United States Department of the Interior

Comments on Draft Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives

December 6, 2010

Thank you for this opportunity to comment on the State Water Resources Control Board (Board) Draft Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives (Draft Technical Report). The U.S. Department of the Interior (Interior) looks forward to participating in the Board's upcoming workshops for review of the San Joaquin River flow and Southern Delta salinity objectives. Interior has reviewed the Draft Technical Report and submits these comments on behalf of the Bureau of Reclamation (Reclamation) and the U.S. Fish and Wildlife Service (Service).

As you know, the San Joaquin River flow objectives have not been fully implemented since their initial adoption by the Board in 1995. Instead, the Board has provided for a phased implementation, allowing for a Vernalis Adaptive Management Plan (VAMP) experiment to determine biological benefits of spring and fall pulse flows. Interior, together with water users in the San Joaquin basin, have implemented these VAMP experimental flows pursuant to the San Joaquin River Agreement (SJRA) for over the past ten years, in lieu of the Board's original flow objectives for the San Joaquin. Despite the efforts of Interior, the SJRA parties, and others, San Joaquin salmonid populations have experienced significant reductions since 2000. Interior remains very concerned about the continued decline of the San Joaquin basin fall--run Chinook salmon. In-river adult salmon escapement into the three main San Joaquin tributaries (Stanislaus, Tuolumne, and Merced rivers) has precipitously declined since the fall of 2000, when an estimated 37,500 adult Chinook salmon returned to spawn. In the fall of 2007 fewer than 1,000 adult Chinook salmon returned, which represents a reduction of over 97% in the last seven years. While the Service recognizes that ocean conditions have likely been a factor in the reduction of 2007 spawners, ongoing long-term studies on Chinook salmon survival indicate that lower instream flow conditions in the San Joaquin River system seems to be related to the lower number of adult salmon that return to spawn, 2 ½ years later.

Flow on each of the major San Joaquin River tributaries is important to salmonids in the San Joaquin Basin. Each tributary has salmonid populations that depend on appropriate quality, quantity, and timing of flows to provide habitat for the freshwater part of their lifecycle. It is important that the Board not only consider flows at Vernalis, but also flows within each of the tributaries in the San Joaquin Basin.

In its Draft Technical Report, the Board is exploring the scientific basis for San Joaquin River flow objectives, and is initially focusing on developing a flow objective during the February through June period which represents a straight percentage of unimpaired flow. The Board is looking at flow objectives based upon 20%, 40% and 60% of unimpaired flow. The Board theorizes that by using a percent of unimpaired flow, the resulting flow objective would capture the highs and lows of the natural hydrograph for the San Joaquin basin, and, presumably, provide better flow patterns for fish.

Interior believes that the natural hydrograph is a useful metric to determine what appropriate flow objectives for the San Joaquin, and its tributaries, should be. This is especially true for the February through June time period. Managing the natural hydrograph with some flexibility to meet defined biological or hydrological objectives may be useful in meeting the broader ecosystem and species goals, and the functional flow objectives. Interior believes that the Board should provide a more detailed analysis of the existing reservoir systems on the San Joaquin River and its tributaries in crafting river flow objective(s) which may be more beneficial to fish, given the existing modified environment. The San Joaquin and its tributaries are impaired by numerous reservoirs, including many smaller power generating reservoirs in the upper elevations, and larger rim reservoirs. These reservoirs serve numerous purposes, including long-term drought protection, cold water pool reserves, and flood control. The result is that the San Joaquin and its tributaries have had managed flow patterns for decades. Therefore, a responsible analysis of San Joaquin River flow objectives necessarily includes an analysis of reservoir operations and reoperations.

As detailed below, Interior believes that more flows are needed to restore the fishery on the San Joaquin River and its tributaries. However, stated specific species and ecosystem goals should be a key component to flow objectives. In addition, the objectives should be adaptively managed to meet specified ecosystem goals and functional flow objectives. Therefore, Interior believes that if the Board constructs a regulated flow regime based solely on a percentage of natural flow on a system, like the San Joaquin Basin, that is prone to long and severe droughts, it is important to fully evaluate and understand the consequences of that approach.

Managing long-term reservoir storage yield, like New Melones Reservoir, involves balancing drought risk over multi-years. Traditionally, the Board allocates and regulates water on an annual basis, indexing flow objectives to water year type as a way to mitigate for the variable, natural availability of water. However, this method is not fully consistent with managing reservoir storage over the long-term to protect multi-purposes against drought. For drought protection, reservoir carryover storage levels should be taken into consideration as much as any individual water year type. This is a significant issue, especially on the Stanislaus River, where the yield of New Melones Reservoir was designed to meet multiple purposes, including fish and wildlife and water quality needs over the long-term.

Interior's comments on the San Joaquin River flow objectives are intended to help identify for the Board additional tools and information the Board should consider in evaluating alternative flow objectives. Some key considerations are: specific species and ecosystem goals; adaptive management; drought protection; and reservoir operation and reoperation analysis. In this vein, Interior also suggests that the Board's Draft Technical Report be peer reviewed by hydrology experts, as well as fish experts.

With respect to Southern Delta salinity objectives, Interior believes that the Hoffman report provides the Board with significant evidence that the current objectives may be over-protective of crops grown in the Southern Delta and that the objectives can be relaxed without any loss to crop yields.

A. San Joaquin River Flow Objectives

1. Scientific Basis (Biology and Ecosystem)

Interior commends the Board for continuing the process of developing alternative San Joaquin River flow objectives using the best available technical information and tools. The Board's Draft Technical Report is a good summary of the information and tools available to inform the decision-making process for establishing San Joaquin River flow objectives during the February through June period, and southern Delta salinity objectives. Interior understands that the Board (in its November 22, 2010 notice) indicated that written comments related to a program of implementation to achieve these objectives do not need to be submitted now, but must be submitted by February 8, 2011. Interior's comments focus on the information and the tools needed to inform the process for establishing San Joaquin River flow objectives.

As the Board is aware, Interior and others have commented previously, that salmonid populations in the San Joaquin Basin and its three main tributaries (Stanislaus, Tuolumne and Merced rivers) have experienced significant declines since the fall of 2000. Although sufficient evidence exists that additional flows are needed to support viable salmonid populations in the San Joaquin basin, there is additional information the Board should consider in this process. There is uncertainty in our understanding of how flow and salinity will affect future biological beneficial uses, consequently decisions must be made with uncertainty. Because of these uncertainties, any San Joaquin River flow objectives should be implemented, then evaluated and refined over time (adaptive management) to ensure the lessons learned are used to further refine the management of flows and salinity for meeting biological goals.

It is important to note the correlation between San Joaquin River flows and survival of migrating Chinook salmon from the San Joaquin basin through the Delta, especially during the February to June period. Although, the Board has indicated that tributary flows will be the focus of future Board proceedings, the Board should develop a comprehensive and integrated plan that addresses San Joaquin's tributary flows and Delta flows (at Vernalis) simultaneously. This process should give consideration to not only the source of the flows, but the balancing of flow needs for aquatic resources in the Delta as well as the flow needs upstream in the rivers. When considering the needs of anadromous fish, for example, the conditions in the Delta are important and the conditions upstream (such as temperature objectives) are important and both affect fish populations at different life stages.

The Board has requested written comments and is holding a workshop on their Draft Technical Report. Interior's responses to the primary questions are below.

The workshop is being held to determine whether:

1. *This information and these tools are sufficient to inform the State Water Board's decision-making to establish San Joaquin River flow and southern Delta salinity objectives and a program of implementation to achieve these objectives; and*

Yes, the Board has sufficient information that warrants increasing Vernalis flows to support a healthy San Joaquin Basin ecosystem. The Board should also consider additional information to inform its decision-making including:

- Developing an implementation plan that considers additional analyses discussed below and comments submitted to the Board by February 8, 2011.
- Outlining a process for how the flows will be established.
- Adding additional compliance points (to the one currently at Vernalis) at reservoirs on each of the major tributaries, with some level of protection to ensure the flows reach Vernalis and the Delta.

2. *The State Water Board should consider additional information or tools to evaluate and establish San Joaquin River flow and southern Delta salinity objectives, and a program of implementation to achieve these objectives.*

Yes, the Board has sufficient information that warrants increasing Vernalis flows to support a healthy San Joaquin Basin ecosystem, but should also consider the following when evaluating and establishing San Joaquin River flows:

- Implementing flows guided by the natural hydrograph, but with specific flow objectives to ensure the ecological and biological benefits of the flows are realized
- Consider the flow needs (timing, magnitude, duration, temperature, etc) of fish populations on each of the tributaries
- Establishing specific goals and metrics of success intended to be met by modifications of flow objectives
- Providing Vernalis flows that restore the functional elements of the natural hydrograph will improve the survival of San Joaquin Basin salmonids, thus aiding the recovery of native fishes in the Delta
- Analyzing the relationship of Vernalis flows to Old and Middle River flows
- Conducting additional analyses using temperature models and water quality models to evaluate the potential trade-offs associated with the 20/40/60 percent of unimpaired flow scenarios
- Evaluating opportunities to meet San Joaquin flow objectives, temperature objectives and Delta salinity objectives in a complimentary or synergistic manner
- Using independent life-cycle models to assess what flow alternatives are hypothesized to meet biological objectives and success metrics
- Establishing a monitoring plan specific to measure biological metrics of success and develop alternative management scenarios to employ a true adaptive management process in order to respond to changing circumstances and new information
- Implementing flows with flexibility to assure biological goals are met
- Review examples of adaptive management programs implemented in other systems (eg Trinity River http://www.iims.trrp.net/DocumentLibraryFiles/IAP_1.01.pdf, and VAMP) to guide the development of an adaptive management program in the San Joaquin Basin

Goals and Objectives: Ecosystem and Biological

Clearly articulating the goals for protecting and restoring the San Joaquin Basin ecosystem should be the starting point in the Board's process of developing San Joaquin River flow objectives. For example, the Board should adopt the overall goals that support the 1996 U.S. Fish and Wildlife Service Delta Native Fish Recovery Plan and the Central Valley Project Improvement Act of 1992 (CVPIA). Specific objectives include: a) self-sustaining populations that will persist indefinitely; b) large enough populations for limited harvest; c) improved habitat for aquatic life in general and for fish species of concern in particular; and d) salmonid doubling goals (consistent with the Board's narrative salmon doubling goal), to guide flow criteria development and implementation, but also to share common goals with the implementing agencies.

Defining and implementing goals to restore physical habitat is imperative in achieving ecosystem goals. The results of restoring appropriate flow patterns for fish cannot be fully realized without restoring the important functions of natural geomorphic processes. Restoring geomorphic processes including; maintaining spawning habitat, creating floodplain habitat, suspending fine sediment that increases the turbidity load, are a few examples of the crucial role geomorphic processes have in creating and maintaining habitat for various fish species. Thus, increasing flows to activate geomorphic processes is essential to restore and recover a healthy ecosystem.

Key to having useful biological and physical habitat objectives is that they are measureable. Objectives that are not measurable cannot be tracked or ultimately assessed for success or failure. The use of metrics to assess progress towards achieving objectives is an important component of the adaptive management process.

Both species specific and ecosystem goals are useful for guiding flow decisions, and should be included in the Board's Draft Technical Report. In addition, specific biological objectives and metrics should be identified and modeling should occur to determine what flow objectives will meet the biological objectives and metrics. Appropriately scaled monitoring should be developed to determine if the initial flow objectives were successful in meeting the biological objectives and metrics. If the biological objectives are not met, an alternative set of flow objectives should be initiated. This type of adaptive management process is necessary to refine flow objectives, respond to changing environmental conditions due to climate change and other factors and meet the biological objectives and longer-term ecosystem goals.

Use of the Natural Hydrograph

In general the natural hydrograph is a useful tool to guide flow releases of complex riverine systems, especially where the understanding of ecosystem dynamics is incomplete. As the Board's report states Fleenor, et al. (2010) suggests that while using unimpaired flows may not indicate precise, or optimum, flow requirements for fish under current conditions, it would, however, provide the general seasonality, magnitude, and duration of flows important for native species (see also Lund, et al. 2010). A more natural flow regime, in particular greater flows in the spring, in combination with reservoir releases that provide temperatures more closely mimicking the natural temperature regimes of the San Joaquin River system, would benefit the aquatic ecosystem at multiple levels (food web, fish communities, and cold water salmonids). However, because of the significant level of modification (e.g. dams) present in the San Joaquin Basin Rivers, a natural hydrograph alone may not always the meet the needs of all life stages of target species. Given that the natural hydrograph has changed and will continue to change with the effects of climate change, there should be some level of flexibility associated with the implementation of flows that mimic the natural hydrograph. Managing the natural hydrograph with some flexibility to meet defined biological or hydrological objectives may be useful in meeting the broader ecosystem and species goals and the functional flow objectives.

