RON OTT/SAC

FISH SCREENING AND FISH PASSAGE ANALYSIS

of the

CALFED BAY-DELTA PROGRAM
PHASE II DELTA CONVEYANCE ALTERNATIVES

Committee Status Report of the

CALFED Interagency Fish Facilities Technical Team

(Representing DWR, DFG, USBR, NMFS, USFWS, USGS & USEPA)

Prepared under the Direction of

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July 28, 1997

INTRODUCTION

An interagency Fish Facilities Technical Team composed of multidisciplinary agency fish passage experts and an independent advisory panel was assembled to investigate the major fish passage facility issues and alternatives within the CALFED Bay-Delta program. In addition, the Team assisted in the development of viable conceptual fish facilities and examined the feasibility and impacts of proposed fish facilities to be incorporated in the Bay-Delta solution.

The Team was assembled in May 1996 and jointly chaired by Dan Odenweller (DFG) and Darryl Hayes (DWR). The agency and consulting staff (Team members) involved in each of the approximately quarterly workshops is presented in Appendix A. Three outside fish facility experts were selected by the co-chairs and approved by the larger Team to provide balance and expertise on the facility alternatives and recommendations. The advisory panel included Ken Bates (Washington Department of Fisheries and Wildlife), Dennis Dorratcague (Montgomery-Watson Engineers), and Ned Taft (Alden Research Lab).

In addition to the organization and charge of the larger Fish Facility Team meetings, a smaller group was convened in spring 1997 to establish better communications between CALFED staff and a subgroup of the Fish Facilities Team. This smaller group dealt with the detail facilities and planning developments specific to the 17 alternatives being considered in Phase II of the CALFED Program, while the larger group was charged with determining the technical feasibility of screening at two general areas (i.e. north and south Delta). This group met on three occasions during April and May 1997 and was effective in helping CALFED and the Technical Team communicate with each other on the issues and needs. The Co-Chairs of the Fish Facility Team used this information and those of the Team to prepare an evaluation of the alternatives for CALFED consideration. Although the views on the specific alternatives have tried to incorporate the general recommendations of the Team on the north and south Delta fish facilities, these views remain those of the authors since they were not adequately reviewed by the Team. This review is included in Appendix B.

Several informational documents, "white papers", management questions, modeling results and presentations were prepared for each of the workshops. These documents as well as material prepared for previous evaluations of Delta alternative facilities (such as the "Peripheral Canal," the "North and South Delta Program," and the "Five Agency Salmon Team" evaluations) were used in building a foundation for a set of recommendations to CALFED on Fish Facilities planning. However, Team requests for more specific information on the CALFED alternatives, including proposed operations, and fishery protection goals were unanswered since CALFED had not advanced sufficiently to provide this detail. As a result, the team proceeded without the benefit of this information. These requests are restated as "Information Needs" in this report. Some of the referenced material includes the following:

- "Fish Facility Development Plan for the CALFED Bay/Delta Solutions Process (or "Where do we go from here"), dated July 22, 1996 by Darryl Hayes. This paper presented a series of questions in an attempt to focus the participants on the process, and the information needs.

- "Fish Facility Planning Considerations", dated October 1996 by Dan Odenweller. This brief discussion paper of fish facilities planning considerations included a list of questions to be answered by the appropriate CALFED working groups.

- "CALFED Fish Screening Assignment, Basis for Design Assumptions", dated November 15, 1996 by Dan Odenweller. This document describes a Team assignment to develop fish screens for a total of 15,000 cfs, in some combination from the north and south Delta.

- "Evaluation Of The Feasibility Of Protecting Downstream Migrant Chinook Salmon Smolts In The Sacramento River And San Joaquin River with Physical Facilities," dated July 15, 1991, by the Five Agency Salmon Team.

- Various workshop handout material on fish screening issues, hydraulic modeling of site specific designs, design criteria and meeting notes, dated December 1996 through May 1997 by Darryl Hayes and others.

After the Team reviewed and discussed the fish facility issues and design concepts being considered, a set of Team consensus recommendations was developed and is provided here. This document was thoroughly reviewed by the Team and can be used to assist CALFED in further developing and narrowing the alternatives from their perspective. Written responses from several of the Team members are included as Appendix C.

The conceptual design of the proposed fish passage facilities (juvenile and adult) relied on the vast experiences of the fish facility experts and investigations into several state-of-the-art fish facilities. Some of the projects these concepts were based on included the proposed Glenn-Colusa Irrigation District Screen (3000 cfs), the Tehema-Colusa Canal diversion (3,000 cfs), the Red Bluff Research Pumping Plant, the Tracy Fish Facility Investigations and several new fish screens in the Northwest. Conceptual renderings of proposed north and south Delta fish facilities are shown on Figures 1 and 2.

Although the Team considered several screening concepts and focused many of it's recommendations on one particular design (the off-channel multiple bay design with fish bypasses), it is important to understand that there are other factors that may influence this option and the reasons behind that choice. Until further development of the alternatives and flow criteria are established, several concepts, such as "In-River" screens at multiple diversion points, or new applications of new technologies may be reconsidered. These options generally have site specific limitations, flow requirements, operational concerns or will require long lead times to develop the necessary biological or hydraulic criteria. Therefore, the Team decided to focus on a concept that we all believed would be the most flexible and adaptive as well as not going too far beyond our current understanding and screening criteria developed for larger fish screen structures. This approach helped us focus on the question of feasibility, research needs and significant issues which was our charge.

The Team will continue to meet on an approximately quarterly basis, or as necessary, as the CALFED Bay-Delta Alternatives are refined. With new information, the Team will review and investigate refined concepts, determine construction sequencing or phasing options, develop specific testing or focused research programs, perform hydraulic and operational models, and report findings to CALFED.

Fish Facility Team Recommendations for the CALFED Phase II Alternatives

June 2, 1997

GENERAL

Note: No screening facility has been or can be constructed and operated without some negative impacts. This will also be true of all proposed facilities, especially considering their scale and inclusion of elements that have limited track records (e.g. "fish friendly" pumps). In general, the greater the flow diverted the greater the impact. These impacts are due to the screening and bypass process itself and are in addition to the impacts of removing water from a river system.

1) Based on the Fish Facilities Team Analysis and their collective professional judgement, there are no technical limitations of constructing fish protection facilities for anything up to 15,000 cfs diversion capacities. However, a size of about 3,000 cfs is the largest screening example in existence. Therefore, breaking the facility into a series of smaller screens (multiple bay units of say 3,000 cfs) is preferable. In addition, there are hydraulic and fish exposure issues that are addressed by this size of unit.

2) Facility operation and function should be made with the understanding that the entire context of flow schedules, storage, and fish and ecosystem needs are balanced. Any alternative should be fully integrated hydrodynamically and operationally through rigorous modeling of all components together in the context of Delta hydrodynamic issues. These studies may dramatically effect fish migration and fish facility operations. Facility design may be modified when further information is available.

