005) found that: "[r]iver discharge has had the biggest impact … on hypoxia"; their modeling demonstrated that increased management of other important factors would be far less effective without improvement of freshwater flows in this area. San Joaquin River inflows during the February – June period of the narrative objective (and at all other times) should exceed 2,000 cfs to limit or eliminate migration impairment for migratory fish species.

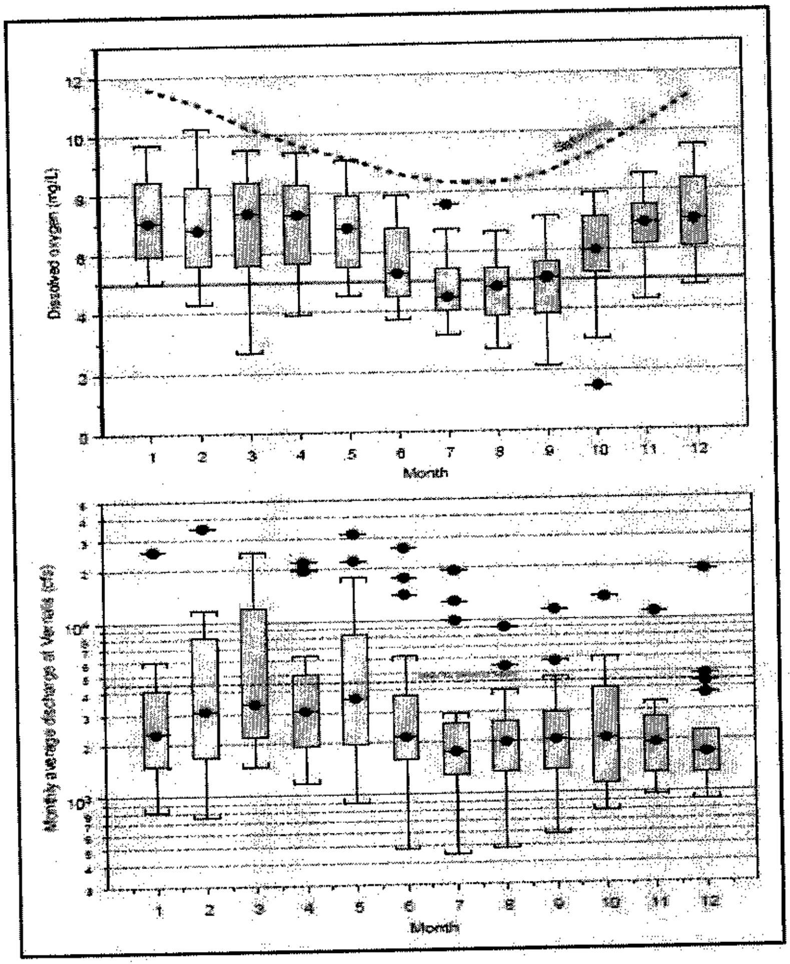

Figure 2: Top panel: *Fig. 2 from Van Nieuwenhuyse, E. E. 2002.* Box plot of summary statistics for monthly average values of daily minimum dissolved oxygen in the ship channel at the Rough and Ready Island continuous monitoring station (DOmin), 1983-2001 (n=19/month).
Bottom panel: *Fig. 6 from Van Nieuwenhuyse, E. E. 2002.* Box plot of summary statistics for monthly average discharge in the San Joaquin River near Vernalis (Qvern), 1983-2001.

July – January flow objectives

Fall-run Chinook salmon, green and white sturgeon

Spatial extent – As noted above, persistent low DO conditions in the lower San Joaquin River produce migration barriers that limit the spatial extent of fall run Chinook salmon and steelhead in this system. Inflows of less than 2,000 cfs contribute significantly to low DO concentrations in the lower San Joaquin River (Van Nieuwenhuyse 2002). Year-round San Joaquin River inflows should generally exceed 2,000 cfs to limit or eliminate migration impairment for migratory fish species. Specifically to promote adequate spatial distribution of fall run Chinook salmon (i.e. in the San Joaquin River and its tributaries), the average weekly flows should exceed 2,000 cfs in all weeks of all years during the San Joaquin River fall run Chinook salmon upstream migration period (October-December).