Having flow standards tied to biological objectives to determine success will allow an assessment of the effectiveness of the flow standards so more effective management can be implemented in the future. Table 1 is an example of displaying the functional flow objectives as they relate to the salmonid life stages during the year. This approach offers the ability to set objectives and measure success at achieving those objectives.

Table 1: Example of general fall run Chinook salmon and steelhead trout functional objectives. Specific functional objectives (e.g. temperature between 50 degrees and 60 degrees during x months) should be developed in the process, but with the allotted time for comments we were unable to fully develop them.

Life stage	**Example functional flow objectives**	**Fall**	**Winter**	**Spring**	**Summer**
Adult		Importance of flows for each life stage			
Temperature	Provide suitable temperatures to reduce or eliminate temperature induced pre-spawn mortality during spawning and migration. Provide sufficient flows to minimize effects of contaminants and/or disease.	High			Medium
Spawning habitat	Provide flows to maximize quality and provide an appropriate quantity of spawning habitat for adult salmonids.	High	High		
Upstream migration	Mimic natural occurring fall pulse flows to cue upstream migration of adult salmonids.	High			
Fry/Smolts					
Temperature	Provide suitable temperatures (less than 65 degrees) to maximize survivorship and growth of rearing salmonids.	Low		High	Medium
Rearing habitat	Provide flows to connect the river to the flood plains for 3 months (February –May) to realize improved productivity of macro invertebrates and increased growth rates of juvenile salmonids, and providing refuge from predators.			High	Medium
Downstream migration	Provide flows between 5,000 and 20,000 cubic feet per second (cfs) from March 15 to June 15 to maximize survival of out migrating juvenile salmon to support viable salmonids populations.			High	Low
Eggs/Alevin					
Temperature	Provide suitable temperatures to maximize survivorship of incubating salmonids.	High	High	Low	Medium
Geomorphic process	Significantly high enough flows to activate geomorphic processes to: mobilize fine sediments and deposit fines in riparian floodplain habitats.		High	High	

Adaptive Management

The importance of an adaptive management approach and supporting monitoring cannot be overstated. Interior believes a strong science program and adaptive management are essential to meeting the biological goals using San Joaquin River flow. The Board should first state what the flow criteria are intended to achieve (ecosystem goals) and second identify how flows would be modified to meet stated ecosystem goals. The use of models can be utilized to determine what flow criteria to initially implement and test. Specifically designed monitoring to determine the success or failure of the initial flow criteria to meet the objectives is needed to achieve long-term goals.

Interior has developed guidance for the implementation of adaptive management (AM) in a report, Adaptive Management: The U.S. Department of Interior Technical Guide, available at http://www.doi.gov. Several conditions are required for successful application of AM. They include (a) opportunity to apply learning, (b) clear management objectives, and (c) monitoring systems with a reasonable expectation of reducing uncertainty. All of these conditions represent management challenges. In particular, the requirement of clear management objectives emphasizes the need for the Board to establish specific biological goals and objectives that flow objectives are intended to achieve.

Example of an adaptive management approach:

1a. Set ecosystem goals that describe the desired condition of the San Joaquin Basin

- Achieve recovery of at risk native species dependent on the San Joaquin Basin
- Minimize the need for future endangered species listings by reversing downward population trends of native species that are not listed
- Rehabilitate natural processes in the San Joaquin Basin to fully support, with minimal ongoing human intervention, natural aquatic and associated terrestrial biotic communities and habitats, in was that favor native members of these communities
- Maintain and/or enhance populations of selected species for sustainable commercial and recreational harvest, consistent with the CVPIA, Service, California Department of Fish and Game (CDFG) and other goals
- Protect and/or restore functional habitat types in the San Joaquin Basin for ecological and public values such as supporting biotic communities, ecological processes, recreation, scientific research and aesthetics
- Prevent the establishment of additional nonnative invasive species and reduce the negative ecological and economic impacts of established nonnative species in the San Joaquin Basin
- Improve and/or maintain water and sediment quality conditions that fully support healthy and diverse aquatic ecosystems in the San Joaquin Basin; and eliminate, to the extent possible, toxic impacts to aquatic organisms, wildlife, and people

1b. Identify biological and physical indicators to track progress towards stated ecosystem goals
Consider species and physical parameters that are sensitive to particular aspects of the health of the ecosystem. One example would be to specify a specific smolt survival rate (average of 50%, range from 30 to 80%) from Vernalis/Mossdale to Chipps Island for San Joaquin basin salmonids and the method of measurement.

1c. Monitor biological/physical indicators to establish baseline
Conduct appropriate level of biological and physical monitoring to establish baseline conditions. To monitor the example above, monitor survival using Coded Wire Tags (CWT) and acoustic tag methodology to estimate survival from Mossdale to Chipps Island to determine baseline survival.

2. Assess the problem
   Assessing the threats in a comprehensive systematic way will make decisions about prioritizing management actions possible at varying scales. For example: one problem is that survival of juvenile salmonids is too low to maintain healthy and sustainable populations in the San Joaquin basin.

3. Use models and available data to develop hypotheses and select a suite of management actions to meet biological objectives and accomplish ecosystem goals
   Utilize a decision support process informed by mathematical models, conceptual models, and data to select the most appropriate flow objectives to accomplish ecosystem goals.

4. Implement management actions to accomplish ecosystem goals utilizing a formal experimental approach
   Implement the priority management actions to accomplish ecosystem and biological goals.

5. Monitor response of biological indicators to management action
   Develop monitoring that is explicitly designed to measure the success or failure of management actions to achieve specific ecosystem and biological objectives.
   To monitor the example above, monitor survival using CWTs and acoustic tag methodology to estimate survival from Mossdale to Chipps Island to determine if the survival goal has been met.

6. Evaluate the result of the management action- how effective was the action in reaching goals?
   The data collected from the monitoring will need to be assessed to determine if the objectives were achieved. The level of response of the indicator to the management action should be fed into mathematical models for use in future predictive scenario exercises.

7. Use what was learned to adapt management actions to improve efficiency and effectiveness in meeting goals
   Utilize monitoring results to recommend and refine future flow objectives. Use what was learned to modify models, and change flows to achieve ecological and biological goals. In the long-term this process will lead to better flow objectives that meet the biological objectives and ecosystem goals.

The Board should consider reviewing the adaptive management approach considered in other river systems (such as the Trinity River http://www.iims.trrp.net/DocumentLibraryFiles/IAP_1.01.pdf, etc) to inform this process on the San Joaquin River.

Tributary Flows

Flow on each of the major San Joaquin River tributaries is important to salmonids in the San Joaquin Basin. Each tributary has salmonid populations that depend on appropriate quality, quantity, and timing of flows to provide habitat for the freshwater part of their lifecycle. It is important that the Board not only consider flows at Vernalis, but also flows within each of the tributaries in the San Joaquin Basin, which would provide fishery benefits not only at Vernalis, but would improve conditions for fish populations on each San Joaquin tributary. Careful consideration should be given to the losses that might occur below the reservoirs, and adequate protection provided to ensure the tributary flows reach Vernalis. Although, the Board has indicated that tributary flows will be the focus of future Board activities, the most comprehensive and integrated plan would address both the tributary and Delta flows simultaneously.

Changing Environmental Conditions

Future conditions will likely be different than current conditions; the effects of climate change, urban development, changes to agricultural practices, and others will alter the future of the San Joaquin Basin. Periodic reviews of San Joaquin flows will be necessary to adapt to changing conditions while continuing to meet defined goals and objectives. Additionally, it is likely that the unimpaired hydrograph will be changing in timing, magnitude, and duration; however, the biological needs of the existing ecosystem will remain relatively constant. This information should be taken into consideration as part of the planning process.

San Joaquin Outflow as a Component of Delta Outflow

Providing Delta inflows from the San Joaquin River and its tributaries would help provide adult salmonids with the olfactory cues they need to successfully navigate through the Delta back to their natal streams. Out-migrating smolts would benefit from higher instream flows in the spring months, and having a more balanced and diverse set of inflow sources could improve survival through the interior Delta where survival rates are low. Having multiple sources of inflow also provides benefits to more riparian communities by improving their habitat. San Joaquin River outflow also provides concurrent benefits in terms of habitat and temperature.

Freshwater inflow and outflow directly affects the survival of juvenile salmonids moving downstream through the Delta. In the historical data, adult escapement increases with flow during the smolt outmigration 2 and ½ years earlier. Survival through the Delta for juvenile fall run Chinook salmon originating from the San Joaquin basin has also been shown to increase with increased Delta inflows at Vernalis. In addition to juvenile salmon survival being higher with higher flows, the abundance of juvenile salmon leaving the Delta is also higher with greater river flow. The Service has developed predictions of flows needed at Vernalis to achieve doubling in Chinook salmon production for the basin. These were derived from regressions of smolt survival against flow (USFWS 2005). The Service's AFRP has also identified flows from the San Joaquin tributaries (Stanislaus, Tuolumne and Merced rivers) needed to meet desired Vernalis flows to achieve the CVPIA salmon doubling goals.

As Interior has commented on previous occasions, flow in the Delta is one of the most important components of habitat availability and ecosystem function. Inflow to the Delta and outflow to the Bay have significant effects to spawning, larval/juvenile transport, rearing, and adult migration of Delta fish species, including the Delta smelt. The Delta provides habitat conditions for various life stages of fish, and those habitat conditions must be present when needed, and have sufficient connectivity to provide migratory pathways and the flow of energy, materials and organisms among the habitat components (USFWS 2008). Inflow into the Delta determines habitat availability and effects fish populations in many ways: the migration of adults and juveniles, affects the level of entrainment into water diversions, cues adult delta smelt begin moving up the Estuary, affects the position of X2, controls nutrient inputs that supports primary productivity (Jassby 2008; Cloern 2007), and affects turbidity loads that delta smelt need to successfully forage and, in turn, to elude predators.

Summary of Scientific Basis

The Board should outline the process for evaluating and establishing San Joaquin River flow objectives. At the end of this process the Board should have three primary products: (1) defined ecosystem goals (using specific biological and physical indicators to track success of flow objectives; (2) San Joaquin River flow objectives that were developed to meet the defined ecosystem goals; and (3) a process or approach to adaptively manage flows to meet the ecosystem and biological goals. The flow objectives that the Board adopts should be viewed as a starting point that will be modeled, monitored, evaluated and implemented using a flexible management regime to meet the ecosystem goals, learn from the flow actions, and respond to changing environmental conditions and increased understanding. Interior will continue participating in the Board's process, and coordinating with CDFG, National Marine Fisheries Service (NMFS) and other parties to work out the details of evaluating, establishing and implementing alternative San Joaquin River flow objectives.

Additional specific comments on the text in the Draft Technical Report are included as Attachment A.

2. Hydrology and Water Supply

First, Interior wishes to commend the Board in its new approach at looking at flow standards from a comprehensive tributary watershed approach. Historically, San Joaquin River flow standards have been considered as strictly Delta inflow standards. The tributary approach described in the Draft Technical Report sets a new paradigm in assessing Delta inflow standards from the San Joaquin River based upon a more holistic ecosystem consideration of the San Joaquin watershed itself, including its component tributaries. This is particularly important as the San Joaquin River Restoration Program is being implemented and salmonid fish species begin their migration upstream in the basin after many decades. As fish species begin to be reintroduced on a larger scale to the upper San Joaquin River and the basin tributaries, individual tributary and overall basin outflows will be just as critical as Delta inflows.

In assessing the Draft Technical Report, Interior has tried to review the technical work from the perspective of whether the report contains the full range of information and rigor to address alternative flow and salinity objectives as well as to scope an implementation strategy that considers the very complex environment of multi-purpose reservoir storage management and beneficial water uses in the San Joaquin Basin. It is imperative for the Board to have not only a strong fundamental scientific basis in setting any standards, but also an understanding and recognition of practical considerations and limitations in operationally implementing any new strategy that is foundationally watershed and tributary based.