3) The use of "best feasible technology" should be recommended for all diversion screening locations. Presently, for screen systems we have focused on vertical flat plate screens which meet agency criteria, however, we do not intend to limit the development or application of new technologies or configurations if they are adequately developed prior to final design. Fish screen design criteria shall apply uniformly at the North and South Delta facilities (i.e. new facilities should use positive barrier screens).

4) Fish screens will be designed to protect fish in the vicinity of the screen over one inch in length....not eggs and larvae.

5) It is desirable to keep as many fish in the river from which they came so they may continue their residence or migration.

6) It may be desirable to divert a portion of the Sacramento River and a portion of the San Joaquin River to minimize the fish impacts on both rivers.

7) It is desirable to provide diversion flexibility in the system to adjust diversions between intakes (north and south Delta) to take advantage of river flows and react to specific events like eggs and larvae and hatchery releases. However, to accommodate ultimate flexibility, full sized facilities (i.e. assuming available flow) would potentially have to be built at each intake site requiring more operational assurances and complexity.

8) Facilities which minimize fish bypass handling and decrease potential delays in downstream fish migration are preferable to facilities and alternatives that do not.

NORTH DELTA DIVERSION SCREENS (Isolated or Through Delta)

9) Diversion screens should be located as far upstream as practical, given site suitability and construction feasibility, to minimize the impacts related to the tidal influence, resident Delta fish species (such as locating the diversion further away from delta smelt habitat which we have less certainty of protecting with a screen), water quality, fish salvage, and debris handling.

10) We recommend a North Delta isolated diversion at 15,000 cfs over all other North Delta conveyance options (primarily based on fish facility performance). The Team agreed that it made little sense to screen at Hood and then expose the concentrated fish left in the river to an unscreened diversion at the Delta Cross Channel (or allow unscreened cross Delta flows). Therefore, the Team felt that the DCC gates should be closed most of the year as they are now.

11) To avoid potential impacts to upstream migrating fish (salmonids, Striped bass, sturgeon, longfin smelt, etc.), an isolated facility is preferable to a screened through Delta conveyance option. Impacts may include delays, passage blockage, straying, and temperature related stresses.

12) If "through-Delta" fish screen facilities are considered, they must deal with passing a variety of fish which may be falsely attracted to the back side of the fish screen. A variety of options are necessary including fish lifts, false weir ladders and periodic screen openings. The performance of these facilities, however, is largely unknown for many Delta fish species.

13) Positive barrier screens should be located off-channel in multiple bayed, Vee configured arrangements to operate with uniform hydraulic conditions under all possible river and diversion conditions. Gates to isolate individual screen bays should be provided for hydraulic performance, operational flexibility, and maintenance. Wedgewire screens (with adjustable baffles) will be used.

14) Physical model studies (in addition to numerical model studies) should be used to assist in designing a major fish facility and evaluate site hydraulic conditions.

15) Numerical Model runs indicate that an acceptable velocity and flow distribution can be achieved at the screens at diversions ranging from 2,000 to 15,000 cfs, even at extreme river flow conditions.

16) Clean screens are essential to function. Surface deflectors, trash racks with automated debris removal systems and screen brush cleaners or comparable devices are necessary.

17) Sediment removal basins and resuspension systems should be considered for all facilities.

18) On-river screening concepts should be considered for concentrated diversions of 5000 cfs or less, or where hydraulic conditions or maintenance considerations would be favorable to their development.

19) A low head canal pumping plant behind the fish screened diversion is essential for the controlled hydraulic performance of the screen and bypass system.

20) Fish screen bypasses with "fish friendly" water pumps/lifts will be required. Such pumps are experimental, but the preferred alternative. Fish pumps/lifts will be required to induce bypass flow and overcome differential head in return pipes. The committee feels that the fish passage effectiveness of appropriately sized pumps is a reasonable expectation based on tests being conducted at Red Bluff with large pumps (e.g. internal helical) and lifts (e.g. Archimedes).

21) The fish bypass should be a closed pipe (as opposed to an open channel) and about three to five percent of the total diverted flow. The bypass will exit fish in the center of the main river channel at near invert depth. The bypass pump/return system design will have to balance pump head, velocity, passage, and predation issues.

22) The team concurs that the diversion must be designed and operated such that a particle released from the bypass will not recirculate into the diversion intake channel. The maximum bypass length should not exceed 5000 feet.

23) Additional storage capacity south of the Delta and "in-canal", can be considered

to help balance water requirements with water withdrawal rates in consideration of fish protection needs. Added storage would permit withdrawals to be curtailed or ceased during critical fish passage periods. For example, the ~40 miles of canal created by an isolated conveyance would represent additional storage in itself.

SOUTH DELTA SCREEN FACILITIES

24) Added complexities of species, temperature, fish hauling, and debris conditions in the South Delta will increase the cost and risk of any facility at that site.

25) We are not in favor of this alternative as a stand alone source for pumped water because it would draw Sacramento River water across the Delta leaving us with much the same problem that we now have (given existing aquatic habitat and hydrodynamic conditions in the Delta).

26) The requirement of a south Delta facility to collect, sort, hold and truck fish was viewed by the Team as a major disadvantage (viewed as a fatal flaw by some) of this alternative. A facility here would be best used as a backup facility to a north Delta diversion facility or used for occasional system operational flexibility.

27) Debris is a major problem with the existing louver facilities. Debris loading is increasing as new aquatic plants increase in diversity and abundance. Any new facility will have to include effective debris management systems.

28) The facility type shall be of the same type as considered in the North, except that additional provisions for debris and extreme flow variables be incorporated (See #33 and 34). Due to shallow channels, the screen invert would be higher and the screen length longer. This would require more bays (to reduce fish screen exposure in any given bay) and higher capital costs.

29) A multiple bayed, positive barrier Vee screen should be constructed in an off-channel configuration much like that proposed for the north Delta. Each bay shall have automatic flow control structures and gates to control the hydraulics from the dynamic tidal filling of the Clifton Court Forebay.

30) The screens will likely have to be sized 50 to 100 percent larger (when placed at the CCF intake site) than the pumping capacity to overcome CCF inflow (even if control gates are installed). An isolated conveyance facility putting water in CCF could reduce the SD screen sizing requirement (unless more intake flexibility is desirable).

31) Fish shall be collected at the bypasses and transported back to the Delta away from the hydraulic influences of the pumps with in-river considerations for

predation, temperature, water quality, diel, tidal and lighting issues. Fish holding facilities shall not be designed like the existing system due to the problems with debris, hydraulic head, predation, etc. Fish sorting may be considered as well as "fish friendly" lifts, debris separators, and alternative fish transport methods (barging?).

