Preliminary DRAFT –5/26/00

Assessment of Delta Cross Channel operations and a Potential Second Sacramento River to Mokelumne River Connection

Introduction

Presented below is a proposal for water quality and north Delta fisheries and facilities evaluations to address the issues and impacts of Delta Cross Channel (DCC) operations and a potential second diversion between the Sacramento and Mokelumne Rivers. The DCC and the second diversion would serve the same primary purpose of improving water quality in the central Delta, but the second diversion would be screened to protect fish better. The second diversion would most likely be at Hood, but other locations will be considered.

The CALFED Preferred Alternative includes future North Delta water management strategies to improve water quality including the evaluation of various DCC closures and Environmental Water Account (EWA) operations and a possible second connection channel between the Sacramento and Mokelumne Rivers to address water quality degradation. The actions to be implemented will be selected in the context of CALFED's goal of improving fish, water quality and supply reliability.

The June 1999 *Revised Phase II Report* stated that, "A screened diversion at Hood will be evaluated and may be implemented if necessary." The required action is the evaluation and not the implementation. In very general terms, this report describes the nature of the evaluation and the conditions that must be met to proceed with the screened diversion. The evaluation must confirm that water quality goals can not be met by revising DCC operations, and show that a 0-4000 cfs diversion can meet water quality goals without adverse impacts on fish populations.

North Delta Conveyance Decision Steps

The following describes the programmatic decision process for North Delta conveyance.

- Study and evaluate a screened connection between the Sacramento and Mokelumne rivers at Hood with a range of diversion capacities up to 4,000 cfs as a measure to improve drinking water quality in the event that the Water Quality Program measures and DCC operations do not result in continuous improvements toward CALFED drinking water goals. The Hood diversion would include a fish screen.
- The Hood diversion is a contingent action to be considered only after three separate assessments are satisfactorily completed:

  1. A thorough assessment of DCC operation strategies and confirmation of continued concern over water quality impacts from DCC and EWA operations;
  2. A thorough evaluation of the technical viability of a Hood diversion facility; and,
  3. Satisfactory resolution of the fisheries concerns about a Hood diversion facility

  These evaluations will start immediately and will be completed within three years following the CALFED's programmatic EIS/EIR Record of Decision. If these evaluations demonstrate that a Hood diversion facility is necessary to address drinking water quality concerns and it can be constructed without adversely affecting fish populations, design will commence and a project specific EIS/EIR will be prepared. The facility will be constructed as soon as the design, environmental documentation and permitting are finalized.

Major Issues to Be Assessed

The major issues to be addressed in the evaluations include:

1. Can the unscreened DCC be reoperated to provide additional fish protection while achieving CALFED's water quality goals?
2. Can CALFED's Water Quality Program insure continuous improvement in water quality without a new diversion?
3. What water quality improvement and fisheries effects are associated with various levels of flow through a new diversion?
4. Will a Hood diversion be more favorable for fish than a DCC, considering that it would:
   - Exposes young salmon and other fish to a new major diversion and screen,
   - May impair cues of migrating fish on the Sacramento, Mokelumne, and San Joaquin Rivers,
   - May block or impair upstream passage of anadromous species, and
   - Reduces flows in the Sacramento River between the diversion and the DCC.
5. If the answers to the questions above demonstrate a need for a new diversion, what size diversion facility can be built and operated in conjunction with the DCC to improve water quality without adversely affecting fish populations?

Critical Policy Assumptions

The following assumptions will underlie the evaluations:

1. The total combined diversions at the DCC and the Hood diversion will not exceed the capacity of an open DCC.
2. To assess the need for water quality improvements, this program will need to define current conditions and assess how DCC reoperation and a Hood diversion could meet CALFED water quality goals.
3. Any fish screen at Hood will be designed to protect downstream migrant salmon, steelhead, American shad, sturgeon and delta smelt(?).
4. The criteria for downstream migrants at a Hood screen will be based on existing policies of NMFS, USFWS and DFG, as they may be modified based on ongoing studies. No new studies related to criteria for downstream migrants are needed as part of this program.

6. Any Hood screen will not be designed to protect fish eggs and larvae less than 20 mm long. If protection for eggs and larvae is needed, it will be provided through curtailment of diversions.

Proposal

The following is a brief outline of the measures to be taken during the next three years to provide the information needed to decide whether to proceed with construction with a Hood diversion or to rely on some modification of DCC operation to meet water quality and fishery goals.

Implementation of CALFED's Water Quality Program would begin immediately and involve:

- **Refine and clarify CALFED's drinking water quality goal.** CALFED has proposed a programmatic goal of continuous improvement in Delta drinking water quality. Before actions to improve drinking water quality can be selected, the relationship between the CALFED goal and current or potential drinking water quality standards must be clarified.