Interior supports the concept of standards based upon contributions from the various tributaries and sub-basins of the San Joaquin River. Interior believes that this new paradigm will also require a whole new approach in implementation strategies for flow management in the San Joaquin Basin. Again, to date, flow objectives have been set at Vernalis from the perspective of Delta inflow. These flow objectives have been met primarily through operations of New Melones Reservoir. This implementation strategy will not be tenable in the future. Delta inflow objectives will no longer be the only water management objectives in the Basin. As the San Joaquin River Restoration Program is implemented it is likely that fishery regulatory agencies will request management of specific water volumes and flow patterns to be defined for all the San Joaquin Basin tributaries to maintain the viability of multiple fishery species. These new ecosystem water management approaches to the San Joaquin Basin will affect many other water uses including hydropower generation, flood control, and water supply for both agricultural and municipal and industrial uses. From this perspective Interior supports the establishment of a new implementation strategy that is focused on a "top down" approach. In this strategy flow objectives should be managed from the reservoir water releases on the specific tributaries. Historical strict flow objectives at Vernalis, which form a partial basis of Delta inflow, should become flow objectives that are defined in terms of being provided with some exceedence probability criteria of reliability. All objectives, both at the upstream reservoirs at Vernalis should also be defined in terms of an adaptive management program.

It is within this context Interior has reviewed the Draft Technical Report as to its scientific and technical sufficiency and the adequacy of the tools used to assess or scope alternative flow management objectives and other beneficial use objectives. We have reviewed the Draft Technical Report with the view as to long term implementation all water management strategies within the San Joaquin Basin.

The scoping comments detailed and conceptualized here are structured to address key technical considerations of implementing alternative flow management strategies specifically for the multiple purposes of water use in the San Joaquin Basin. The comments are intended to give guidance to the revision of the Draft Technical Report, in order for the report to be a solid foundation to the eventual Substitute Environmental Document (SED) on flow management alternatives in the San Joaquin Basin. In these written comments Interior will address the following key considerations:

- Recognition of multiple purposes of dams and reservoirs and their influence on flow standards.
- Reservoir storage management and the multi-year variability of hydrology in the San Joaquin Basin.
- Scoping and implementation considerations of variability within a year of hydrology in the San Joaquin Basin.
- Scoping and implementation considerations of flow management timing and scheduling strategies.
- Tools for water supply and flow standard modeling and analysis.

Recognition of multiple purposes of dams and reservoirs and their influence on flow standards.

The Draft Technical Report illustrates well that the natural hydrograph is impaired by large reservoir facilities in the San Joaquin Basin. The large reservoirs impair the "natural hydrograph" to meet multiple purposes. The Draft Technical Report should acknowledge that through reservoir storage management, control of the natural hydrologic variability is the foundation of achieving benefits for multiple purposes. Re-analyzing the flow objective needs of the San Joaquin Basin must be cognizant of the multiple purposes for which the large reservoirs were developed. The Draft Technical Report gives consideration to the role of reservoirs associated with fisheries management, salinity control, and water supplies for consumptive use. While the analyses the Board has completed to date are very pertinent, they are not complete. In addition, no consideration is given to the influences of flow objectives on flood control and hydropower generation. A primary concern of Interior is that no consideration has been given to interrelationships between meeting water quality and flow objectives and meeting the multiple purposes that have been directed by Congress in the operation of federal dams and reservoir projects.

Interior recognizes that the SED work required to implement any new flow objectives must fully evaluate all impacts in these areas. The Draft Technical Report should acknowledge that further studies will be required.

Considerations in how the multiple purposes of dams and reservoirs relate to the establishment of new flow and salinity objectives are described below:

- Flood Control
  - Fundamentally flood control is a purposeful control of natural hydrologic variability.
  - Physically controlling the flow of rivers to minimize historic flood damages that occurred during high flow events. The flood control purpose was a major component of benefits that led to the authorization of many of the dams and reservoirs.
  - The interrelationship of the flood control purpose with flow management relates to the amount of available storage in a reservoir to capture water for other beneficial uses.
  - Flow management must also be cognizant of channel capacity limitations, seepage to adjacent lands, and flood control protection.

- Water Storage Provides Reliability for Multiple Beneficial Purposes

  - In scoping flow management objectives it is important to retain and utilize reservoir storage management flexibility to address the following purposes:
    - Fishery Protection (with recognition of the reservoir impairment reality)
    - Water Supplies for Consumptive Use purposes
    - Water Quality (generally dissolved oxygen and salinity)

- Storage to utilize towards protecting these water-dependent beneficial uses over sustained multi-year drought periods

Key scoping deficiencies of the Draft Technical Report from a hydrologic perspective include:

- The Draft Technical Report does not discuss for what purpose hydrologic impairment occurs or how reservoir storage management generally functions in the San Joaquin Basin to support multiple uses. Without this reservoir storage management context, it is very difficult, if not impossible, to create a sound decision-making basis to scope or quantify potential changes to flow and salinity objectives in the San Joaquin Basin and how they might be effectively implemented.

- To consider a percentage of the annual natural hydrograph as a partial scientific basis for river flow management objectives the Technical Report must recognize that the annual hydrograph represents the total natural availability of water resources to distribute for all beneficial uses.

- The hydrologic concept of annual availability of natural water supplies must also consider the specific goal of retention of reservoir storage for multi-year carryover in order to distribute water supply benefits to meet multiple purposes. This carryover storage of water supplies is used to manage a multi-year drought sequence where there is low natural water availability. It is difficult to assess one single beneficial use as indexed by annual natural water availability outside the technical context of all beneficial uses and multi-year water supply reliability.

- The current Draft Technical Report does not discuss, nor frame, how natural water availability over multi-year sequences influences the development of alternative flow objectives in a scientific manner. The scientific framework under which alternative flow objectives are evaluated must be based in the context of the physical storage dynamics of operating the dams and reservoirs that control the vast majority of water resources in the San Joaquin Basin. A key consideration in this context is to recognize that collectively the large reservoirs in the San Joaquin create a water control system that distributes water for multiple purposes both annually and over multi-year periods. Reservoir management and operations is a multi-discipline scientific endeavor that must be fully considered in the establishment of implementable flow objectives. Reservoir management is a scientific endeavor worthy of the suggested peer review process.

- The current Draft Technical Report uses the unimpaired hydrology at the upstream tributary reservoirs as a potential basis for allocating tributary responsibilities to meet flow objectives. The Board should analyze and consider the significant differences between unimpaired hydrology at the upstream tributary reservoirs and the unimpaired hydrology at Vernalis. If the objective of the Board is to proportion responsibilities for meeting inflow to Delta objectives, the proportions should be based upon the tributary contributions to unimpaired hydrology at Vernalis, not solely on the unimpaired hydrology at the upstream reservoirs. Each tributary system has certain losses to seepage which may never reach

Vernalis or the Delta. This is particularly apparent in relation to the upper San Joaquin reach below Friant Dam.

Reservoir Storage Management and Multi-year Variability of Hydrology in the San Joaquin Basin

To begin to scope systematic changes about how water is managed in the San Joaquin Basin, it is fundamental to begin with characterizing the variability in the natural water supply availability over multiple years.

Figure 1: San Joaquin Basin Hydrology Multi-Year Variability

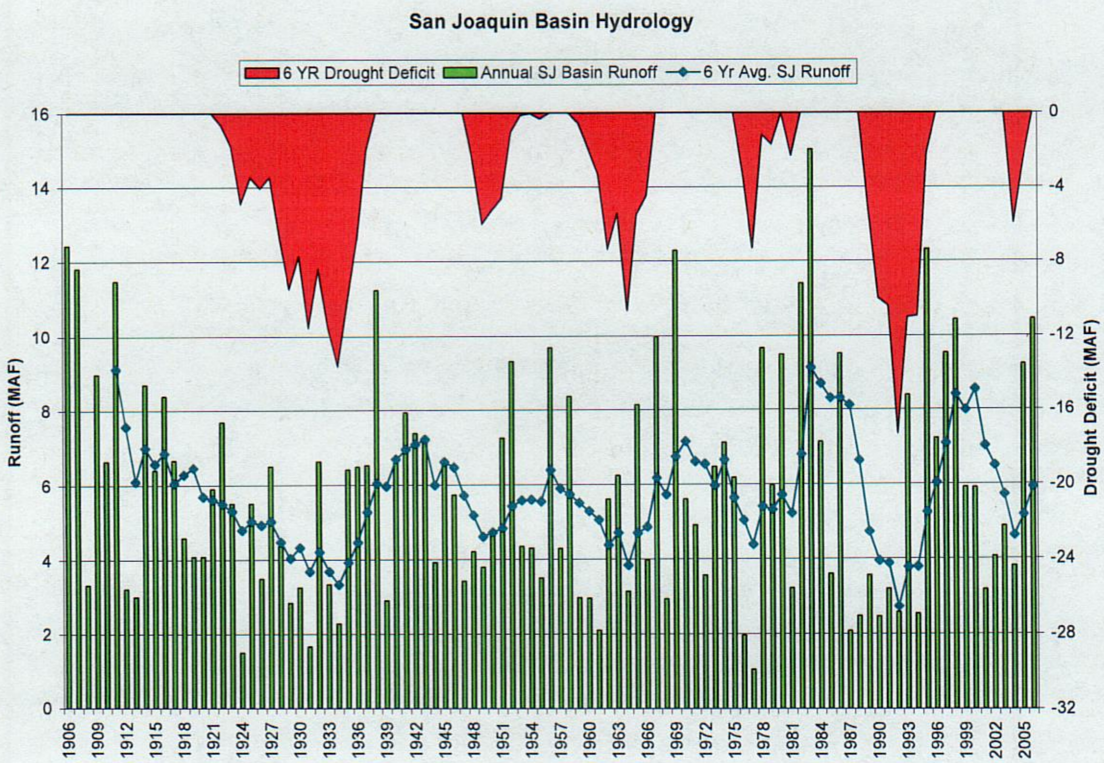


Figure 1 is intended to illustrate some of the key aspects of the natural water variability of the San Joaquin Basin. The figure illustrates the unimpaired inflow estimates for the combination of the Stanislaus River, Tuolumne River, Merced River, and Upper San Joaquin River at the major reservoir water control facilities. The green bars represent the annual quantities, and illustrates the large variability from year to year in the annual runoff that is characteristic of the rainfall and hydrologic patterns for San Joaquin Basin. The blue line is a 6-year running average of the hydrologic conditions. The 6-year running average of hydrologic conditions is a key hydrologic principle as to how reservoir carryover storage is managed over multiple years for multiple purposes. Reservoir storage management is significantly keyed on how to sustain storage through extended (6-yr) adverse drought conditions. This approach allows the maximization or optimization of multiple purposes.