32) There are at least water quality and possibly fish or other ecosystem benefits for maintaining some level of pumping facilities in the South Delta. We suggest that, as a strawman, something like a third of the total export capacity be provided with best technology fish protection in the South Delta. Larger facilities may be constructed for added flexibility, but this comes with added cost and requires more assurances for proper operation.

1/3 15,000 or 5,000 cfs

33) Any new fish facilities contemplated for CCF should be placed at the intake to minimize predation. Although there was not a specific disagreement amongst the Team, there was not a consensus that a screen that could supply the full capacity of the SWP and CVP diversion inflows could be built in the CCF or the surrounding South Delta.

34) The function of CCF will still be necessary to prevent cavitation at the pumps and to stabilize water levels in the south Delta. CCF may be required to be enlarged to meet the demands of both the CVP and SWP if there is an intertie.

ENLARGE

35) The existing Tracy louver facilities require major capital improvements merely to keep them operational for the next 10-15 years. Our Team recommended a replacement facility there using best feasible technology positive barrier screens. This facility could be used as a pilot facility for expanded facilities and even be a part of future screen facilities in the South Delta. However, upgrading the Tracy Fish Facility should be done within an overall, long-term solution package that has been committed to. Improving these facilities for the interim, on a parallel track, provides an incremental benefit, but it should not serve to pre-select a solution that would not otherwise be chosen or delay a comprehensive solution. The latter would clearly be to the detriment of the resource.

INFORMATION NEEDS

The Fish Facility Team specified that there are certain information needs requiring resolve before any concept can be finalized and detailed. Several of these needs are currently being addressed by various efforts, including CALFED, but are included here because of their importance to fish facilities development.

General Management Questions and Goals

What are the management goals for the species in question? How much operational flexibility should be built into the fish facility operation? What species and lifestages should be protected? What are the anticipated range of water delivery schedules and curtailment criteria on a month-by-month basis? Do these variables change on any given water year type?

Fish Species

As a basis of design one needs to know the fish species for which the screens will be designed. The species, life stages, and timing of their presence in the area of the proposed intake must be agreed to by all agencies (i.e delta smelt). A multi-year preproject field program might be required.

Set Screen Performance Goals and Criteria

This is extremely important. The goals and criteria must be agreed to by all participants. Since many stakeholders are involved the process, to set the criteria must be started early and must be completed before design can begin. Standard NMFS and CDFG criteria might not apply depending on the design species selected. Should facilities be designed for fish protection of all species under all circumstances at all times? Could "Real Time Monitoring" or other criterion be used to operate a facility that might operate "out of spec"?

Hydraulic Data

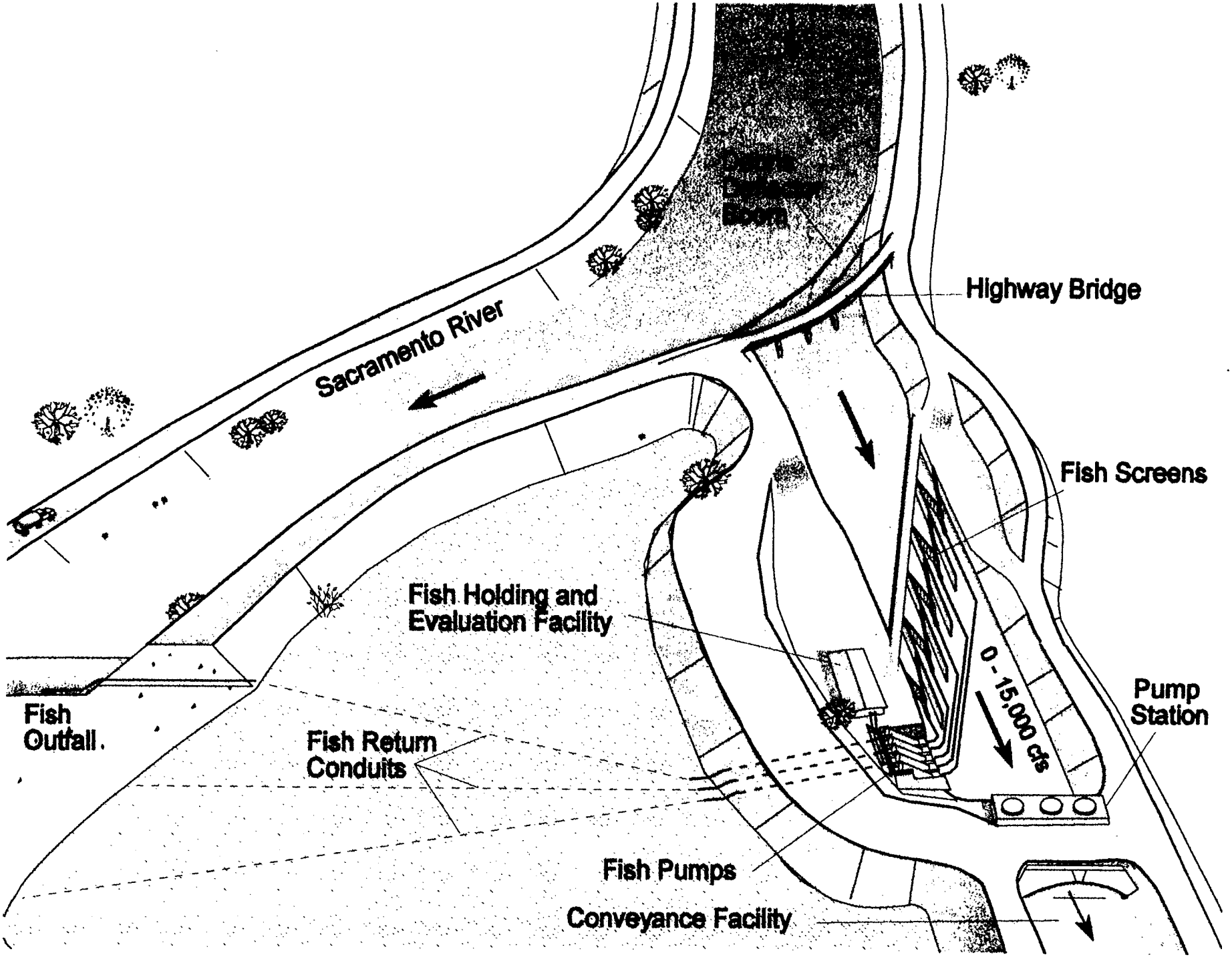
A lot of the hydraulic data gathering is complete, but more information will be necessary. Boundary conditions for facility simulation models (physical and numerical) will require detailed DSM2 or equivalent data. More site specific hydraulic models will be required at the end of the preliminary design phase.

Criteria

Fish screen velocity criteria needs to be developed for Delta species. Operational considerations for emergency situations should be factored into criteria. All agencies and stakeholders must buy into the criteria prior to design. If in design it is found that some criteria must be changed, all agencies and stakeholders must agree to the change.

General

Complete conceptual proposals should be put together for the 6-8 alternatives. Information needs and research schedules should be identified for each component. Specific information needs should be scoped before committing to new research facilities.