Water quality is also likely to impair sturgeon migrations upstream and downstream within the San Joaquin River drainage. Specifically, both sturgeon species are highly sensitive to low dissolved oxygen conditions (Israel and Klimley 2008; Israel et al. 2009 *and sources cited therein*) and low dissolved oxygen levels in the Stockton Deepwater Ship Channel are believed to inhibit sturgeon migrations into and out of the San Joaquin watershed (CVRWQCB and CBDA 2006). Flows and other actions necessary to increase dissolved oxygen levels in the lower San Joaquin River above minimum thresholds have been determined (Jassby and Van Nieuwenhuyse 2005). Inflows of less than 2,000 cfs are the largest contributor to low DO concentrations in the lower San Joaquin River. Year-round San Joaquin River inflows should exceed 2,000cfs. At a minimum these flows are required in months when adult sturgeon migration is desired and during August through March in the two years (juveniles rear in their natal rivers for 1 to 2 years) following such spawning migrations when juvenile emigration from the San Joaquin would occur.

Steelhead

Juvenile steelhead rear in freshwater for a year or longer. As a result, these fish require freshwater flow volumes and quality that can support them throughout the year, particularly in the higher elevation waterways where these fish spawn and rear. Adult migration can last from late August through early November (McEwan 2001; Williams 2006). During this period, low DO conditions in the lower San Joaquin River may impede adult migration success. Inflows of less than 2,000 cfs are the largest contributor to low DO concentrations in the Stockton Deepwater Ship Channel (Jassby and Nieuwenhuyse 2005).

As with Chinook salmon, pulse flows are likely to provide the cues necessary to attract adult steelhead to the San Joaquin River. Because of their extended migration period, the Vernalis flow objectives should include attraction pulse flows (of the magnitude already identified for fall run Chinook salmon) for steelhead that occur for several weeks between late August and early November. In order to maximize support for different life histories, these migration pulse flows should not occur in the same narrow time window every year.

Sacramento splittail

Prior to the winter – spring spawning period, the Vernalis objectives should include flows sufficient to attract spawning adult Sacramento splittail from November through January.

Table 2 summarizes the recommended flows discussed above that should be used to determine the initial flow rate and adaptive range for the February – June narrative objective and to establish other objectives for the July – January period.

TABLE 2: GUIDANCE FOR SETTING VERNALIS FLOW OBJECTIVES (in cfs). Months in parentheses indicate the period when these flows will serve the objective; see text for applicable durations of these flows that are desirable. In order to meet objectives, these flows should occur every year, except where noted.

		Season			
Source	Goal	Winter	Spring	Summer	Fall
TBI	Steelhead spatial distribution and life history diversity			> 2000 (Aug-Nov)	
TBI	Steelhead spawning recruitment			3600 (Aug-Nov) pulse flow	
TBI	Splittail spawning[2]		25,000 (Feb-April)		
DFG	Splittail recruitment[3]		Continuous inundation (30 days, Mar-May)		
TBI	Sturgeon spawning recruitment[4]	>6400(Nov-Apr)	20,000 (Feb-July)		
TBI	Hypoxia prevention (Steelhead, sturgeon)	> 2000			
TBI	Salmon productivity		> 2000 (Feb-June) > 5000 (Apr-May)		
TBI	Salmon Doubling[5]		> 10,000 (Mar-Jun, 2 weeks)		
DFG	Salmon Doubling[6]		7000-15,000 (Mar-Jun)		
TBI	Floodplain inundation (salmon, Sacramento splittail)[7]		> 25,000 (>1 month)		
TBI	Temperature maintenance (salmon)		5000 (Apr-May)		
TBI	Minimum low flow			> 2000 (July-January)	
SWRCB	Delta flow criteria	"60% of unimpaired flow from February through June… to achieve": >5000 (in most years), >10,000 (in 45% of yrs.)			
SWRCB	Delta flow criteria				3600 (Oct., pulse flow)