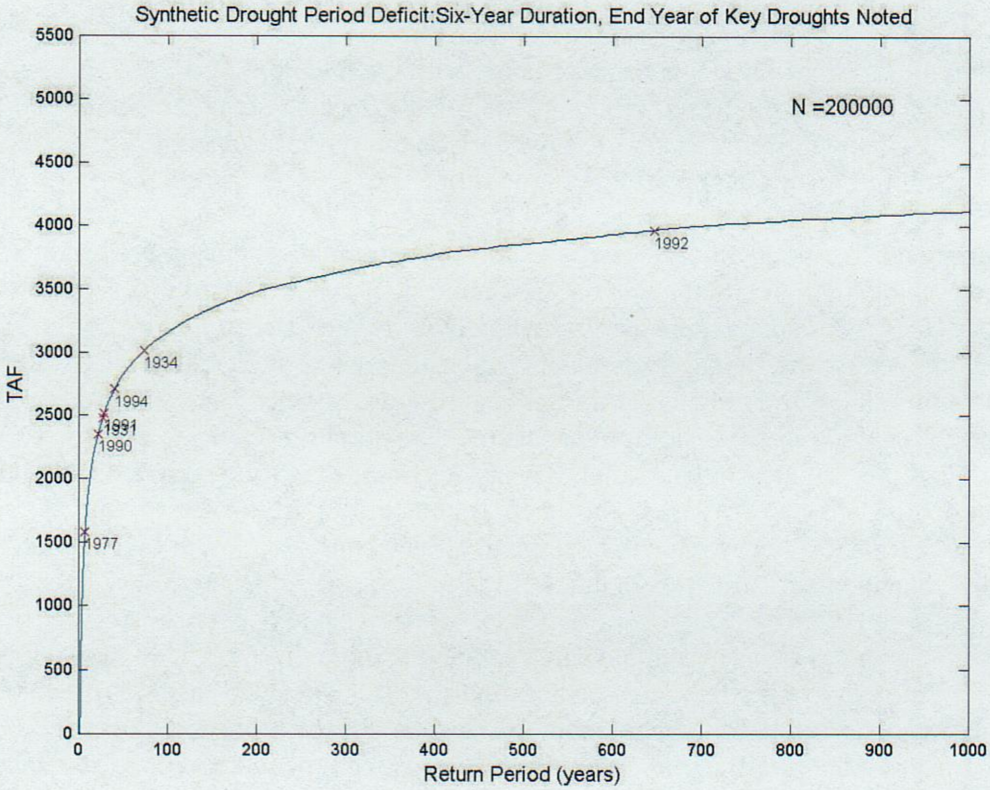
The red volumetric portion of this illustration is intended to characterize drought sequences. The red "deficit" volume is simply the accumulated volume of the previous six years as compared to a six year basin average volume condition. The drought deficit can help to characterize differences in individual drought sequences. This figure illustrates that the 1930's drought is the longest sustained drought in the hydrology record in terms of duration. The figure also shows that the 1990's drought was the most severe in terms of "deficit" from normal. The 1930's drought deficit peaked at approximately 14 MAF difference from average over a 6 year period, and represents a deficit of approximately 2.5 years "normal" runoff within a 6 year period. The 1990's drought deficit peaked at approximately 17 MAF from average over a 6 year period, and represents a deficit of nearly 3 years "normal" runoff within a 6 year period. The difference in deficit between the 1930's drought sequence and the 1990's drought sequence of approximately 3 MAF, and is extremely consequential as to how a reservoir system is designed to perform towards meeting all purposes over a sustained drought period.

Scoping, planning, or assessing all uses of a reservoir system must design general criteria for the utilization and management of storage against the "unknown" risk nature of entering a sustained drought period. This risk management assessment activity in the water planning community has generally been known as water yield analysis. For the Central Valley of California, water planning has traditionally used the 1930's drought conditions as the basis of this risk/yield relationship to help guide reservoir storage management principles to provide the water supply reliability intended or estimated to be available near the end of the drought period for all the permitted beneficial use considerations. The Draft Technical Report does not frame nor analyze this extremely significant water storage management choice consideration in evaluating alternative flow management strategies in the San Joaquin Basin.

The San Joaquin Basin has experienced a drought sequence more "severe" than the 1930's drought in recent memory. This fact must also be analyzed for its potentially significant management ramifications to flow management alternatives for the San Joaquin Basin. One method to characterize the ramification of a more severe drought occurrence is to statistically estimate a "return period" metric to compare drought deficits. Figure 2 is a graphical depiction of estimated "return periods" for the Stanislaus River in the San Joaquin Basin, based on full natural flow estimates.

For the Stanislaus River, the 1930's drought is estimated to a have a return period of approximately once in a hundred year cycle. The 1990's drought is estimated to have a return period of once in greater than 500 years. This is very important for scoping or evaluating alternative flow management in the San Joaquin Basin. In order for reservoir storage to be available in year 6 or 7 of a sustained drought, reservoir storage management principles must consider and manage to a reasonable "risk" of water supply availability over a drought cycle in an attempt to provide for all beneficial uses at some sustained level. In considering flow management objectives, the Board should consider what level of risk is acceptable to meet all competing beneficial uses over an extended drought period. Operationally maintaining reservoir storage to a risk level of a once in a hundred year chance is probably a reasonable risk metric to use in designing reservoir storage management principles. On the other hand, a once in 500 hundred year chance is probably too conservative. Designing reservoir storage management principles to such a conservative criteria would mean that only a very small percentage of water in storage could ever be put to beneficial use. A very large proportion of water would be left in storage to provide protection against an extreme drought within a 500 year return period.

Figure 2: Synthetic Drought Period Deficit



The fact that the San Joaquin Basin has experienced a drought sequence with a more "severe" hydrologic deficit than commonly accepted risk drought criteria is itself a significant planning or scoping consideration. All permitted purposes cannot be realistically expected to be achievable if the San Joaquin Basin experiences another drought significantly worse than the planning design drought estimates. This is a particular troubling hydrologic management tradeoff in scoping analysis, regulatory permitting, and modeling efforts. Essentially, the fact that the San Joaquin Basin has experienced a drought sequence more "severe" than traditional risk parameters means that the multiple existing purposes under operating permits may not be achievable during a repeat of such a severe drought cycle, or achievable in environmental modeling analysis that utilizes a historic hydrologic record. In some environmental planning process this hydrologic risk "severity" problem is minimized by recognizing a numeric hydrologic threshold of drought persistence at which point it is expected that severe conflicts or emergency management conditions would occur. This "severe" conflict would be managed on a case-by-case emergency process. The Draft Technical Report does not frame this consideration of scoping alternative flow management strategies for the San Joaquin Basin.

The selection of an appropriate drought horizon to analyze beneficial use and storage management risk tradeoffs is a very fundamental and key aspect to analyzing and understanding the San Joaquin Basin and reservoir storage system, water resource inter-dependencies, and overall tradeoffs, especially under alternative flow management scenarios. **The selection of an appropriate drought horizon significantly influences how a reservoir system performs under all hydrologic conditions because the storage "value" is always assessed against the water availability of a sustained drought.** Therefore, selecting a very conservative drought sequence would translate into fewer attainable purposes each and every year, and more probability of the reservoir system in a full or flood control release condition under more favorable hydrologic sequences, due to the desire to protect against a very extreme event. For the San Joaquin Basin, this design choice is essentially between the drought horizon of the 1930's drought versus the 1990's drought.

A drought horizon analysis in the context of reservoir storage management principles must be analyzed as an extremely significant key systematic scoping consideration in any re-evaluation of San Joaquin Basin alternative flow objective strategies. The information set produced by such an analysis illustrates why large multi-year storage reservoir facilities are needed to produce a desired set of purposes over a period of limited natural water availability. The Draft Technical Report does not frame this fundamental hydrologic consideration of alternative flow management in the San Joaquin Basin. The Draft Technical Report is conceptually linked only to the annual natural hydrograph and not the systematic reservoir management aspect of alternative flow management in the San Joaquin Basin over multiple years.

As a numerical example of the difference that the time period influences the statistical representation, some general relationships on the Stanislaus River are represented in Table 2.

Table 2: Averaging Considerations on the Stanislaus River

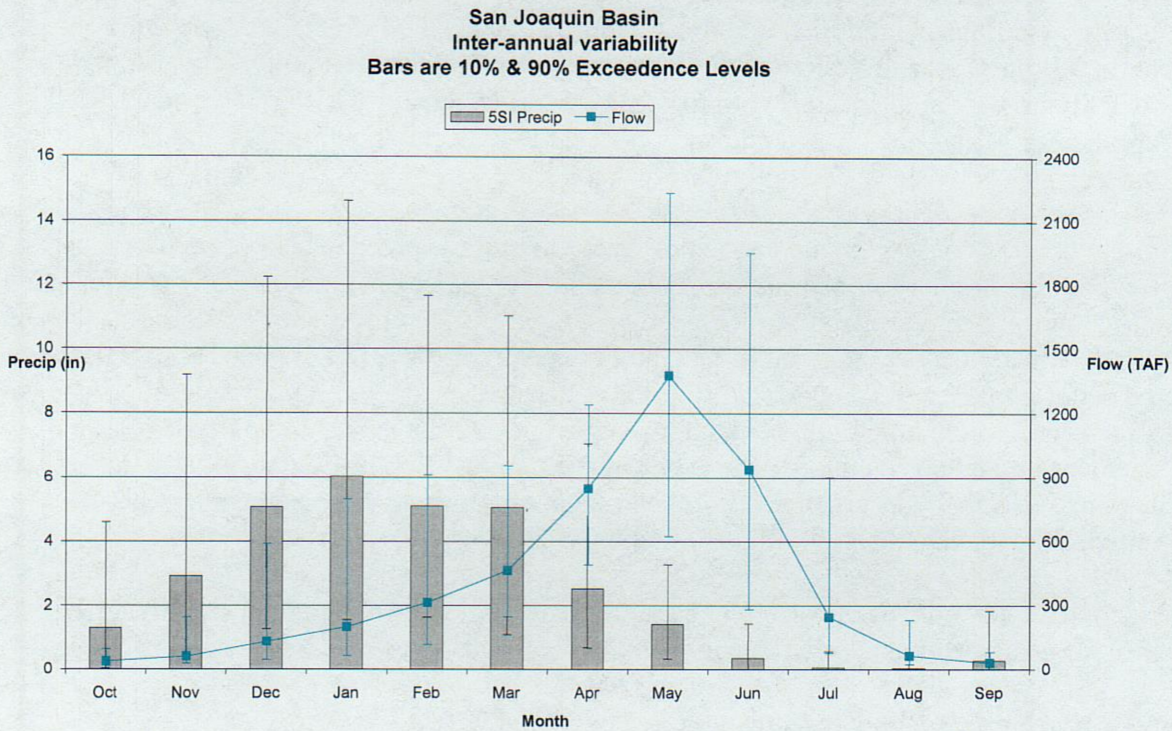
Period	Long-term Avg.	1928-34 Drought	1987-92 Drought
Inflow Thousand Acre-Feet (TAF)	~1100	~687	~498
Min. River Flow (TAF)	~150	~150	~150
% of Period	~14%	~22%	~30%

The permitted minimum flow regime below Goodwin Dam consists of the 1987 Agreement with CDFG and summertime flows to meet a dissolved oxygen goal at Ripon. The combination of these minimum flow goals is roughly a 150 TAF/yr schedule. Comparing this 150 TAF minimum flow goal to the hydrologic variability of differing water availability periods of concern, produces different statistical representations. It also implies very different availability of water resources and storage management to produce multiple purposes.

Scoping and Implementation Considerations of Variability within a Year of Hydrology in the San Joaquin Basin

The San Joaquin Basin is a snowmelt dominant hydrologic basin. Figure 3 illustrates the general hydrologic patterns within a year that influence flow timing in the San Joaquin Basin. The 5 Station Index (5SI) is a group of 5 precipitation stations located along the Sierra Nevada Range and San Joaquin Basin. The 5SI is utilized as a tracking index for precipitation conditions in the San Joaquin Basin. Figure 3 illustrates the wide variability of winter month precipitation events. Figure 3 also illustrates the wide variability and uncertainty of these winter precipitation events producing direct runoff or contribution to snowpack and eventually springtime melt patterns.

Figure 3: San Joaquin Basin Variability Within a Year

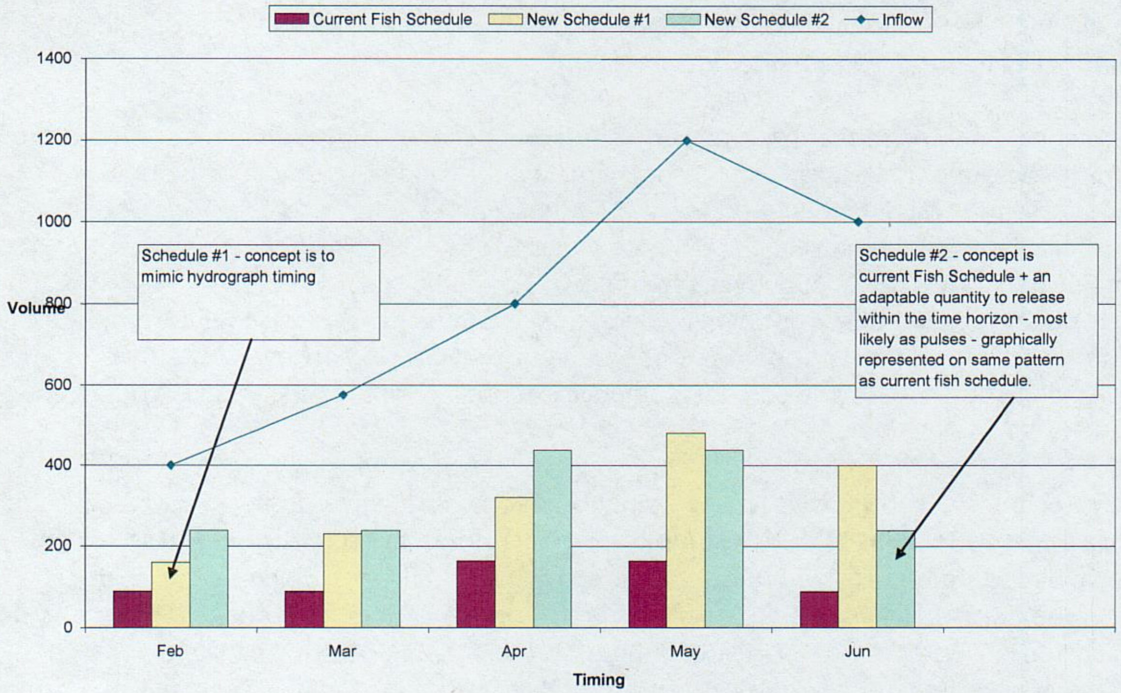


Scoping and implementation considerations in flow management timing and scheduling strategies.