Sacramento River Diversion Intake and Fish Facility

Figure 1

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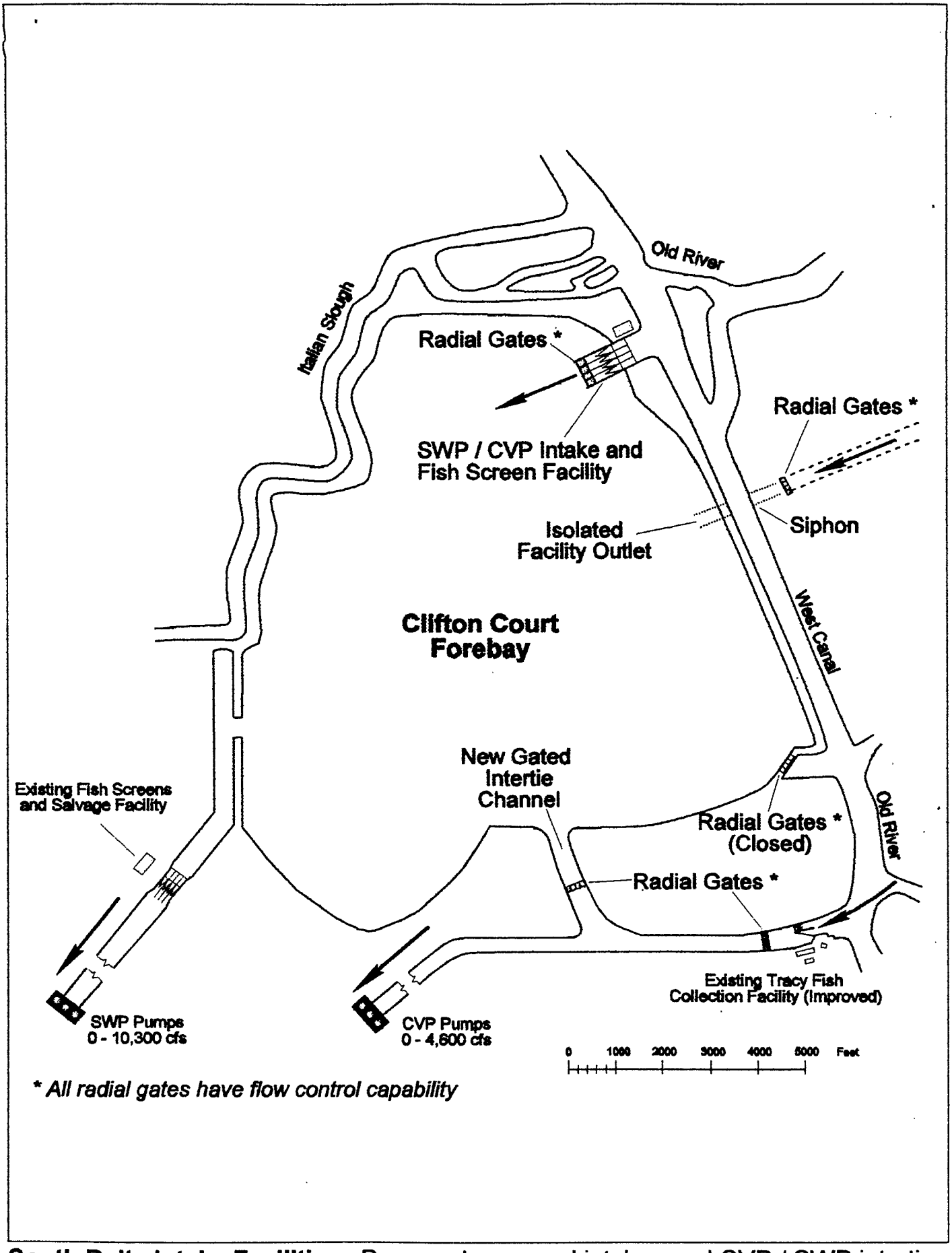
Figure 2



South Delta Intake Facilities: Proposed screened intakes and CVP / SWP intertie.

APPENDIX A

CALFED Interagency Fish Facility Technical Team (Large Team) Workshop/Meeting Participants

Phase II - Meeting 1, December 12, 1996

Attendance List:

Darryl Hayes (co-chair), DWR ESO
Dan Odenweller (co-chair), DFG IFD
Jeanne Schallberger, DWR DOE
Ted Frink, DWR ESO
Shawn Mayr, DWR ESO
Marcin Whitman, NMFS
Michael Thabault, USFWS
Brent Mefford, USBR Denver Technical Center
Charles Liston, USBR Denver Environmental Sciences
Ron Brockman, USBR
Michael Lee, USBR
George Heise, DFG ESD
Kevan Urquhart, DFG Bay-Delta
Bob Fugimura, DFG Bay-Delta
Scott Barrow, DFG Bay-Delta
George Edwards, DFG Bay-Delta
Ron Ott, CALFED
Michelle Wong, CALFED
Jim Buell, Buell and Associates and Metropolitan Water District
Dennis Dorratcague, Montgomery-Watson and CALFED Consultant
Ned Taft, Alden Research Lab and DWR Consultant
Ken Bates, Washington Department of Fisheries and Wildlife and DWR Consultant

Phase II - Meeting 2, February 25, 1997

Attendance List:

Darryl Hayes (co-chair), DWR ESO
Dan Odenweller (co-chair), DFG IFD
Randall Brown, DWR
Jeanne Schallberger, DWR DOE
Ted Frink, DWR ESO

(Phase II - Meeting 2, February 25, 1997)
(Attendance List continued from last page)

Marcin Whitman, NMFS
Brent Mefford, USBR Denver Technical Center
Ron Brockman, USBR
Michael Lee, USBR
George Heise, DFG ESD
Kevan Urquhart, DFG Bay-Delta
Bob Fujimura, DFG Bay-Delta
Scott Barrow, DFG Bay-Delta
George Edwards. DFG Bay-Delta
Jim Buell, Buell and Associates and Metropolitan Water District
Dennis Dorratcague, Montgomery-Watson and CALFED Consultant
Ned Taft, Alden Research Lab and DWR Consultant
Ken Bates, Washington Department of Fisheries and Wildlife and DWR Consultant
Dave Starks, DWR Delta Field Division
Jim Spence, DWR Operations and Maintenance

Phase II - Meeting 3, May 1, 1997

Attendance List:

Darryl Hayes (co-chair), DWR ESO
Dan Odenweller (co-chair), DFG IFD
Ron Ott, CALFED (PM only)
Ted Frink, DWR ESO
Marcin Whitman, NMFS
Brent Mefford, USBR Denver Technical Center
Ron Brockman, USBR
Dave Gore, USBR
George Heise, DFG ESD
Bob Fujimura, DFG Bay-Delta
Scott Barrow, DFG Bay-Delta
Jim Buell, Buell and Associates and Metropolitan Water District
Dennis Dorratcague, Montgomery-Watson and CALFED Consultant
Ken Bates, Washington Department of Fisheries and Wildlife and DWR Consultant
Jim Spence, DWR Operations and Maintenance