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[2] Should occur at least once every three years.
[3] Should occur at least once every three years.
[4] Should occur at least once every seven years
[5] See Table 1 for periodicity
[6] See Table 1 for periodicity
[7] See Table 1 for periodicity

Conclusion: proposed language for Attachment 2, Table 3 of the NOP

February – June Vernalis flow objective:

Maintain a percentage of unimpaired runoff[8] *from the San Joaquin River watershed to the Delta at Vernalis sufficient to support and maintain the abundance, spatial extent or distribution, genetic and life history diversity, migratory pathways, and productivity of native San Joaquin River watershed fish populations migrating through the Delta. Specifically, this flow rate shall be maintained sufficient to support a doubling of natural production of fall-run Chinook salmon from the average production of 1967-1991, consistent with the provisions of State and federal law; sufficient to support abundance, distribution and migration habitat of steelhead*[9]*; sufficient to support successful and significant spawning*[10] *of Sacramento splittail; and sufficient to support successful green and white sturgeon migration and spawning*[11]*.The best scientific information will be used to adjust the flow rate within the adaptive management range to better achieve the biocriteria identified in the objective and to evaluate the relative effect of implementing this objective against the relative effect of other reasonably controllable measures in the San Joaquin River Watershed toward achieving the biocriteria.*

July – January Vernalis flow objective:

Minimum average flow rate of 2,000 cfs in all years

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[8] Defined as between XX% and YY%, with an initial value of ZZ%.

[9] Defined as average annual abundance of 10,000; distribution in the mainstem San Joaquin River and at least two tributaries with populations at low risk of extinction; and adequate migratory habitat for juveniles during the outmigration period.

[10] Defined as detection at least once in every three years of the density of emigrating Sacramento splittail juveniles over a duration that would indicate a successful floodplain spawning event (performance criteria to be developed jointly by CDFG and USFWS).

[11] Defined as at least three times in once every 7 years.

Thank you for the opportunity to provide comments on the NOP. We look forward to working with you to identify, adopt and implement much needed improvements in protection for the Bay-Delta estuary.

Sincerely,

Gary Bobker Program Director The Bay Institute	John Cain Conservation Director American Rivers

REFERENCES

California Department of Fish and Game (CDFG). 2005. San Joaquin River salmon population model. SWRCB SJR Flow Workshop Sept. 17, 2008. Marston, D. and A. Hubbard. Available at: http://www.waterrights.ca.gov/baydelta/docs/sanjoaquinriverflow/dfgpresentation_salmon.pdf

California Department of Fish and Game (CDFG). 2010. Exhibit DFG-1: Effects of Delta Inflow and Outflow on Several Native, Recreational, and Commercial Species. Prepared for the Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem Necessary to Protect Public Trust Resources Before the State Water Resources Control Board.

Central Valley Regional Water Quality Control Board and California Bay Delta Authority (CVRWQCB and CBDA) 2006. Dissolved oxygen concentrations in the Stockton Deep Water Ship Channel: Biological and ecological effects model. Available at: http://www.sjrdotmdl.org/concept_model/bio-effects_model/lifestage.htm

Feyrer, F., T. Sommer and W. Harrell, 2006. Managing floodplain inundation for native fish: production dyanmics of age-0 splittail (*Pogonichtys macrolepidotus*) in California's Yolo Bypass. Hydrobiologia 573:213-226.

Interagency Ecological Program (IEP). 2010. Interagency Ecological Program 2010 Pelagic Organism Decline Work Plan and Synthesis of Results. Prepared by: Randall Baxter (DFG), Rich Breuer (DWR), Larry Brown (USGS), Louise Conrad (DWR), Fred Feyrer (USBR), Stephanie Fong (CVRWQCB), Karen Gehrts (DWR), Lenny Grimaldo (USBR), Bruce Herbold (USEPA), Peter Hrodey (USFWS), Anke Mueller-Solger (DSC), Ted Sommer (DWR), and Kelly Souza (DFG). December 6, 2010.