Predicting natural flow events, and their timing contribution, at any given time is a significant information uncertainty. The Draft Technical Report does not frame how alternative flow strategies would or could be predicted or managed due to such an uncertain hydrologic information basis. To scope and analyze how the San Joaquin Basin system could be managed to alternative flow strategies requires a predictable hydrologic metric to operationally react with an appropriate management response. The current Draft Technical Report does not discuss this key consideration of alternative flow management in any significant detail.

Conceptually, the Draft Technical Report is framing a consideration of managing flows on a more direct linkage to annual water supply or runoff availability. This is a reasonable assessment goal for alternative flow management investigation in regards to potential benefits to the target beneficial use considerations, but lacks specific clarity on implementation timing strategies within the year. Figure 4 illustrates the concepts.

Figure 4: Timing of Implementation Schedule



New Schedules patterns #1 and #2 are both a managed reflections of 40% of the inflow volume. The assumed current fish schedule is a reflection of 15% of the inflow volumetrically, with a 30 day pulse flow centered on April 15 to May 15, and a base flow in the other periods. Schedule #1 assumes a general mimicking of the inflow pattern. Schedule #2 assumes an additional volume (based on the 40% inflow) is available to be managed as adaptive enhancements to the current fish schedules, and therefore is illustrated as the same basic timing considerations as the current fish schedule. The management concept of Schedule #2 is that it would be scheduled in a manner that is cognizant of the influence of the impairment reservoirs inter-relationship with fishery management goals directly below the release facility. It is likely that this scheduling paradigm would be a series of pulsed releases from the reservoir facility over the time horizon that benefits the fishery management goals.

The significant point of the illustration for scoping and assessing alternative flow management strategies is that different scheduling strategies will have different tradeoffs. How the flow management strategy is scheduled through time will have a significant influence on the primary target objective (fishery enhancement) and the reservoir performance strategies towards meeting all the other purposes for the remaining stored water.

As an example, the alternative schedule patterns would have different effect influences on the flow rates at Vernalis. The alternative schedule patterns would have different influences to fishery life stage management in the vicinity of the reservoir release location. Both alternative schedules would have different influences on the water quality (EC) at Vernalis. This illustrates the classic potential schedule timing tradeoffs directly below the reservoir release location and the subsequent influences on total flows and quality at Vernalis. A single release timing strategy cannot provide competing beneficial use goals simultaneously, because the timing strategy must be primarily designed either for an upstream consideration below the reservoir release point or as a flow enhancement for downstream locations. The only management "knob" for these flow considerations is the reservoir release rates.

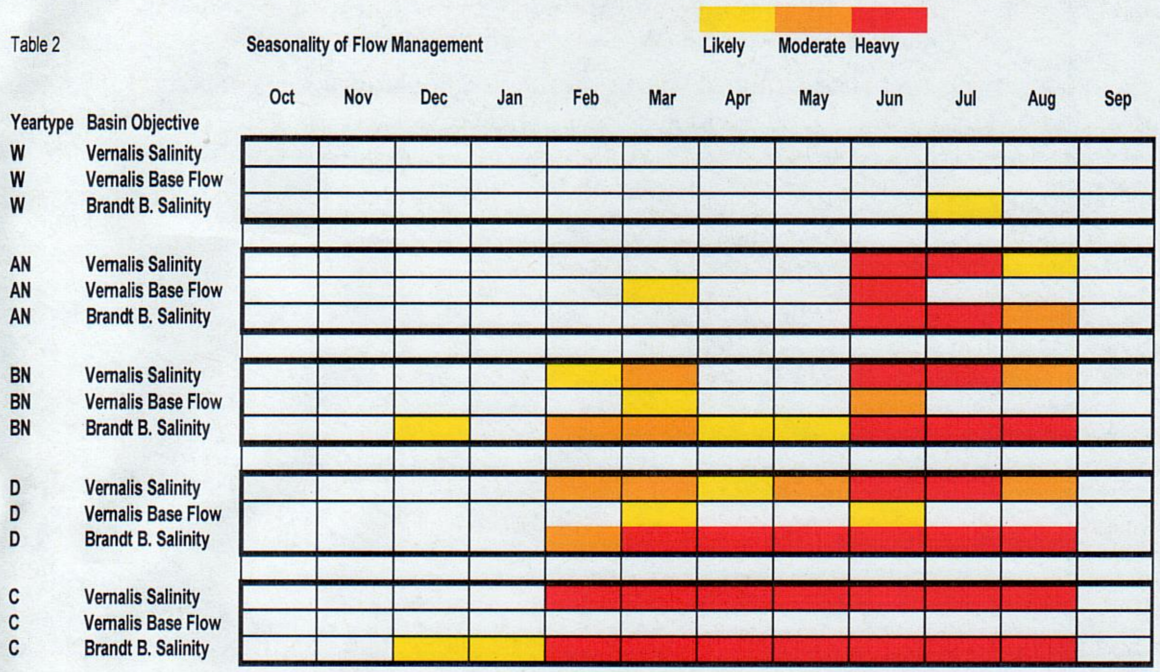
In mathematical/engineering terms, one degree of freedom (release rates) cannot solve for two unknowns at the same time (upstream management stability and downstream flow rates). The San Joaquin Basin is fundamentally different than the Central Valley Project (CVP) – State Water Project (SWP) system in the Sacramento River Basin in regards to managing simultaneously to downstream and upstream objectives. In the case of the CVP-SWP system managing to downstream delta outflow considerations, there is the dual management option of increasing reservoir release contribution to the Delta or reducing export rates to "solve" or manage for delta outflow flow needs. In mathematical/engineering terms, this is two degrees of freedom to meet an objective.

The Draft Technical Report has little discussion of the scheduling and timing considerations of flow management strategies to differing purposes. Therefore, it is very difficult to assess any changes to managed purposes without discussion of the scheduling foundation and its direct relationship to the primary objective of enhancing fishery objectives by modifying reservoir release schedules. Without some consideration of the scheduling of flow management alternatives, it is extremely speculative to surmise or quantify how the beneficial use mix of the San Joaquin Basin would change due to an alternative flow management strategy that is primarily implemented through reservoir release and storage management. Therefore, the scientific basis of the draft Technical Report is deficient.

Interior has illustrated this beneficial use/timing/scheduling consideration through Figure 5 on several occasions. Figure 5 is intended to show that timing and seasonality highly influence the magnitude of potential new reservoir releases in order to meet different flow management objectives. Figure 5 is also intended to illustrate that different beneficial use objectives "compete" for additional stored water. The Draft Technical report does not frame this consideration with significant detail.

The Draft Technical Report illustrates the general differences in flow timing between natural flow events and the flow rates that have historically occurred at Vernalis. The premise of the Draft Technical Report is that by investigating alternative flow management strategies based on a percentage proportion of the natural flow events as a scientific basis underpinning, new flow management strategies can be evaluated and ultimately quantified for potential changes to other beneficial use considerations.

Figure 5: Seasonality of Downstream Objectives and Likelihood of Additional Reservoir Release Requirement



In general, flow management strategies can be statistically compared to natural flow processes, so yes, understanding the natural regime is definitely a fundamental part of the scientific understanding of implementing flow management strategies. Where the Draft Technical Report falls short is in the recognition that implementation strategies, due to the large storage impairment reality of the San Joaquin Basin reservoir system, requires implementation strategies that recognizes the inherent hydrologic uncertainties and utilizes impairment in ways that are predictable and attainable to manage to the objective intended.

Near real-time implementation scoping of alterative flow management strategies and hydrologic uncertainty.

In general, unimpaired flows represent the influence of rainfall runoff and eventual snowmelt runoff patterns. Neither of these hydrologic phenomena is predictable or quantifiable on a real-time basis to index an appropriate management response to, especially in the short term during active weather conditions and flow dynamics. Therefore the unimpaired flow hydrograph has very limited usefulness as a regulatory or management response metric in the sense of real-time management responses or goals. In many cases, the flow impairment of power production reservoirs above the larger valley rim reservoirs is simply unknown for a significant period of time. Power reservoirs significantly influence in time when the water resources are available to support the large downstream reservoir performance goals.

Storm events produce significant rainfall runoff contribution from creeks and smaller rivers on the San Joaquin Valley floor. Some of these creeks contributions are constant while others are ephemeral; but both are highly responsive and flashy in terms of flow to significant rainfall storm events. The cumulative contribution of flow to Vernalis due to rainfall/runoff events over the San Joaquin Valley floor is highly sensitive to the geographic location of rainfall and the travel time distance to Vernalis. Under active weather patterns, the prediction of potential creek flow contributions to Vernalis flows is extremely variable both in quantity and timing.

Attempting to coordinate or manage multiple reservoir releases towards a Vernalis target flow objectives during the active storm winter months would be an extremely challenging, if not impossible, endeavor. To conceptualize this consideration, an understanding of the general travel times from given reservoir release point to Vernalis must be understood. In general, the travel times from reservoir release points are characterized in Table 3.

Table 3: Travel time considerations to Vernalis from the major San Joaquin Valley reservoir release points

Stanislaus @Goodwin	Tuolumne @ La Grange	Merced @ McSwain	San Joaquin @ Friant
~ 2 days	~ 2 days	~3 days	Unknown or uncertain hydraulic connectivity
With Consideration of Power Grid Management Requirements			
~ 5 days	~ 5 days	~6 days	Unknown or uncertain hydraulic connectivity

In general significant reservoir release points have significant power production implications; from a scheduling management perspective it is highly desirable (economically) to inform power grid managers of changed power production schedules three days in advance of actually changing the reservoir release rates and power production. This power production scheduling reality increases the conceptual lag time that a decisional operators must have for river flow management.

In very general terms, predicting the quantity and geographic location of significant winter rain events is at best a 2 to 3 day advance warning endeavor with inherent uncertainty. Therefore, **to attempt to actively coordinate the San Joaquin basin reservoir system releases towards a Vernalis flow management target, during the active rain months would require predicting rainfall events farther into the future than can now be reliably even be estimated.**

As a discussion example, in order to schedule a reservoir release response, an operator on the Merced River would need to have a reliable estimate of creek flow contribution towards Vernalis flows at least a week in advance; this scientific technologic prediction capability simply does not exist. The Draft Technical Report does not address nor discuss the capabilities to manage to Vernalis flow targets during the winter months with consideration of precipitation or runoff lag time uncertainty realities. The scoping implementation goal of alternative flow management needs to have consideration of wintertime flow uncertainties and management system capabilities.

The Draft Technical Report must also systematically acknowledge the unique hydrologic and hydraulic uncertainties of the Friant Reservoir subsystem as part of the San Joaquin Basin.

Historically, minimum flow releases from Friant Dam achieved a 5 cfs flow rate at Gravelly Ford, 40 miles downstream, before completely infiltrating and resulting in a dry river bed. During periods of flood, Reclamation would attempt to recapture flows at Mendota Pool with the remainder diverted into a flood bypass and routed to the confluence with the Merced River 150 miles downstream of Friant Dam. Little data exists on losses and the conveyance capacity of the historical river channel is unknown in many locations. Infiltration, rewetting of the channel, and riparian diversions result in depletion of flows released from Friant Dam by the time those water reach the Merced River. Releases for the San Joaquin River Restoration Program in 2010 resulted in approximately half of the water from Friant Dam reaching the Merced River confluence during the spring pulse period. The San Joaquin River Restoration Program is currently gathering monitoring information to better understand and address the hydraulic routing uncertainties associated with increased releases from Friant Dam.