CALFED Interagency Fish Facility Technical Team
Coordination Meeting (Small Team)
Meeting Participants

Phase II - Coordination Meeting 1, March 27, 1997

Attendance List:

Stein Buer, CALFED
Ron Ott CALFED
Darryl Hayes, DWR ESO
Ted Sommer, DWR ESO
Rick Oltman, USGS
Pete Chadwick, DFG
Bruce Herbold EPA
Michael Thabault, USFWS
Don Stevens, DFG B-D
Dan Odenweller, DFG IFD

Phase II - Coordination Meeting 2, April 30, 1997

Attendance List:

Darryl Hayes, DWR
Steve Yaeger, CALFED
Bellory Fong, CALFED
Kevan Urquhart, DFG B-D
Stein Buer, CALFED
Ron Ott CALFED
Pete Chadwick, DFG
Bruce Herbold EPA
Michael Thabault, USFWS
Dan Odenweller, DFG IFD
Jim Buell, Buell and Associates

Phase II - Coordination Meeting 3, May 9, 1997

Attendance List:

Stein Buer, CALFED
Ron Ott CALFED
Bellory Fong CALFED
Pete Chadwick, DFG
Bruce Herbold EPA
Darryl Hayes, DWR
Dan Odenweller, DFG IFD
Kevan Urquhart, DFG B-D
Jim Buell, Buell and Associates

Appendix B

PHASE II - ALTERNATIVES REVIEW

by Darryl Hayes, DWR and Dan Odenweller, DFG, dated June 2, 1997

The following analysis of the Phase II CALFED Bay-Delta alternatives was prepared by the Co-Chairs of the Fish Facilities Technical Team for consideration by CALFED. Although the views on the specific alternatives have tried to incorporate the general recommendations of the Team on the north and south Delta fish facilities, these views remain those of the authors since they have not been adequately reviewed by the Team. This review is based on the generally limited available information on the alternatives to date and as we understand them. These views may be modified as the alternatives are further developed or clarified.

A total of sixteen alternatives are described in the report titled "Status Reports on Technical Studies for the Storage and Conveyance Refinement Process" draft, dated March 4, 1997. A seventeenth alternative, and revisions to some of the other alternatives were added late in the process (May, 1997), and are noted in this review.

The seventeen alternatives consist of eight basic configurations, with varying levels of development (or project yield). Essentially, the configurations consist of the components within the Delta, with as many as three alternatives of development outside the Delta. We will briefly discuss the fish protection issues associated with fish screens and fish passage facilities for each configuration, with appropriate comments regarding levels of development as appropriate.

ALTERNATIVE 1, "THE EXISTING THROUGH DELTA SYSTEMS"

This system is limited by the capacity of the north Delta to pass flows into the south Delta without experiencing tidal reversals in the western Delta. As such, significant limitations on operational flexibility would continue to impact both the CVP and the SWP export capability. The second and third alternatives make minor improvements to the export capability by modifying the location of the intake gates and minor channel improvements.

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ALTERNATIVE - 1A

This alternative involves the re-operation of the existing CVP and SWP facilities in the Delta. It assumes that the existing fish protective facilities will be brought up to their original design standards, but will not be significantly improved.

In short, this is a continuation of the status quo, although existing limitations on exports may be lifted. Should this happen, and exports during the late spring and summer increase, we could expect striped bass (eggs, larvae and juveniles) to suffer more entrainment losses through lower louver efficiencies. This will result in an increase in the losses of young of the year striped bass. Further, an increase in the numbers of fish lost to predation in Clifton Court Forebay could also be anticipated.

Recommendation - Keep in the process as the "no project alternative," from the fish facilities perspective.

ALTERNATIVE - 1B

This alternative combines the previous alternative with CVP and SWP Improvements. The CVP improvements include a connection between the Delta Mendota Canal and Clifton Court Forebay with two radial gates (10,300 cfs capacity), and new state-of-the-art fish screens at the Tracy Fish Protective Facility (on Old River). The SWP improvements would include a new intake at the north end of Clifton Court Forebay, new state-of-the-art fish screens at the J.E. Skinner Fish Protective Facility, and a new gate (presumably at the site of the existing radial gates onto Clifton Court Forebay). As an option, a new state-of-the-art fish screen may be placed at the head of the CCF in lieu of an upgraded facility at the existing site. This option implies that the intertie between the CVP and SWP screen facilities would need to be behind both facilities.

This plan, in retrospect, clearly anticipates the diversion of up to 15,000 cfs (plus additional flows from tidal filling) from two locations. The first is the CVP intake at Old River, the second is through the enlarged intake to Clifton Court.

Screening an average of 15,000 cfs at the CVP intake on Old River would entail a new fish screen capable of handling approximately 30,000 cfs at high tides unless flow control structures are added. It is difficult to envision such a facility in the available space unless one of the new high velocity fish screens is proposed for the site. These screens (Eicher or MIS screens) have not been proven for the mix of species present in the Delta, and would present substantial issues for the fishery agencies.

State-of-the-art fish screens (i.e. positive barrier screens) at the site of the J.E. Skinner Fish Protective Facility are more feasible, due to the space available and

hydraulic uniformity issues. However, the gains in fish screening efficiency would have to be balanced against the known predation losses in Clifton Court Forebay. These concerns led the Fish Facility Team to recommend new state-of-the-art fish screens at a new intake on the north end of Clifton Court Forebay.

The exact sizing of a fish screen and necessary flow control devices would depend on operations studies and modeling of the tidal amplitudes and CCF storage requirements, work which is yet to be done.

This alternative requires more gates and hydraulic control than stated in the documents. Allowing complete flow control flexibility will be necessary to equalize water levels, prevent pump cavitation and allow for good hydraulic conditions at the fish facilities (especially if located ahead of the forebay).

Two, larger intakes will likely make the South Delta water level/quality impacts more difficult to deal with due to increased CCF filling.

Fish entrainment through the nearly adjacent dual intakes will have little fishery differences with the increased draw of water into the South Delta. It is anticipated that there will be even less of a difference with the construction of barriers, i.e. both draw from the same basic source water.

Recommendation - Modify to provide one fish screen complex at the head of Clifton Court Forebay, as recommended by the Fish Facilities Team, or abandon the alternative. We do not believe the fish entrainment at these two sites to be all that different (especially if the barriers are installed) and may not justify the expense and complications of two, full-sized facilities.

ALTERNATIVE - 1C

This alternative combines the previous components with south Delta improvements to improve conveyance capacities in the south Delta channels and improve water surface elevations and water quality in the southeastern portion of the Delta. Fish facilities concerns would be the same as for Alternative 1B, although the addition of the "flow control structures" could require fish passage facilities. Studies of the interim barriers in the south Delta should provide the information necessary to address these issues.