Israel, J.A., A. Drauch, and M. Gingras. 2009. Life History Conceptual Model White Sturgeon (*Acipenser transmontanus*). Developed for the Sacramento-San Joaquin Delta Regional Ecosystem Restoration Implementation Plan. Available at: http://www.essexpartnership.com/wp-content/uploads/2010/10/WhiteSturgeon-_1_.pdf

Israel, J.A., A. P. Klimley. 2008. Life History Conceptual Model North American Green Sturgeon (*Acipenser medirostris*). Developed for the Sacramento-San Joaquin Delta Regional Ecosystem Restoration Implementation Plan. Available at: http://www.essexpartnership.com/wp-content/uploads/2010/10/GreenSturgeon-_1_.pdf

Jassby, A. D. and E. E. Van Nieuwenhuyse. 2005. Low dissolved oxygen in an estuarine channel (San Joaquin River, California): Mechanisms and models based on long-term time series. San Francisco Estuary and Watershed Science 2:1–33.

Kratville, D. 2008. Final Species Life History Conceptual Model Sacramento Splittail (*Pogonichthys macrolepidotus*). Developed for the Sacramento-San Joaquin Delta Regional Ecosystem Restoration Implementation Plan. Available at: http://www.essexpartnership.com/wp-content/uploads/2010/10/Splittail-_1_.pdf

Lindley, S.T., R.S. Schick, E. Mora, P.B. Adams, J.J. Anderson, S. Greene, C. Hanson, B.P. May, D.R. McEwan, R.B. MacFarlane, C. Swanson, and J.G. Williams. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin basin. San Francisco Estuary and Watershed Science 5(1): [Article 4].

Lindley, S.T., R. S. Schick, A. Agrawal, M. Goslin, T.E. Pearson, E. Mora, J.J. Anderson, B. May, S. Greene, C. Hanson, A. Low, D. McEwan, R.B. MacFarlane, C. Swanson, and J. G. Williams. 2006. Historical population structure of Central Valley steelhead and its alteration by dams. San Francisco Estuary and Watershed Science 4(1) Article 3.

McElhany, P., M. H. Rucklelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. NOAA Technical Memorandum NMFS-NWFSC-42.

McEwan DR. 2001. Central Valley steelhead. In: Brown RL, editor. Fish Bulletin 179. Contributions to the biology of Central Valley salmonids. Vol. 1. Sacramento (CA): California Department of Fish and Game. p 1–43.

Moyle, P.B. 2002. Inland fishes of California. University of California Press. Berkeley, CA.

Moyle, P. B., R. D. Baxter, T. R. Sommer, T. C. Foin and S. A. Matern, 2004. Biology and population dynamics of Sacramento splittail (*Pogonichthys macrolepidotus*) in the San Francisco Estuary: a review. San Francisco Estuary and Watershed Science 2:article 3.

Miller, J.A. A. Gray, J. Merz. 2010. Quantifying the contribution of juvenile migratory phenotypes in a population of Chinook salmon (*Oncorhynchus tshawytscha*). Marine Ecology Progress Series 408: 227–240.

Quinn, T.P. 2005. The behavior and ecology of Pacific salmon and trout. University of Washington Press. Seattle, WA.

Sommer, T., L. Conrad, G. O'Leary, F. Feyrer, and W. Harrell. 2002. Spawning and rearing of splittail in a model floodplain wetland. Transactions of the American Fisheries Society 131: 966-974.

State Water Resources Control Board. 2010. Development of Flow Criteria for the Sacramento- San Joaquin Delta Ecosystem: Prepared Pursuant to the Sacramento-San Joaquin Delta Reform Act of 2009. Sacramento, CA.

The Bay Institute. 2010a. Exhibit TBI-1: Written Testimony Submitted to the State Water Resources Control Board Regarding Flow Criteria for the Delta Necessary to Protect Public Trust Resources – Analytical Framework. Prepared for American Rivers, The Bay Institute, Environmental Defense Fund, Natural Heritage Institute, and Natural Resources Defense Council.

The Bay Institute. 2010b. Exhibit TBI-3: Written Testimony Submitted to the State Water Resources Control Board Regarding Flow Criteria for the Delta Necessary to Protect

Public Trust Resources – Delta Inflows. Prepared for American Rivers, The Bay Institute, Environmental Defense Fund, Natural Heritage Institute, and Natural Resources Defense Council.