Concurrently during the spring months, the natural hydrograph of the San Joaquin River above Friant Dam is significantly impaired by a system of power reservoirs. The combined storage retention above Friant Dam is similar in magnitude to the storage capability of Friant Dam. This adds another significant uncertainty on the potential reservoir release rates that could be managed from Friant Dam.

The combination of impairment above Friant Dam and the hydraulic uncertainty of the loss rates between Friant Dam and the confluence of the Merced River, creates significant hydrologic and hydraulic questions. The connectivity of the available water supplies produced from a natural hydrology above Friant Dam to the Merced River confluence has been both a historical uncertainty and a current river corridor uncertainty. Given this level of hydrologic uncertainty it is extremely speculative to characterize how the upper San Joaquin River basin catchment natural hydrograph above Friant Dam would or could influence hydrologic characteristics at the confluence of the Merced River. This is a very significant uncertainty question for approximately 30% of the natural hydrograph of the San Joaquin Basin that only "theoretically" would connect to flows at Vernalis. This uncertainty develops into a natural question. Is it appropriate to characterize the water supplies of the Upper San Joaquin Basin as having a significant contribution potential to Vernalis flow objectives? The Draft Technical Report does not fully develop this connection uncertainty for a very significant geographic and numeric issue.

Scoping challenges implied by the incomplete Draft Technical Report.

The Draft Technical Report is incomplete in terms of the scientific information needs to assess how a scientific approach could be managed or implemented for alternative flow management strategies in the San Joaquin Basin. These comments have illustrated the scientific hydrologic considerations in a large reservoir storage impairment basin such as the San Joaquin River Basin. The Draft Technical Report assumes an over-simplification of scientific hydrologic processes, though the natural hydrograph, in a complex basin with a system of reservoirs controlling a vast majority of the water resource availability for multi-objective and inter-related beneficial use purposes. There is a fundamental "science" component to reservoir storage management principles that must be a companion to the information set in Draft Technical Report. The "tools" utilized for estimated quantification of potential changes to other beneficial use considerations in the draft Technical Report simply ignores the scientific endeavor of understanding reservoir system management through impairment of the natural hydrograph.

The scoping challenge implied by the Draft Technical Report is generally one of understanding how volumetric beneficial use goal changes, as the conceptual linkage to natural water availability, would or could be implemented into alternative flow management strategies. This scoping activity is attainable if the key reservoir management principle foundations are recognized. The reservoir release points constitute a **system** of managing how storage functions towards meeting multiple purposes over significant timeframes. The common denominator to this scientific investigation is how to scope and implement a reservoir release scheduling framework that is flexible, has consideration of all the dependent beneficial uses that characterize the San Joaquin Basin needs, and has certainty and reliability in regards to water availability (natural hydrograph inputs over time).

Tools for water supply and flow standard modeling and analysis.

The Draft Technical Report analysis techniques have no scientific grounding into how the San Joaquin Basin, as a multi-year reservoir storage dominant basin, performs towards meeting multiple purposes annually or multi-annually. Therefore, the quantifications illustrated in the Draft Technical Report have little value to describe potential tradeoffs between either beneficial use considerations or alternative flow management strategies to any single purpose.

The Draft Technical Report needs to illustrate the general scoping considerations of how to utilize reservoir storage management towards meeting the inter-dependent and often competing beneficial uses and purposes within the San Joaquin Basin.

This type of analysis generally requires a good broad based scoping of the considerations and timing needs of all purposes, and how reservoir storage (impairment) can potentially be utilized to manage towards these purposes. In this comment letter, this type of analysis is referred to as "General Investigation" (GI) analysis. In a GI analysis, a full description of the general beneficial use goals and purposes of reservoir storage are described and depicted and/or illustrated in conceptual forms and magnitudes, and seasonal timing needs. For the San Joaquin Basin reservoir system this analysis should consider the following:

- Paramount need to physically control Sierra Nevada runoff before reaching the San Joaquin Valley Floor, in order to provide flood control throughout the Basin
- Seepage damage concerns in river corridors
- Fishery Flow management below reservoir release points
- Coordination concepts of a system of reservoir release points and how that influence San Joaquin Basin outflows (Vernalis) and inter-related fishery considerations
- Salinity (or dilution) management goals
- Other significant water quality parameters (dissolved oxygen, coldwater pool management) general considerations
- Consumptive uses and the type of diversion structures utilized to provide for them
- The hydrologic connectivity of the Friant Subsystem to the lower San Joaquin basin.
- How use of reservoir storage influences the availability of coldwater resources in the reservoir and the linkage back to fishery flow management
- How management of the above considerations influences reservoir operations and storage volumes on an annual and multi-annual (drought) basis

With a comprehensive description of these management considerations, a GI analysis can be structured to investigate and illustrate the inter-dependencies and beneficial use tradeoff considerations as a performance measure through reservoir storage utilization. The key goal of a GI model is an information gathering process to investigate and understand and frame the beneficial use tradeoffs consistent with a reservoir storage performance management strategy.

Simple reservoir management strategies can be employed in a GI analysis in order to illustrate general timing effects and tradeoffs between potential beneficial uses and other purposes. As an example, a common simple reservoir rule is to allow the September reservoir carryover storage to be utilized in annual midpoint increments against the designed power pool limitation of that reservoir facility. This gives a common basis of reservoir management performance to assess inter-dependent beneficial use dynamics and assess tradeoff implications through multi-year management.

With this GI reservoir storage management performance framework – investigation and analysis of alternative flow goal criteria can begin to be analyzed in a systematic manner. Consideration must be given to the human limitations of information assessment, or attainability of implementation, in a real-time manner. Additional considerations include:

- Need for flow management alternatives and constructs that have an information basis and are attainable in real-time management considerations – then assess beneficial use tradeoff influences of performing to such information sets with GI modeling;
- Need for recognition of appropriate "operational buffers" due to uncertainties of hydrology variability and timing that occur in the real system on an inter-month basis that is not captured in monthly GI models;
- Recognition that fishery flow management objectives and salinity/dilution flow management objectives **compete** for a limited water supply availability due to differences of the timing need of these objectives. These are highly interdependent;
- Recognition that the San Joaquin Basin is reservoir-storage-controlled hydrologic system designed to operate to meet multiple use needs over multiple years. Therefore, alternative flow management goals will influence all timing characteristics of reservoir storage management performance. Changes to reservoir storage performance through time will re-influence performance to all management objectives, especially over drought periods and when the reservoir system refills. This is the inter-dependent nature of the reservoir storage controlled San Joaquin Basin and why a GI model investigation is critical and vital to understanding the inter-dependent tradeoffs;
- With a GI model approach – the significant beneficial use inter-dependencies can be analyzed through reservoir storage performance and beneficial use quantification estimates; and,
- With the output of GI analysis, potential water right permit and terms can be compared and contrasted iteratively until a satisfactory understanding of how the beneficial use tradeoffs, through permit terms, would likely be influenced. This approach gives a greater "certainty" that the eventual final permit term language and implementation of the flow management alternative would be similar.

CALSIM II is not a "GI" model. CALSIM II has been engineered to simulate the San Joaquin Basin system given an implied set of water right priorities and a set of basin flow objectives. The reservoir storage management strategies in the model have been highly modified to this set of assumptions. The general datasets of CALSIMII would be useful to develop a GI model. In essence, a GI model version of CALSIMII would need to significantly simplify the model structure, to perform a good GI analysis of the flow management inter-dependencies. The GI analysis could then be a basis to "design" a new set of basin flow objectives and ultimately the water right permit terms and conditions to implement them.

The following pages are some conceptual illustrations of how GI analysis output is useful to begin to visualize the information content and relationships that a full GI analysis of San Joaquin Basin relationships would likely develop.

Conceptual Illustration of GI Analysis and the Time Inter-dependencies.

Table 4 and Figures 6 – 11 illustrate a conceptual tradeoff analysis of systematic effects in a large reservoir storage basin such the San Joaquin River. They are intended to illustrate why and how a flow objective designed around a single year (like percent of inflow towards fishery management) influences reservoir storage management over multiple years. This is intended to illustrate the need for a "General Investigation" analysis of San Joaquin Basin flow objectives.

Legend
Inflow = Annual Inflow Volume (TAF);
Fishery Schedule #1 = Is an assumed min. fishery permit requirement of 100 TAF/yr.
Fishery Schedule #2 = For the percent of natural inflow fishery alternatives (TAF)
 20% = simple 20% of inflow during each month of Feb-Jun is utilized as fish flows (This illustrates the concept of an inflow variable/release management strategy)
 40% = same as 20% but 40%
 60% = same as 20% but 60%
Dilution = Release needed towards meeting a water quality target (TAF)
CU = Consumptive Use diversion (TAF)
 Target annual CU used was 500 TAF based on a Mar. to Feb contract year.
Flood Control Release = Flood control only releases (TAF)

Generic Reservoir
Size 1000 TAF
Flood Control Reservation 150 TAF

Generic System Reservoir Operation Rule
If carryover (sep) is projected at greater than 700 TAF – meet all beneficial use goals for that year.

If carryover (sep) is projected between 700 TAF and 300 TAF – utilize a generic half step drawdown rule of;

This year target carryover (Sept) = ½ of the difference between last year (Sept) carryover and 300 TAF. This is a common continual midpoint strategy.

This type of reservoir performance rule produces a representative tradeoff operation of storage dynamics through a multi-year analysis.

The graphics are intended to illustrate the performance difference during a "full reservoir to full reservoir" hydrologic cycle consistent with the San Joaquin Basin hydrology dynamics.

The Tables are intended to illustrate the interdependent changes to beneficial uses through the simple reservoir storage management. The Tables are also illustrated in the Figures for simple comparison of year to year changes.

Table 4: Conceptual Effects of Alternative Schedules

Base	O-S	O-S	O-S	M-F	O-S
Year	Inflow	Fishery	Dilution	CU	FC Rel
1	500	100	18	500	35
2	376	100	18	479	0
3	601	100	18	500	0
4	376	100	18	347	0
5	331	100	18	256	0
6	331	100	18	237	0
7	983	100	18	500	0
8	796	100	18	500	97
Avg.	**537**	**100**	**18**	**415**	**17**

Fish 20%	O-S	O-S	O-S	M-F	O-S
Year	Inflow	Fishery	Dilution	CU	FC Rel
1	500	133	16	500	35
2	376	109	18	452	0
3	601	151	2	500	0
4	376	109	18	310	0
5	331	108	18	238	0
6	331	108	18	224	0
7	983	196	2	500	0
8	796	179	9	500	0
Avg.	**537**	**137**	**13**	**403**	**4**

Fish 40%	O-S	O-S	O-S	M-F	O-S
Year	Inflow	Fishery	Dilution	CU	FC Rel
1	500	211	7	500	32
2	376	161	10	367	0
3	601	251	2	443	0
4	376	161	10	227	0
5	331	144	10	196	0
6	331	144	10	187	0
7	983	341	2	500	0
8	796	307	2	500	0
Avg.	**537**	**215**	**7**	**365**	**4**

Fish 60%	O-S	O-S	O-S	M-F	O-S
Year	Inflow	Fishery	Dilution	CU	FC Rel
1	500	290	2	484	23
2	376	216	5	284	0
3	601	351	2	327	0
4	376	216	5	177	0
5	331	189	5	153	0
6	331	189	5	146	0
7	983	486	2	500	0
8	796	435	2	365	0
Avg.	**537**	**297**	**4**	**305**	**3**