One advantage of the barriers is that it could provide more flexibility in South Delta water levels management and therefore more flexibility in the fish facility operations. This is in part to a longer allowable CCF filling cycle.

Additional system wide storage may allow more flexibility in reducing potential fish entrainment losses, if storage can take you through those periods.

Recommendation - Modify to provide one fish screen complex at the head of Clifton Court Forebay, as recommended by the Fish Facilities Team, or abandon the alternative.

ALTERNATIVE 2, "THE IMPROVED THROUGH DELTA SYSTEMS"

These proposals all include features intended to remove the channel capacity constraints which limit the transfer of water across the Delta to the export pumps. This would improve flexibility for operations at present export levels, and would accommodate significant increases in exports from the Delta.

ALTERNATIVE - 2A

This alternative assumes a new 10,000 cfs screened intake from the Sacramento River at "Hood," with North and South Delta channel improvements. The alternative incorporates a new intake structure to Clifton Court Forebay, but does not address the fish facilities in the south Delta, nor does it provide a connection between the CVP and SWP facilities in the south Delta.

The open conveyance system, coupled with a fish screen at "Hood" will present major upstream migrant passage problems. These can be addressed, but will complicate the facilities and increase costs. Further, limiting this screened intake to 10,000 cfs means that the balance of the water (up to 5,000 cfs) could come from the Delta Cross-channel/Georgiana Slough complex. This would mean that the fish screened at "Hood," and concentrated in the water remaining in the Sacramento River, would face an unscreened diversion lower in the system. Although cross Delta flows (and presumably fish) may be proportionally less, these fish will be exposed to cross Delta losses according to USFWS salmon survival studies.

The reliance of the existing fish protective facilities in the south Delta has the same limitations as those discussed in Alternative 1. In addition, the south Delta improvements will have the same problems as discussed earlier.

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Recommendation - Increase the size of the screened intake at "Hood" to accommodate the full 15,000 cfs, and close the Delta Cross-channel/Georgiana Slough Complex. Add a boat lock and fish passage complex to the intake site, and eliminate the use of Snodgrass Slough as a part of the canal. Impacts of moving water through this existing channel could be significant. In addition, incorporate new fish screens at the head of Clifton Court Forebay in the south Delta and connect the CVP to the screened water in Clifton Court Forebay. Since most of these improvements are contained in Alternative 2B, abandon this alternative.

This modified alternative would look much like one proposed by Pete Chadwick, DFG outlined in an exchange of e-mail earlier this year.

ALTERNATIVE - 2B

This alternative is much like Alternative 2A, with the south Delta fish facility improvements. As such it suffers from the same north Delta shortcomings of that alternative. The south Delta fish facility improvements are identical to those in Alternatives 1B and 1C, and suffer from the same problems.

Recommendation - Incorporate the 15,000 cfs north Delta fish screen recommendation from Alternative 2A, and the south Delta fish screen recommendations from Alternative 1C. Close the Delta Cross-channel/Georgiana Slough complex, and provide boat locks and fish passage facilities for upstream migrants. Abandon the use of Sr.odgrass Slough as a conveyance channel.

ALTERNATIVE - 2C

This alternative cannot stand alone, and is now incorporated into the new Alternative 3I. As discussed earlier, this alternative assumes the use of the existing CVP and SWP fish screens, with the same concerns described in the review of Alternative 1. The predation losses would be expected to increase due to the additional area of "forebay" created by the three arms.

The western arm would take out about one third of the Holland Tract "Habitat Island" proposed as wildlife mitigation habitat for the Delta Wetlands project impacts. This would have to be resolved before either project moved forward.

Recommendation - Although it may be costly, (from and O&M and capital expenses point of view), we believe that the three intake arms should be screened for much of the same reasons as we recommend the intake to the CCF be screened. Operationally, hydraulically controlling the three "arms" on a real time basis will be difficult. These intake screens will require elaborate flow control structures for the intake facilities to

operate within reasonable flow limits (tidal filling could be in excess of present CCF inflows). Allowing the fish salvage facilities to remain at their existing locations will suffer from the same problems as listed for Alternative 1 configurations. If this alternative is carried forward, consider as Alternative 3I.

ALTERNATIVE - 2D

This alternative is identical to Alternative 2B from a fish facilities point of view. As such it shares the same concerns. In addition, the creation of large amounts of "shallow aquatic habitat" along the migratory corridors leading to and from the Mokelumne River could present major problems to anadromous fish migrating into and out of the Mokelumne River system.

Recommendation - Abandon, Alternative 2B has a more reasonable configuration.

ALTERNATIVE - 2E

This alternative assumes that water can be diverted from the Sacramento River onto the Delta islands (which become a conveyance corridor) without fish screens. The alternative further assumes that fish diverted from the Sacramento River will survive on the flooded islands. The presence of large amounts of water from the Sacramento River in the central Delta would add to the attraction and confusion of upstream migrants, adding to these problems in the Delta.

Recommendation - Abandon, since it cannot be modified to be "fish facilities friendly."

ALTERNATIVE 3, "THE ISOLATED CONVEYANCE SYSTEMS"

These alternatives all accomplish the same objective of Alternative 2, but include some component of an isolated system to transfer water from the Sacramento River to the export pumps. The range of facilities include an open channel, a closed pipeline, and a "chain of lakes."

ALTERNATIVE - 3A

This alternative uses a 5,000 cfs "isolated conveyance facility," and increased diversion capacity in the south Delta with the existing CVP/SWP fish screens. As discussed earlier, since this alternative would depend on up to 10,000 cfs of Sacramento River water from the Delta Cross-channel/Georgiana Slough complex, it would not be compatible with the recommendations of the Fish Facilities Team. It is recognized that reducing cross delta flows may be incrementally beneficial for

D-007150

Sacramento River and Delta fish, however, continuing a disproportionate reliance on the South Delta fish facilities to collect and haul fish (entrained into this area via the cross delta flows) away from a dead end area is a poor compromise to the system. The benefits to an isolated system go beyond improved fish facility operations and function to include water quality, reliability, operational flexibility, in-Delta storage and other benefits.

Recommendation - Abandon this alternative as incomplete and inconsistent with the objectives of the fish facilities.

ALTERNATIVE - 3B

This alternative is identical to Alternative 2A, with the addition of new and improved fish facilities for the CVP/SWP. Since the fish facilities are in the same locations as presently built, the alternative suffers from the same problems as described for Alternative 1B.

Recommendation - Better than 3A, but questionable overall fish facility benefits. Increase the screened diversion on the Sacramento River, even if only 5,000 cfs is isolated.

ALTERNATIVE - 3C

This alternative is identical to Alternative 3B except for the use of a buried pipeline.