Van Nieuwenhuyse, E. E. 2002. Statistical Model of Dissolved Oxygen Concentration in the San Joaquin River Stockton Deepwater Channel at Rough and Ready Island, 1983-2001, Draft Technical Memorandum. Submitted to the San Joaquin Dissolved Oxygen TMDL Technical Advisory Committee. March 28, 2002, revised April 18, 2002.

Weber, P.K., I.D. Hutcheon, K.D. McKeegan, and B.L. Ingram. 2002. Otolith sulfur isotope method to reconstruct salmon (Oncorhynchus tshawytscha) life history. Can. J. Fish. Aquat. Sci. 59:587–591.

Williams, J.G. 2006. Central Valley Salmon: A Perspective on Chinook and Steelhead in the Central Valley of California. San Francisco Estuary and Watershed Science. Vol. 4 (3) http://repositories.cdlib.org/jmie/sfews/vol4/iss3/art2

THE BAY INSTITUTE

AMERICAN RIVERS

May 23, 2011, Comments To The State Water Resources Control Board Re: Revised Notice Of Preparation For Review Of Southern Delta Salinity And San Joaquin River Flow Objectives

ATTACHMENT 1:

A User's Guide to the Logic Chain

Note: The Logic Chain approach was originally developed by The Bay Institute and American Rivers to assist in the development of the Bay-Delta Conservation Plan (BDCP), and the following text, prepared for a BDCP audience, offers a summary of this approach. In our view, the Logic Chain approach also offers a useful framework that could be adapted with minimal effort to help address the complex issues and multiple processes associated with establishing, and adaptively managing implementation of, Water Quality Control Plan objectives in order to achieve desired outcomes for protection of beneficial uses and public trust uses.

Background and need

The San Francisco Bay-Delta and its watershed are home to numerous imperiled species, including (but not limited to) those that are officially protected by the federal or state Endangered Species Acts. The watershed is also the source for much of California's agricultural, municipal, and industrial water supply. Planning efforts to reconcile these two, often competing, demands are underway (e.g. BDCP).

The process of developing and implementing a plan that would allocate sufficient water and undertake other actions to meet these different needs is extremely complex. Restoration planning is complicated by the number and diversity of covered species, the physical complexity of the Delta, and uncertainty about the nature and strength of cause-effect relationships operating in this ecosystem. Furthermore, the ecosystem is changing in ways that are relatively well understood (e.g. sea level rise), incompletely understood (e.g. pelagic organism decline), and those that are unknown.

The Logic Chain architecture is designed to (1) standardize terminology used in the planning process, (2) increase clarity and specificity regarding expected outcomes of plan implementation (e.g. to allow evaluation of a conservation plan prior to its implementation), and (3) develop the inputs that will be necessary for a conservation plan's adaptive management program to evaluate efficacy of the plan (post-implementation) and adjust efforts accordingly. This document serves to describe and define tiers of the Logic Chain so there is a shared understanding of terminology, the questions underlying different parts of the architecture, and expectations of a comprehensive plan description.

The Logic Chain articulates a pathway from a plan's Goals and Objectives, to the specific measures designed to achieve those aspirations, to the monitoring, research, and metrics that will capture the effects of the conservation measures, and through an adaptive management process that adjusts conservation effort in light of progress made towards Goals and Objectives. The Logic Chain captures the underlying rationale and assumptions for the conservation measures that comprise the overall conservation strategy ("the plan") and establishes benchmarks against which progress can be measured. This approach increases specificity and clarity regarding:

- goals and objectives for recovery of covered species;
- the stressors assumed to impede attainment of goals and objectives;
- the plan's intentions for stressor-reduction
- the conservation measures and their projected outcomes
- the metrics that will be monitored and studies performed to assess plan success.

Increased clarity and specificity in these components of the Logic Chain will improve our understanding of the data collection, analysis, synthesis, and evaluation processes that enable adaptive management. By articulating what the conservation strategy is trying to accomplish and how it intends to achieve its objectives, the Logic Chain architecture facilitates both evaluation of the initial plan and assessment of its efficacy during implementation.