Figure 6: Conceptual Illustration of Change to a 20% Inflow Requirement

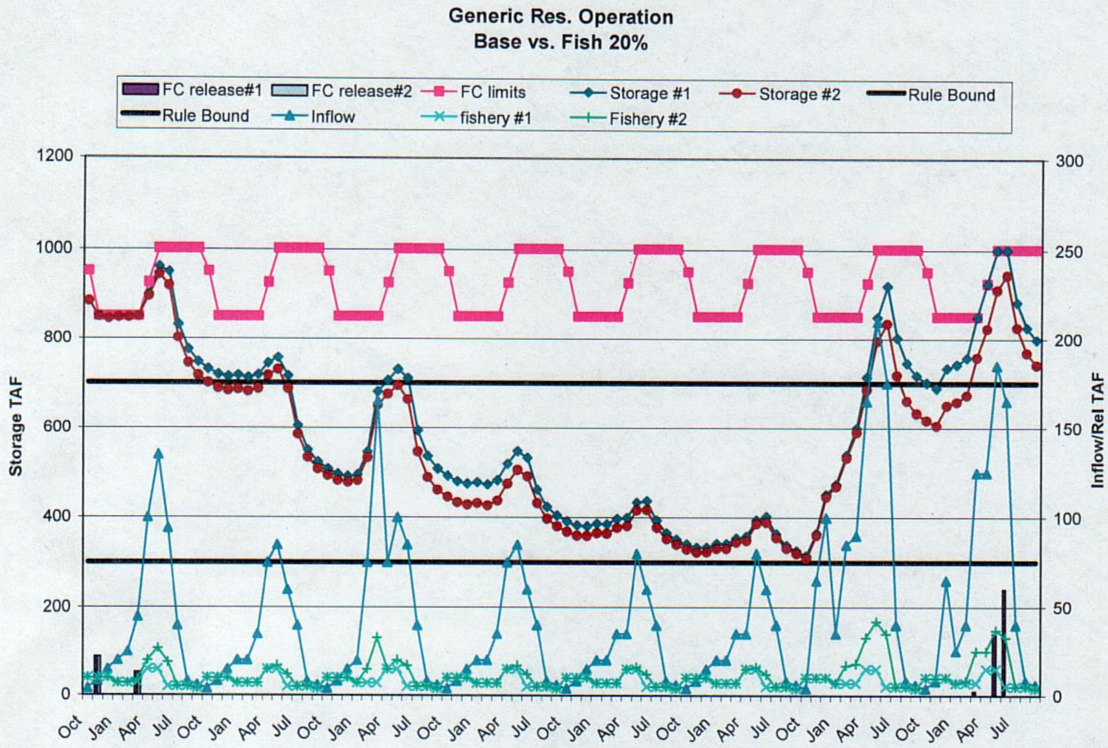


Figure 7: Comparison of Release Volumes for a Change to a 20% Inflow Requirement

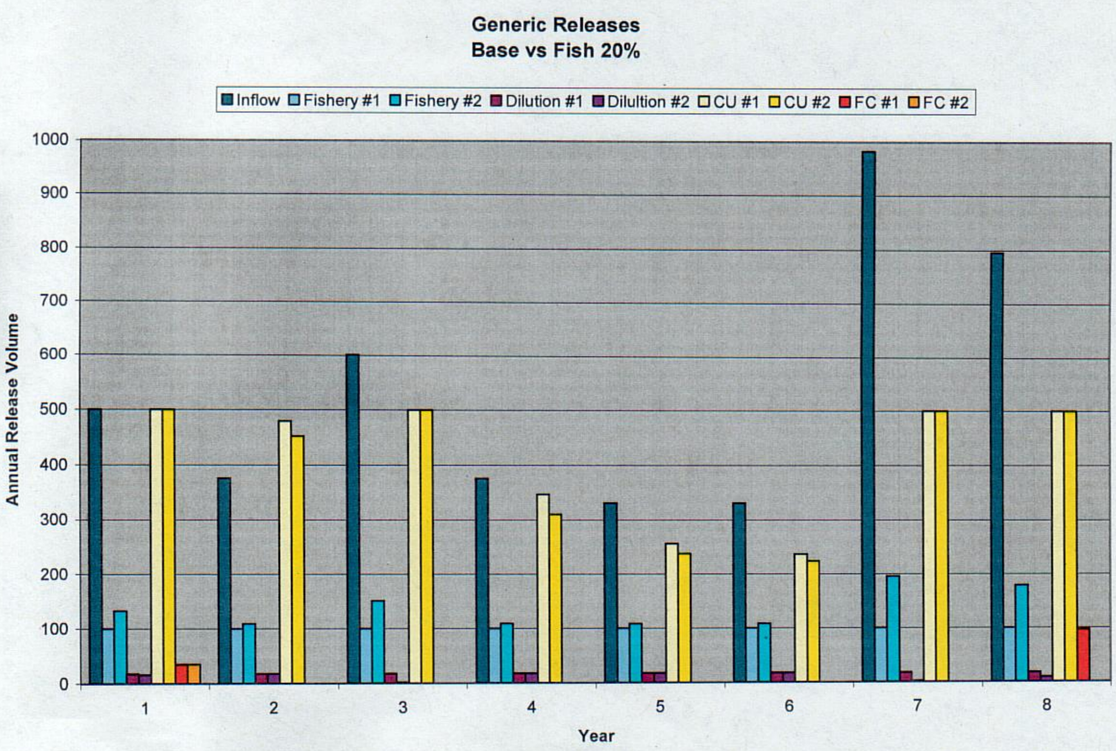


Figure 8: Conceptual Illustration of Change to a 40% Inflow Requirement

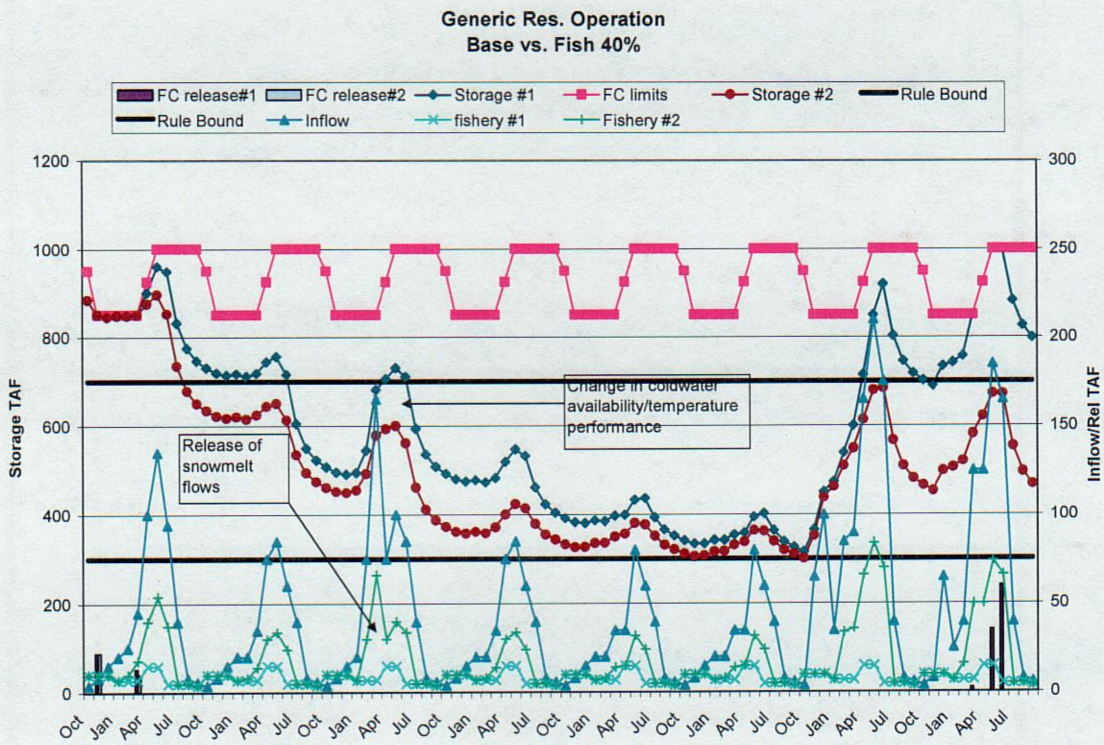


Figure 9: Comparison of Release Volumes for a Change to a 40% Inflow Requirement

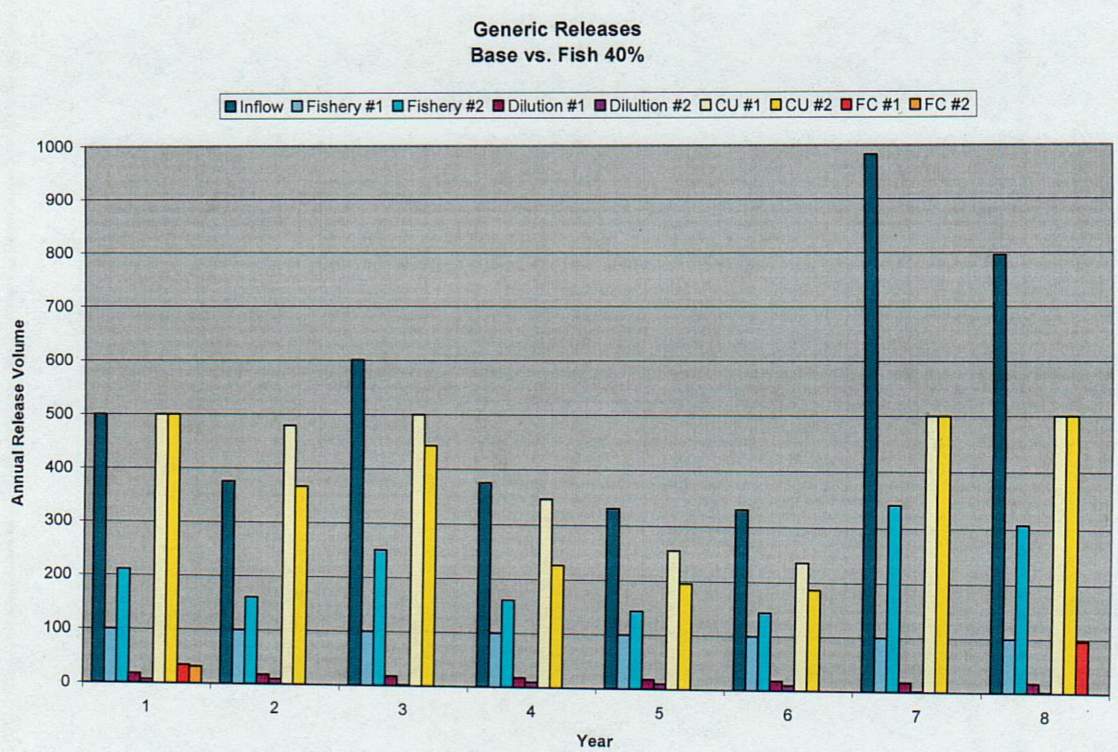


Figure 10: Conceptual Illustration of Change to a 60% Inflow Requirement

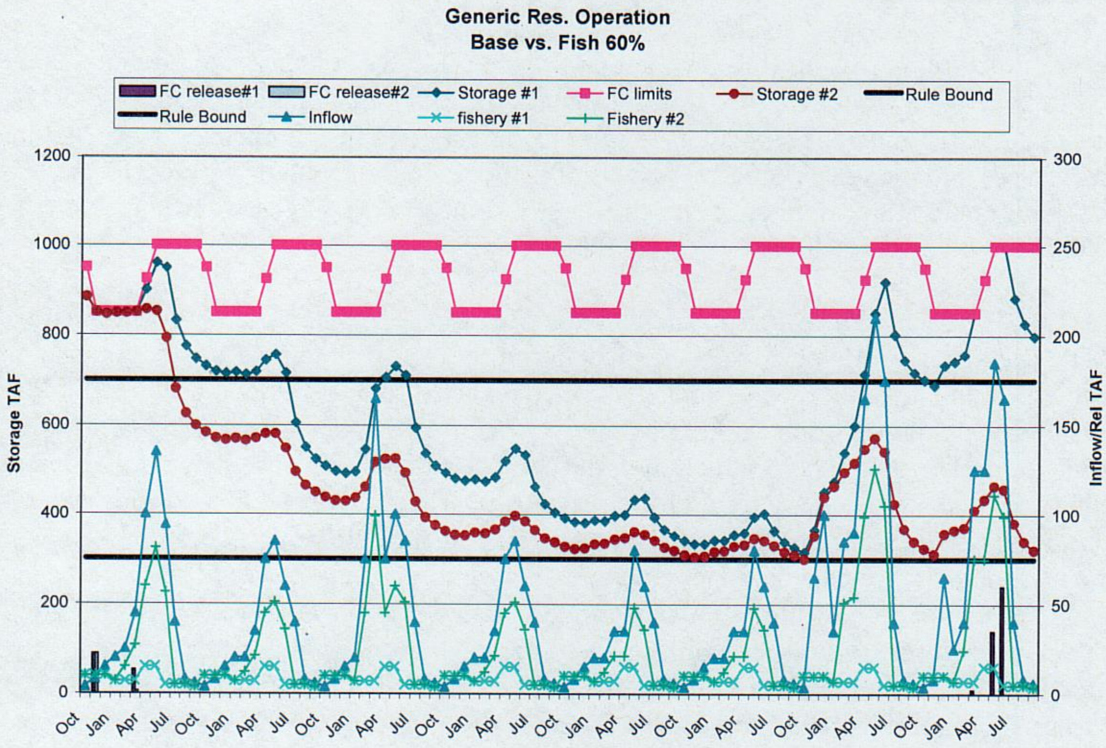
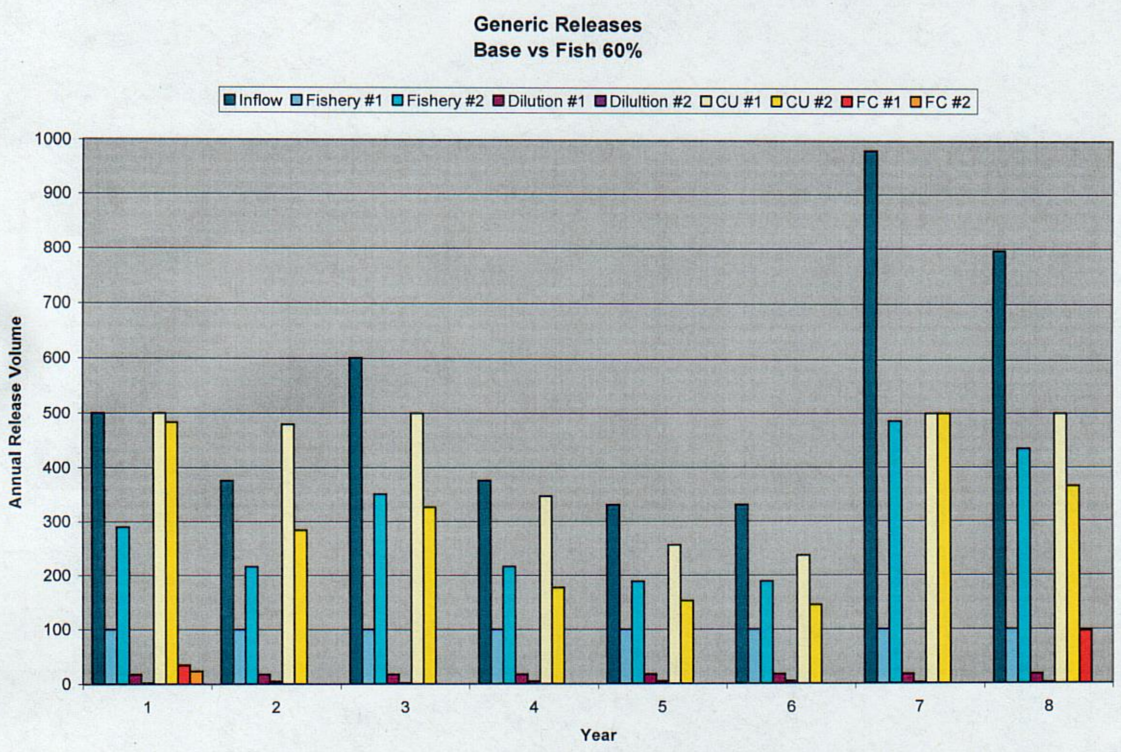


Figure 11: Comparison of Release Volumes for a Change to a 60% Inflow Requirement



B. Southern Delta Salinity Objectives

The State Water Resources Control Board first established salinity objectives to protect Delta agriculture in their 1978 Water Quality Control Plan. For the south Delta, the State Board adopted an interim implementation plan of a Vernalis objective to be met through New Melones Reservoir releases and the development of physical facilities in the Delta to provide adequate circulation and/or substitute supplies. Over the course of more than 40 years, the state has struggled to make this approach work.

The January, 2010 report *Crop Salt Tolerance in the Southern Sacramento-San Joaquin River Delta* by Dr. Glenn J. Hoffman provides the most current information on factors that impact crop production with saline irrigation water and analyzes the agricultural beneficial use needs with respect to salinity and boron of the southern Delta. Dr. Hoffman analyzed a variety of factors which influence crop growth and production in the southern Delta including irrigation efficiency, effective rainfall, and soil leaching fraction. The report provided evidence that current water quality conditions in the southern Delta can support existing agriculture without impact to production and modeling results demonstrate that water quality standards could be increased and agricultural uses would be protected. This information could provide a new avenue of flexibility in the management of the basin where multiple uses compete for a limited water supply. With the salinity objective being the most flexible, alternatives could include a relaxation of the standard when more pressing needs arise.

The information from the Hoffman Report provides a strong science foundation for developing alternatives which balances all uses of the river. Although the Hoffman report is thorough in its analysis, the SWRCB must recognize the following:

- Salinity is regulated in the South Delta and the Lower San Joaquin River solely for protection of agricultural beneficial uses. Drinking water is protected as a beneficial use in the western Delta at Delta intakes, at a higher salinity than then most protective existing agricultural standards. There are no existing drinking water uses of the South Delta or the Lower San Joaquin River, which would require permission from the California Department of Public Health.

- The management of salinity in the San Joaquin basin should not be approached merely from a traditional Clean Water Act, one pollutant loading perspective. Water supply, environmental regulations, beneficial use needs, and especially economics should be fully determined and analyzed for the benefits, cost, and tradeoffs of salinity regulation.

- Unlike many constituents, salinity impairment is neither permanent nor irreversible. The water supplies of the San Joaquin basin are prioritized to provide water supplies and to meet other environmental flow and water quality objectives. Periodic wet years already flush out these salts, and the system could be operated/regulated to make salinity regulation a higher priority if important beneficial use protection is needed in the future.

- Porter-Cologne states that water quality standards should provide for the "reasonable protection" of beneficial uses and not full or 100% protection. Applying the "reasonable level" of protection for agriculture should allow the SWRCB to grant flexibility to balance and prioritize all needs.

- Additional studies should take place to evaluate the role of effective rainfall in minimizing potential salinity impacts during various plant growth stages and leaching fraction.

- A common tool modeling tool needs to be developed using south Delta data to provide the information the necessary to the SWRCB, especially as conditions change in the basin.

While the Hoffman Report appears to be a solid update of the science that established the original salinity criteria and Reclamation supports the adoption of objectives that are supported by science, the more difficult work lies in developing an objective and implementation strategy that is fair, achievable, balances all beneficial uses throughout the San Joaquin River watershed and the Delta, and is in the best interest of the State. Such a strategy should include documentation of:

- A quantification of current riparian rights in the south Delta;

- An analysis of the water available to Delta riparian rights considering existing upstream riparian rights;

- Consideration of an appropriate consumptive use allowance for riparian rights – similar to the consumptive use allowance consideration adopted by the Central Valley Regional Water Quality Control Board in their Salinity and Boron Total Maximum Daily Load Program for the Lower San Joaquin River at Vernalis;

- An analysis of salinity loading in the South Delta above the allowed consumptive use;

- An analysis of the conditions under which the standards are not currently met;

- An analysis of the relationship of San Joaquin River outflow to flow in South Delta channels, and identification of other factors influencing flow (perhaps through technical studies and improvements to the DSM2 model);