Recommendation - See 3B. The use of a buried pipeline does not change things from a fish facility point of view or to resolve the fish facilities concerns described earlier.

ALTERNATIVE - 3D

This alternative is identical to Alternative 3C except for the use of a buried pipeline.

Recommendation -See 3B. The use of a buried pipeline does not change things from a fish facility point of view or to resolve the fish facilities concerns described earlier.

ALTERNATIVE - 3E

This alternative is for all practical purposes the "Peripheral Canal," and is the

preferred alternative of the Fish Facilities Team. As envisioned by the team, all diversions would take place through the screened intake at "Hood." Such an alternative would screen all diverted water at an optimum location, and would eliminate adult migrant straying concerns. This alternative is the least risky from a fish facility operational and performance point of view. It is consistent with the recommendation of the Fish Facility Team.

Recommendation - Carry this alternative forward and adopt it as the preferred alternative, from a fish facilities perspective.

ALTERNATIVE - 3F

This alternative combines all the worst features available, from a fish facilities perspective. The Sacramento River intake is moved downstream to an area of greater tidal reversal, and does not screen the full 15,000 cfs of CVP/SWP export capability. A number of smaller diversions in the central Delta are incorporated, and new fish screens at the site of the existing CVP/SWP fish facilities are suggested. This alternative ignores most if not all of the Fish Screen Team (and its predecessors) recommendations, and is inconsistent with the fish protection goals of the program.

Recommendation - Abandon.

ALTERNATIVE - 3G

This alternative also screens only a portion of the water diverted from the Sacramento River, and suffers from the same shortcomings in that regard. In addition, as we have already discussed, this alternatives assumes new fish facilities at the site of the existing CVP/SWP facilities.

This alternative does have the advantage of diverting flows in a less tidally influenced area. However, since this water will be mixed with the Ship Channel water, additional facilities must be constructed at the lower end before crossing the Sacramento River. The construction of a boat lock will not adequately prevent the upstream fish migration concerns as fish are known to enter locks in large numbers during operation. These fish would be lost to the system.

Recommendations - See 3B.

ALTERNATIVE - 3H

This alternative screens only 5,000 cfs of the Sacramento River diversion, with the balance coming from a weir (controlled by an inflatable dam) near the Delta Cross-channel/Georgiana Slough complex. In the south Delta, new fish facilities at the sites of the existing CVP/SWP fish facilities are proposed.

Recommendation - See 3B. The combination of inadequate fish screens and the fish straying problems in the central Delta will be major obstacles to this plan.

ALTERNATIVE - 3I

This alternative incorporates a screened 15,000 cfs diversion from the Sacramento River and an isolated conveyance facility from the diversion point to the San Joaquin River. There the water is released into the San Joaquin River, and then picked up by any one of the three diversions proposed in Alternative 2C. Although Sacramento River outmigrants would be fully protected in this alternative, as long as the screened intake is used, the alternative clearly envisions diversions from the central Delta when the screened intake is out of service. In fact, this sort of alternative could allow an instantaneous draft of about 30,000 cfs from the system, as the canal is recharged after a curtailment, and the pumping demands were met from the other intakes.

The operational considerations and hydraulic impacts of this alternative will be very complex. Because the goal is flexibility, it may be necessary to screen each of the three central delta intakes for a full diversion to avoid excessive predation and losses of San Joaquin and Delta fish. Such facilities would be difficult to hydraulically regulate with or without screens. Although this may be an extremely costly alternative, it does offer added flexibility to the system if it can be monitored and controlled.

Recommendations - Carry this alternative forward, but describe operational constraints more fully so that the timing and frequency of both the use of the three intakes in the south Delta, and the use of the 30,000 cfs diversion capacity are more fully understood.

Appendix C

Review Comments
on
Fish Facility Team Recommendations for the CALFED Phase II Alternatives, Dated June 2, 1997

Summarized by Darryl Hayes

The list of "Team Recommendations" was put together by Darryl Hayes (DWR) based on input from the CALFED Fish Facilities Technical Team and other interested agency staff during the Phase II Bay-Delta Program process. The recommendations presented are based on a consensus view of the Team members relating to fish passage and screening facility issues we believe to be important in developing a preferred alternative. Some points are general in nature, and some deal with specific alternatives, although the numbering convention used in the alternatives (i.e. 1C, 3I, etc.), are not referenced here.

I have incorporated most of the significant comments from the Team into the final set of recommendations. Many responded to the short review period (about a week), but in fairness to some, this may not have been enough time for a significant review. Comments were, however, very constructive and consistent amongst the group. Many of the comments included discussion items or emphasized a point. These items were difficult to fully capture in the brief bullet format used, so the unedited comments received from Team participants as of June 3, 1997 are included below. In the final version, I have adhered to the numbering format I used in the review draft so comments can be cross referenced to individual points (even though I could have consolidated a few points or reorganized it for clarity).

Comments from Stein Buer, dated May 23, 1997

Hi Darryl,

Thanks for sending out the 35 screening recommendations for final review and approval. They will be helpful if the team as a whole supports them. To the extent that they can be supported by specific scientific and engineering information and analyses, they will be even more useful.

A few specific questions:

Recommendation 3 states that new facilities should use positive barrier screens. Should we therefore modify 2C and 3I to include screening at each intake? I would assume screening and pumping to control hydraulics would be required.

Recommendation 8 suggests that on river screen concepts would be preferable since they eliminate the entire bypass and fish concentration process. Recommendation 18 excludes this concept for all CALFED alternative variations. Could 18 be modified to leave the option of on-river screen concepts for 5,000 cfs, as well as multiple intake options, each with 5,000 cfs?

What economic evaluation was done to support recommendation 10?

Thanks!

Stein

Comments from Ron Brockman, Dated May 28, 1997

Darryl, I believe you did a good job in capturing most of the Team's thoughts. Following are some specific bullet by bullet comments for your consideration.

#6. I believe it would be desirable, not, may be desriable, to divert water from both the San Joaquin and Sac. Rivers.

8. I believe you want to say "decrease potential delays"

#10. How about "we recommend ....up to 15K"

#15. "flow distribution can be achieved at the screens at (use diversions instead of flows?)

#16. The last sentence starting with "Wedgewire" maybe should be placed under #13??

#28. Last sentence. "This "would" require more bays....

#29. How about indicating the option of an isolated conveyance as you did for North Delta. As written I am not sure an isolated conveyance channel is really precluded, but later on the focus appears to be towards a structure in front of CCF. I note that in #30 you have indicated an isolated conveyance.

#33. I would reword the second sentence as follows to preclude consideration of an isolated conveyance system off the San Joaquin: "Any new facilities contemplated for CCF should be placed at the intake to minimize predation." The last sentence may need some reference to the need for an approximate 26K screen to clarify the issue you have raised.

#35. Thanks for including this bullet. Charlie and I concur wholeheartedly!!