The logic chain – how it works

By capturing the answers to a set of standard questions, the Logic Chain architecture provides a means for explaining the challenges facing covered species and how a given conservation strategy intends to address those challenges. These questions and their position within the Logic Chain are described below. *The Logic Chain does not identify specific legal obligations (e.g. as spelled out in permit terms or water rights decisions); rather, it forms the basis for determining those obligations.* As our knowledge base grows (through initial evaluation and subsequent implementation of a plan and as a result of ongoing research) the "answers" to these questions will become more specific and accurate, allowing increased efficiency and efficacy in allocation of conservation effort.

Logic chain questions and associated terminology

Below are examples of the questions that drive various levels of the Logic Chain. Each question calls for a particular type of information; labels for these Logic Chain components are indicated with underlining and italics and also appear on the attached schematic diagram.

What is the problem? Numerous fish species in the Sacramento-San Joaquin Delta ecosystem are officially endangered or otherwise imperiled; collectively, they reflect a decline in various ecosystem functions. Ecosystem processes (such as flooding, primary and secondary productivity, sediment production) have been radically altered in this ecosystem. For each imperiled species and for the ecosystem as a whole, *problem statements* provide a concise declaration of the various ecological issues that the conservation strategy is trying to address. Problem statements are general and objective descriptions of the problem(s) and do not assume particular drivers of, or solutions to, those problems.

What outcome(s) will solve the problem? The Logic Chain describes species and process-specific *global goals* – general statements that disaggregate the problem statement into its various components. There may be more than one Goal associated with each problem statement. Goals represent desired outcomes that will solve the issue(s) identified in the problem statement. Again, these are simple, factual statements (that rely on the agencies' expert opinion) and do not pre-suppose a mechanism for solving the problem. The goals are "global" because they describe outcomes that may be partially or completely beyond the scope of any single plan. Still, identification of these global goals is important to create a context for the overall conservation plan. Global goals and objectives are delineated by the fish and wildlife trustee agencies (e.g., as identified in the various conservation/recovery plans).

How will we know then the global goal has been attained (what does solving the problem look like)? *Global objectives* provide specific values that describe the desired outcome (goal). Objectives are specific, measurable, attainable, relevant to the goal, and time-bound (S.M.A.R.T.) statements of what level of restoration constitutes attainment of the goal. Global objectives provide a clear standard for measuring progress towards a goal. Again, global objectives may be only partially relevant to the activities of a particular plan; their function is to define the magnitude of the problems so that recovery activities can be appropriately scaled.

What currently prevents us from attaining the global objectives? Physical, chemical, and biological attributes of the Delta have changed dramatically over the past several decades (and that change is expected to continue into the future). Some of these changes are *stressors* to covered species and important ecosystem processes. However, the precise contribution of each stressor to a species' population decline is uncertain and there is some disagreement over whether particular changes are stressors at all.

Our knowledge base (data, publications, conceptual and quantitative models) identifies stressors and will be used to organize these stressors by both the likelihood and magnitude of their impact; the Logic Chain records this essential information. Describing the stressors (and assumptions about them) is a key step in constructing a conservation plan and in managing adaptively as the plan is implemented. For example, clear statements regarding where a stressor occurs, which species it impacts, and how certain we are that the stressor is important will help focus BDCP on the relevant stressors and prioritize conservation measures.

Some stressors are beyond our control or beyond what we choose to control. For example, annual weather patterns (unimpaired hydrology) and ocean conditions cannot be impacted by local or regional conservation measures. Similarly, some problems may be beyond the geographical or legal scope of any given conservation plan. These *unmanaged stressors* are described in the planning process for two reasons: (1) so that it is clear that other stressors may impact ecosystem performance and (2) so that these stressors can be monitored/measured and used to more clearly reveal the true impacts of plan implementation (e.g. they may be used as covariates in an any analysis of ecosystem performance).