- A state-level drought protection policy, including a beneficial use analysis/prioritization for waters in the San Joaquin River watershed and the Delta;

Reclamation suggests the development of this information in order to inform the development of an implementable regulatory strategy, or at least the development of a flexible strategy to ensure their ongoing resolution through a highly changing watershed. Reclamation is currently responding to Cease and Desist Orders that may partially respond to these information needs and also participates in the CV-SALTS Lower San Joaquin River Committee, which could potentially be relied upon where the information needs overlap.

Attachment A:

Specific comments on the October 29, 2010 Draft SJR Flow and southern Delta Salinity Technical Report

1. Page 30 Head of Old River Barrier discussion

   The physical barrier at the head of Old River appeared to improve survival through the Delta of juvenile salmon originating from the San Joaquin Basin by 1) keeping fish out of Old River and 2) increasing the flows in the San Joaquin River downstream of Old River. The non-physical barrier (Bio Acoustic Fish Fence) only keeps more of the fish in the San Joaquin River when it is on. Although the non-physical barrier appears to deter fish into the San Joaquin River, it has been shown to have predation rates at the barrier of 23 to 27 percent (Bowen, et al., 2009 and Bowen et al., 2010). Your report states that predation was less in 2010, but the numbers reported are the loss from release to the barrier (including the barrier) and may not all be attributed to predation. The predation identified at the barrier can be attributed to predation due to the assessment of 2-D tracks at the barrier.

2. Page 39, 3rd paragraph, last sentence: " Juveniles that use shallow water habitats become larger during smoltification than juveniles that do not, which can lead to earlier exit of the Bay-Delta and therefore gain preferred timing of ocean entry, along with a greater ability to evade predators along the way."

   Comment: Preferred timing of ocean entry is likely to change between years and with climate change: thus the goal is to have a diversity of habitats that salmon use so that the different life history strategies can be supported in all years and there is diversity in when the fish enter the ocean. Shallow water habitat is not always better than another habitat types. Multiple types of habitat are needed to maintain diversity in life history strategies and protect the population from catastrophic losses.

3. Page 49: The VAMP and pre-VAMP CWT studies were similar and involved releasing hatchery fish at various locations on the SJR including: Old River, Jersey Point, Durham Ferry, Mossdale, and Dos Reis (Figure 3-5), and recapturing those fish downstream in the Delta.

   Comment: Recoveries were also made in the ocean fishery and were included in many of the analyses, including the most recent analyses (Newman 2008).

4. Page 52, full paragraph: "NMFS explains that anomalies to the flow relationship (i.e., subsequent low adult returns during high spring flows) can be due to poor ocean conditions upon juvenile entry or low adult returns in the fall prior to the high spring flows"

   Comment: It should be noted that the noise in the escapement versus flow relationships are likely due to multiple age classes returning in the escapement. Although most will be 3 year old fish, there are likely 2 year old fish and fish older than 3 in the escapement. The variation in year classes contained in the escapement likely changes between years and may be more pronounced in years when the 3 year old escapement is low due to low flows 2 ½ years earlier.

5. Page 57: The most recent VAMP annual technical report for 2009 yielded similar results to 2008 during a period with mean flows of 2,260 cfs. Total survival was calculated by combining survival estimates from the Old River route (survival of eight percent) and the SJR route (survival of five percent), and estimated that only six percent of salmon survived through the Delta to Chipps Island

   Comment: This is an incorrect characterization of the VAMP results in 2009. "Total smolt survival through the study area was estimated to be 0.06…" (page 56, 2009 Annual Report). The study area was from Durham Ferry to 6 exit points in 2009 (Old and Middle Rivers at Highway 4, to the CVP trashrack, outside of the entrance to Clifton Court Forebay, at the mouth of Turner Cut and on the San Joaquin near Channel Marker just downstream of Turner Cut) not Chipps Island. So survival between the two years is not comparable and was likely much less in 2009 than in 2008 since survival for half the distance in 2009 was similar to the greater distance to Chipps Island in 2008.

6. Page 58: 2nd full paragraph, last sentence "In addition, predation rates were much lower in 2010 than 2009, ranging from 2.8 to 20.5 percent for each group of smolts released upstream (Bowen et al. 2010)".

   Comment: Although this is what is stated in Bowen et al., 2010, it is unknown if the mortality observed from release to the barrier is all due to predation. It should be stated as loss, not predation rates, between release and the barrier, was lower in 2010 relative to 2009. It should be noted that actual predation at the non-physical barrier, as identified through 2-D tracks, was 23% (ranged between 16.9 to 57.5%) in 2010 and 27% (ranged between 25.2 and 61.6%) in 2009 and is biologically significant in both years. The difference in predation between 23% and 27% is likely not statistically significant due to the large variability in predation within both years.