- **Identify and implement initial actions to improve Delta drinking water quality.** Actions currently described at a programmatic level must be translated into project-level specificity, planned, funded, and implemented.

- **Evaluate initial actions to improve Delta drinking water quality.** The benefits of actions implemented within the next three years will be monitored. For the three-year decision point, however, the primary information on benefits expected from initial actions will be based on modeling studies.

Long-term assessment of the DCC would start immediately and would be conducted by a team with members from the CALFED Operations, fisheries, fish facilities and water quality teams. This assessment would include the general tasks listed below:

- Determine operations to improve fishery protection by monitoring effects of present operating criteria and experimental variations of present criteria.

- Monitoring the water quality effects of the present and experimental operating criteria.

- Determine whether any DCC reoperation in combination with implementation of CALFED's Water Quality Program meet the water quality, water supply reliability and fishery goals.

The Hood diversion facility and joint operation with the DCC assessment will also start immediately an will address the following general tasks:

- **Conduct modeling and analysis of a potential screened diversion.** Study elements would include, but not necessarily be limited to: evaluation and modeling of operation of a Hood screened diversion facility of various sizes up to 4000 cfs; evaluation and modeling of operation of the DCC in conjunction with a Hood diversion structure; consideration of lessons learned from other ongoing fish screen programs; assessment of the effect of a Hood screened diversion on fish populations including upstream migrants and downstream migrants in the Sacramento, Mokelumne and San Joaquin systems; and definition of "adverse effect" on fish populations.

- Determine whether the above evaluation indicates a Hood diversion operated in combination with the DCC and the Water Quality Program would meet water quality, water supply reliability and fishery goals.

In accordance with CALFED policy, progress on all three segments of the program would be shared with the Delta Drinking Water Council or its successor for policy guidance, and both a Delta drinking water quality expert panel and a fishery science panel for technical review and recommendations.

Decision Process at End of Three Years. By the end of three years, staff would summarize results and draft recommendations as to whether to proceed with some modification of DCC operations alone, or to proceed with some modification of DCC operations plus construction of a new Sacramento-Mokelumne Channel. This summary and recommendations would be reviewed and commented on by the Delta Drinking Water Council, a Delta drinking water quality expert panel and a fishery science panel. Staff would then prepare a final summary for policy level review and decision as to a course of action to meet the three-year deadline.

Preliminary DRAFT –5/2/00

Assessment of Delta Cross Channel operations and a Sacramento River Diversion at Hood

Possible Elements of Fish Facilities an Fisheries Study Plan

This phase of the evaluations would start by gathering some basic technical input which would be sufficient to make some policy decisions about the basic features of the Hood facility and the operating criteria to be met. This could narrow the studies considerably in relation to those described below. The studies described below maybe broader studies than necessary or possible to achieve within the allotted time.

A fully developed North Delta diversion facility could include a fish screen, upstream fish passage facilities (locks, ladders, screen openings, etc.), fish bypass facilities (including fish lifts), fish return facilities, channel diversion pumps, and various configurations of control structures to control the volume of water entering the conveyance channel. The operating rules for these facilities would depend on the requirements for both upstream and downstream migrating fish, and on their impacts on habitat shifts resulting from increased flows in the eastern Delta on Delta species.

In general, initial assessments and studies would include modeling and analyzing the impacts of a various configured diversions. Much of the evaluation will draw from information either already being gathered (or that will be underway shortly). One of these focused efforts could include the construction of a test facility at the Delta Cross Channel. These and other efforts are described below.

Specific Facility Components and Fishery Issues

To develop adequate studies and evaluations, we must first identify the criteria to be used and the range of proposed facilities or features we are considering. Any proposed facility would have to be designed with the following criteria in mind:

- Survival goals for juvenile fish (including screen and fish lift if applicable): 95% or greater survival (not including indirect losses) of salmon (all runs) and steelhead. The facility will be designed with delta smelt, splittail, American shad, striped bass, and sturgeon in mind, but due to their limited presence and our uncertain ability to protect or pass them efficiently, criteria should not be set. Incidental protection of other species will be provided using the criteria set for these species.
- Eggs and Larvae Entrainment: Design of screen facilities for E&L will not be considered. Diversion may be reduced or shut off during E&L pulses if necessary. For a through-Delta alternative, this may is not a significant issue unless E&L are damaged as a result of passage through the screen (or pumping plant if applicable).
- Upstream Passage Goals: "Insignificant" delay to migrating salmon, steelhead, shad, striped bass, sturgeon. Possible screen opening passage for these and other fish based on "real-time" monitoring (for instance, delta smelt may not pass a ladder well so pass them operationally). Fish passing to the "wrong side" of screen structure may have a difficult time getting back to their stream of origin. Possible passage opportunities back to their stream of origin should be investigated or considered.