What will BDCP do to reduce stressors? Stemming from the stressors identified for each species and the ecosystem, *Plan Objectives* identify the plan's intent to address perceived problems. As with global objectives, stressor sub-objectives are S.M.A.R.T. statements that clarify the plan's intentions; they articulate a desired outcome resulting from implementation of the conservation measures. These objectives reveal the relative effort dedicated to alleviating each stressor and provide a basis for assessing whether the conservation measures will (cumulatively) achieve the stressor reduction objective (see *expected outcomes* below).

System-wide monitoring metrics and programs will be identified as a means of tracking progress towards stressor reduction (plan objectives), global goals, and global objectives. Monitoring will also track unmanaged stressors as plan effectiveness will be judged after accounting for variance in these "background conditions" (because, for example, a spate of dry years would be expected to result in low abundance of many species and productive ocean conditions would be expected to contribute to higher returns of anadromous fishes). Data from monitoring plans will be collected, synthesized, and evaluated by a special entity (to be defined) that is charged with evaluating plan effectiveness and advising policy-makers about ongoing adaptive management actions.

What actions will be taken reduce stressors (achieve the plan's objectives)? The conservation strategy consists of a number of different actions that address one or more of the stressors identified above for one or more of the covered species (or for the ecosystem as-a-whole). These *conservation measures* must be described in terms of their expected contribution to stressor reduction. In addition, potential negative impacts and other unintended consequences of the conservation measures should be described in the same detail as intended (positive) impacts. Furthermore, the Logic Chain requires an indication of the likelihood (certainty) that conservation measures will produce their anticipated effects (both positive and negative).

How will these actions achieve the goals and objectives? In order to understand the value of each action (e.g. to prioritize implementation) and to assess the strength of the entire proposal, the planning process will convene teams of scientists and technical advisors to make detailed and, where possible, quantitative estimates of *expected outcomes* (positive and negative/unintended outcomes that are anticipated) from each conservation measure. Expected outcome magnitudes will be accompanied by estimates of the *uncertainty* surrounding the magnitude. In this way, the potential efficacy of the proposed plan can be evaluated prior to permit issuance and the plan's accomplishments can be assessed as implementation proceeds.

The magnitude of expected outcomes and uncertainties surrounding those outcomes would be based on explicit hypotheses about how we expect conservation measures to work. To the extent possible, conservation measures will be designed, implemented, and monitored in a way that allows testing the hypotheses upon which they are based. Information gathered from *compliance and performance monitoring* will be synthesized and evaluated to assess the validity of different hypotheses and the efficacy of the conservation measures and the overall plan; conservation effort and the array of conservation actions will be adjusted to make continuing progress towards stressor-reduction sub-objectives and overall plan objectives.

How will we know if it is working (and adjust if it is not)? Given the uncertainties inherent in managing such a large and complicated estuarine environment, a San Francisco Bay-Delta conservation strategy is expected to employ adaptive management – learning to manage by managing in order to learn. Monitoring at various levels (system-wide, compliance, and measure performance) will capture physical, chemical, and biological changes in the ecosystem in order to determine the effectiveness of the overall plan and its component parts as well as ongoing changes in response to other drivers (e.g. climate change).

Data collection, analysis, synthesis, and evaluation are critical to plan success. Appropriate methods and management structures for each of these processes will be established as part of the initial plan proposal. Furthermore, the means by which new information (e.g. lessons learned during early stage implementation) is incorporated into adaptive management decisions will be described in detail prior to plan implementation as part of the BDCP governance process.

Adaptive management processes are characterized by dashed lines on the attached figure because these processes remain to be defined – the details of how management agencies respond to data and analysis of plan or conservation measure efficacy should be defined as part of the original plan – their description cannot be delayed until plan implementation is under way. In particular, performance targets for conservation measures (*measure targets*), stressor reduction (*stressor targets*), and global goals and objectives (*system wide targets*) and these targets must be S.M.A.R.T. Procedures for taking action when these measures are not being attained should be defined in advance. For example, how will managers respond when, despite performance-as-expected of conservation measures, stressor reduction targets are not attained?

Prioritization Principles

How should we choose between competing actions? Conservation measures must be prioritized to maximize the effect of limited resources, to provide rapid relief for this ecosystem's imperiled species, and to insure that the conservation strategy is based on the best available information and understanding of the target species and the Delta ecosystem. Factors that influence the prioritization of conservation measures include:

- Likelihood of positive and negative outcomes
- Magnitude and breadth (number of species affected) of positive and negative outcomes
- Time required to develop and document positive outcomes
- Ability to implement the action (e.g. financial, legal, and logistical constraints).
- Reversibility

These principles are covered in more detail in the plan and are explicitly described as justification for each plan element (conservation measure).

American Rivers
Thriving By Nature

by email to commentletters@waterboards.ca.gov

May 23, 2011

Charles Hoppin, Chair
c/o Jeanine Townsend, Clerk to the Board
State Water Resources Control Board
1001 I Street, 24th Floor
Sacramento, CA 95812-2000

RE: REVISED NOTICE OF PREPARATION FOR REVIEW OF SOUTHERN DELTA SALINITY AND SAN JOAQUIN RIVER FLOW OBJECTIVES

Dear Mr. Hoppin,

This letter is submitted as the comments of American Rivers on the Revised Notice of Preparation and Additional Scoping Meeting regarding the State Water Resources Control Board's (SWRCB) current review of the southern Delta salinity and San Joaquin River flow objectives and the program of implementation for those objectives in the 2006 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. These comments are addressed solely on issues associated with the San Joaquin River flow objectives.

We submitted several comments in a separate submission with the Bay Institute today. The purpose of this letter is to also incorporate by reference all information we previously provided to the water board on February 16, 2010 in preparation for the Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem Necessary to Protect Public Trust Resources that the board convened in March of 2010. Thus, we ask that you incorporate American Rivers exhibits 1 through 13 from our February 16, 2010 submission into American Rivers comments to the Revised Notice of Preparation. I have attached a description of exhibits 1 through 12 from our February 16 submission.

Sincerely,

John Cain
Conservation Director

EXHIBIT IDENTIFICATION LIST (Revised February 11, 2010)
(Due 12 Noon, Tuesday, February 16, 2010)

Delta Flow Criteria Informational Proceeding

Scheduled to Commence
Monday, March 22, 2010

PARTICIPANT: American Rivers (AR), Natural Heritage Institute

Exhibit Identification Number	Exhibit Description
AR-1	Testimony of John R. Cain, Dr. Jeff Opperman, and Dr. Mark Tompkins on Sacramento and San Joaquin Flows, Floodplains, Other Stressors, and Adaptive Management
AR-2	Qualifications of John R. Cain
AR-3	Qualifications of Dr. Jeff Opperman
AR-4	Qualifications of Dr. Mark Tompkins
AR-5	Qualifications of Carson Cox
AR-6 (TBI-1)	Testimony of Dr. Jonathan Rosenfield, Dr. Christina Swanson, John R. Cain, and Carson Cox on General Analytic Framework (submitted by TBI)
AR-7 (TBI-2)	Testimony of Dr. Jonathan Rosenfield and Dr. Christina Swanson on Delta Outflows (submitted by TBI)
AR-8 (TBI-3)	Testimony of Dr. Christina Swanson, John R. Cain, Dr. Jeff Opperman, and Dr. Mark Tompkins on Delta Inflows (submitted by TBI)
AR-9 (TBI-4)	Testimony of Dr. Christina Swanson on Delta Hydrodynamics (submitted by TBI)
AR-10	Bay Delta Conservation Plan Steering Committee, “Technical Study #2: Evaluation of North Delta Migration Corridors: Yolo Bypass,” December 2008 (contained in SWRCB’s Jan. 29, 2010 “Preliminary List of Documents for Technical Introduction”)
AR-11	John R. Cain *et al.*, “San Joaquin Basin Ecological Flow Analysis,” Vol. I, prepared for the Bay-Delta Authority, August 2003
AR-12	Rosalie del Rosario and Yvette Redler, National Marine Fisheries Service, “Residence of Juvenile Winter-Run Chinook Salmon in the Sacramento-San Joaquin Delta” (undated)
AR-13	Expert Report of Dr. Peter Moyle, Friant Cases (E.D. Cal.), August 14, 2005