Listed below in no particular order of importance are a number of issues or project features that will need to be investigated:

- A North Delta diversion may have to operationally deal with significant seasonal pulses of eggs and larvae. However, entrainment may not be a significant issue if the larvae are not damaged by passage through the facility (since this is a "through-Delta" option).
- Salmon and steelhead fry will have to be protected, but these fish should pass the area quickly since there is little rearing habitat available on the Sacramento River near Hood and flows are generally good.
- The facility must include upstream passage facilities for adult fish including salmon, steelhead, delta smelt, splittail, sturgeon, striped bass, and American shad. A variety of options are necessary including fish lifts, false weir ladders and permanent or periodic screen openings. The performance of these facilities, however, is largely unknown for most of the species of concern (especially delta smelt that might be there in dry years and splittail). Also of concern is the additional risk of fish wandering the Central Delta and resisting passage through the conveyance facility or straying as a result of this facility is largely unknown.
- On-river screens will be considered if the maximum diversion is no larger than 4000 cfs and is operated according to established hydraulic criteria and flows in the Sacramento River. The screens shall have uniform hydraulic flows under all possible river and diversion conditions.
- Off-River screens with juvenile collection facilities may be considered for options that include permanent screen openings for upstream migrants.
- A low head canal pumping plant behind the screened diversion might be considered to control the diversion and screen hydraulics. Operations will need to be defined in the initial assessment process. Without a pumping plant, operation of the channel may be significantly constrained during periods of diminished or reversed flows due to tidal action.
- A flow control structure in the channel may have to be considered if the diversion will be limited to 4000 cfs and there is no pumping plant to control flows.
- Maintenance access to screen units will be provided under all river conditions if screened diversion is required.
- Wedgewire screens will be used.
- Surface booms (with underwater deflectors) to deflect floating debris (and possibly even juvenile fish) away from the screen will be considered.
- Screen brush cleaners or comparable cleaning devices will be provided.
- Sediment removal and/or resuspension systems will be considered for all facilities.

Specific Action Plans to Investigate Fisheries/Facilities Impacts

This is the section that needs to be more fully developed and commented on.

Planning Studies that can or should begin immediately – (and are actually feasible to quickly initiated):

Collect Site Specific Data near Hood (see other section for fisheries studies)

- Survey the river bathemetry (needed for modeling)
- Analyze historic hydraulic data (needed for modeling and boundary conditions)

- Set up additional water quality and hydrfaulic monitoring stations on the Sacramento River at Hood or on the lower Mokelumne River if necessary
- Collect suspended sediment and bed load information

Conduct Delta Operations (and System) Modeling with a Proposed Diversion Facility

- DSM2 and CALSIM modeling
- Investigate Flood Control Issues (Flooding of Interior Delta Area?)
- Conduct particle tracking analysis
- Investigate various flow splits (diversion conveyance)
- Investigate operations scenarios (flow restrictions/channel control with gates or pumps/water quality triggers/fish triggers/etc.)
- Look at tide phasing changes in the Delta
- Look at modeled water quality changes
- Investigate head available to possibly drive a bypass system (if needed)

Conduct 2-D Numerical Hydraulic Modeling

- Look at alternative facility configurations and function under various flow conditions
- Analyze range of flows, velocities, and head differentials around the proposed facility that might be occur
- Investigate potential sediment transport/deposition issues
- Investigate River Hydraulic Degradation Potential

Conduct Physical Modeling

- Using boundary conditions and operations scenarios from the numerical models, set up model of the Sacramento River diversion

Conduct site specific fisheries monitoring of the North Delta and Mokelumne area:

- Analyze existing database and old studies in the North Delta area.
- Conduct sampling to investigate the temporal distribution of fish in the North Delta area.
- Conduct fisheries sampling in the Hood area to investigate vertical and horizontal distributions of adult and juvenile (down and up) migrating fish that may be in the area to help in planning facility layouts.
- Investigate timing and spawning/movement triggers of downstream migrating egg and larval in the Hood area (including delta smelt, striped bass, American shad, splittail, and sturgeon).
- Investigate the potential damage to migrating fish and greater exposure to predators, poor water quality, and pumping plants in central and southern Delta by doing more control studies of marked and released fish.
- Compare habitat conditions for juveniles and adult fish and evaluate threats of the possible new fish routes for various flows and residence times for various hydrology.

- Radio tag or monitor juvenile fish movements in the North Delta more intensively to investigate potential fish residence in Delta, downstream migration, and potential for recirculation of fish around or near a fish screen.
- Control experiments using CWT or radio tagged fish to look at the effect of lower net downstream flows below Hood on migration, timing, and success.
- Conduct some pilot studies of delta smelt spawning habitat enhancement in the eastern Delta area (on the Mokelumne side of the proposed diversion channel) in anticipation of having to mitigate for not being able to pass these fish upstream around a screen.
- Expand fisheries sampling at the Delta Cross Channel to better understand gate operations.

Complete Fish Screen Criteria Development for Juvenile Fish – Analyze fish movement and survival along long screens:

- Evaluate studies underway to address salmon and steelhead passage along long screens being conducted at GCID starting in summer 2000.
- Evaluate data from the UC Davis Treadmill studies. This already being done.
- Coordinate studies at the TFTF for application to the North Delta. This should not require much of a change in work scope.
- Consider additional testing for juvenile sturgeon if they may be potentially listed. Consider lab tests at UC Davis Treadmill
- Investigate potential damage to entrained larval and juvenile fish passing through a screen system - mesh size considerations. This should be done in a lab environment and with the TFTF studies.

Initiate Fish Passage and Ladder Investigations

- Analyze (research) various locks and ladders around the world that are designed to pass fish species similar to Delta species.
- Conduct scaled model lab experiments to look at various ladder configurations and velocity profiles of various ladder options that may be considered for Delta Species.

Fish Release Studies - If fish bypass pipes are considered at Hood, various release strategies must be considered. Hood would use a long pipe, instead of a truck or barge, and release directly into river downstream.

- Lab studies could investigate passage problems in long pipes for Delta species
- Expand studies at GCID and the TCCA Red Bluff screens focusing on salmon passage in pipes.
- Expand TFTF release site study to look at predation, fish accumulation at various release sites and possible release pipe configurations

Fish Bypass Lift Evaluations – If salvage/collection facilities are necessary

- Evaluate data from Red Bluff Research Pumping Plant and proposed TFTF studies on fish lifts. Include data on larval fish survival. Data needs are similar so not much change in work scope is anticipated.

- Install new fish lift in Bay #4 at Red Bluff RPP to investigate long term pump reliability issues.
- Investigate passage of adult fish through the fish lifts including salmon, sturgeon, splittail, and delta smelt (since they could get into bypasses) since they could be entrained. This could be accomplished at the RBRPP or the TFTF.
- Evaluate proposed facilities and operations under a range of flows

"Pre-Hood" Diversion Studies Designed to Investigate Upstream Attraction/Paggage Issues

Initial studies could be implemented without constructing a new Hood channel, but these investigations might require construction of monitoring facilities and reoperation of the Delta Cross Channel. These changes might require additional environmental documentation and operations agreements before implementation or studies.

Possible attraction issue studies could include:

- **Delta Cross Channel Investigations** – This facility might give the best insight into Delta fish migration issues and incremental water quality changes. The DCC is close in proximity to the proposed Hood Diversion. Although this channel is considered a navigation channel, the study and corresponding facilities could be developed and operated when the gates might otherwise be closed.
  - Construct large fish trap downstream of the Delta Cross Channel gates. Control flows into the DCC from 1000 to 4000 cfs (net daily) by cracking the gates and investigate the numbers of salmon that might be attracted into the fish traps during and following a change in flow. It might be appropriate to investigate different configurations of fish trap entrances. These insights might help in channeling adults into a future ladder, lock, or simple passage through a screen opening.
  - Investigations might also include tagging adult salmon caught above Hood or in Mokelumne, then transported back to Chipps Island and released. These fish could then be followed to look at their passage back upstream through the Delta (with Cross Channel open to some degree). These studies would investigate the potential delay or the inadvertent passage of non-Sacramento fish over the barrier (DCC). (Do Sacramento Fish only go up the Sacramento River, or do they wander through the Delta channels? Do Mokelumne fish travel up the Sacramento, then cut across?)
- **Sacramento Deep Water Ship Channel Ladder** - Evaluate passage/attraction at the SDWSC Locks adjacent to Sacramento. There is already a known attraction issue there due to lock leakage. Construction of a pilot facility here could be beneficial to that areas water quality and fish attraction problem. I would also be relative to the Delta attraction issue. Allowing some water to enter the channel might help determine the influence of various flows into the channel.
- **Radio Tagging of Adult Salmon** – Conduct an extensive fish tagging effort that will look at passage of adult fish through the Delta. Fish could be tagged in the Suisun Bay area.

Ladder and Lock Investigations in the Field

- Install pilot lock or ladder facility in the Delta using various attraction flows. This could be constructed at the Delta Cross Channel after some initial study on the attraction issue. An alternate location for a pilot facility would be at the SDWSC locks.