If you have any questions call me,

Ron

Comments from Marcin Whitman, dated May , 1997

Darryl,

Thanks for pulling this all together. The bulk of the recommendations accurately reflect the consensus of the group and do a good job of capturing the work done by the Team. Here are my comments on the recommendations list that you sent me. Usually, I've just referred my comment or editing to your numbered list of recommendations but there is one recommendation to add as well.

Additional Recommendation

I think an additional recommendation needs to be added early in the list, the gist of which is:

> #. No screening facility has been or can be constructed and operated without some negative impacts. This will also be true of all proposed facilities, especially considering their scale and inclusion of elements that have a limited track records (e.g. pumps). In general, the greater the flow diverted the greater the impact. These impacts are do to the screening and bypass process itself and are in addition to the impacts of removing water from a river system.

I realize this issue is touched on in #2,#7 and others but I strongly feel that some statement of this sort has to be made explicit to provide a context and so that the other recommendations are not misinterpreted.

Specific Comments:

#6 I agreed with your wording rather than Brockman's suggested modification.

#8 I think you want "minimize " or "decrease" before "potential delays"

#9 "as far upstream as possible" need to be reworded so that it is understood we are not recommending a pipeline from Shasta.

#10 "at 15,000 cfs" see added recommendation above and #7. We recommend 15,000 cfs only if there is a frequent enough need to divert at that quality to fulfill final project objectives (which still need to be defined)

#12 change "should" to "could" in last line.

#19&20 Add " such pumps are experimental but are the preferred alternative"

D-007156

#21 Reword to add that, all else begin equal, a shorter bypass is better. Right now is sounds as if we want them to take a 5000 ft ride.

#23 I believe the group agree that we shouldn't re-release screened water and then have to screen it again. Something about that should be added here.

#24 add "at that site." to the end for clarification.

#31 Any addition about reentry to the river channel besides out of pump influence i.e. predation, temperature and water quality issues, lighting. etc.?

#32 Would like to mention poor bypass conditions as well.

#34 do you mean inter-tie or inner tie?

#35 I cannot see upgrading and increasing the capacity at Tracy unless it is done within an overall, long-term solution package that has been committed to. Improving these facilities for the interim on a parallel track provide an incremental benefit, it should not serve to pre-select a solution that would not otherwise be chosen or delay a comprehensive solution. The latter would clearly be to the detriment of the resource.

Information Needs/Hydraulic Data

What is the water delivery schedule, or range of deliveries on month by month (or more refined) basis in various type of water years? As eluded to in #2, this information will have profound effects on design and operations of the fish facility.

The other general areas in this end section identifies many important issues; thank you for including them. Please send a copy of the final that you forward up the chain.

Marcin

Comments from Jim Buell, dated May 30, 1997

Darryl,

I do have some comments on the points which I think are either significant or important. I hope very much you can include or take account of them. I have also reviewed the comments you transmitted today, and I will try to take those into account in this transmission.

On balance, the "points" to CALFED accurately reflect the Facilities Screening Tech. Team discussions/deliberations.

0) I suggest adding a STRONG recommendation to CALFED that a "piece mealed" approach be conscientiously avoided in favor of an approach which is fully integrated both hydrodynamically and operationally through rigorous modeling of ALL COMPONENTS TOGETHER. Modeling should include complete consideration of delta hydrodynamics (i.e. through DWRDSM, Fischer or the like), to address concerns of the Technical Team regarding fish migration and water flow patterns.

1) I'm concerned about the wording here. It sounds like we can't recommend anything larger than 3,000 ONLY because we haven't seen one in operation anywhere. I don't think this is the only reason. I got the sense that the Team recognized potential hydraulic and fish exposure time problems associated with a very large, single "element" facility, whether a "V" or a long flat vertical plate. We should make this clear.

2) Please add: "For some Team members, this caveat extends to concerns over migratory fish entry into the central delta, in the sense that significant changes in hydrodynamic patterns and habitat quantity, quality and distribution may force reconsideration of some operation and function recommendations."

3) We (especially Dan) discussed the linguistic "trap" in the BAT phrase. I think we might use a different phrase such as "best feasible technology" or the like, OR add "whether or not the technology has ever been built on the same scale" to get ourselves out of a potential "situation".

4) Say why. This is important, I think, especially in light of the "issue" of delta smelt at Hood, and striped bass eggs/larvae. Actually, given the swimming patterns of delta smelt (dart-and-glide), we may not REALLY be able to protect this species very well. I think we should acknowledge this uncertainty, unless you think we're OK, given the latest Treadmill testing (??).

5) Should we highlight the implications of this recommendation for the "screened through-delta" alternatives?

D-007158

7) This should be clarified. For example, we probably should state clearly that, with multiple (have we ever thought that more than 2 is good, assuming that any configuration of Tracy/Banks is 1?) diversion points, each diversion and associated conveyance system should be sized to accommodate the full demand to optimize operational flexibility.

8) First sentence, change "increase potential" to "decrease potential".

9) First sentence, change "as far upstream as possible" to "as far upstream as practical, given site suitability, construction feasibility, etc." You should know that Schuster/Hanson have recently proposed siphoning under the Sacramento River from a site upstream of Hood; Dan pretty well shot that approach down for feasibility (practicality) reasons during one of our discussions.

10) I disagree with Brockman, if I understand the thrust of his comment. I believe that we should recommend 15 kcfs even with a "dual" or "multiple" system, to maintain intake-switching flexibility.

11) In the first sentence, please specify "preferable to a SCREENED through-delta conveyance system." I don't believe the Team ever thoughtfully considered what the implications would be of very significantly altered aquatic habitat and hydrodynamic conditions in the central/northern delta on the concept of an unscreened through delta alternative, such as those in Alternative 2E. Incidentally, something very close to this Alternative has been modeled hydrodynamically, and the changes are very significant, including increased water residence time, local current velocities, salinities, location of X2 (further downstream), tidal attenuation, etc. If you maintain this recommendation (I do not object to maintaining it), please add the caveat, "given existing aquatic habitat and hydrodynamic conditions in the central/northern delta". Did the Team ever thoughtfully consider the available technical information on temperature in the delta? I don't remember such considerations. My best sense of this information is that water temperature in the delta is driven by air temperature, wind, cloud cover and humidity, and it doesn't matter much where you are in the lower system. Absent a focused consideration of specific modeling runs or data, I suggest omitting this reference.

12) Please specifically state that any of the alternative upstream passage technologies considered would fail for delta smelt, with the possible exception of a lock system, IF velocity and predation issues could be addressed (I have serious doubts about a lock system for adult delta smelt, given what we think we know, and all we don't know, about behavior).

13) This recommendation might be redundant. See above.

14) I thought we decided that separate gates to shut off individual bays would be "provided", not "considered". I think they would be nearly essential to prevent siltation of bays and debris accumulation.

16) Rather than lock ourselves out of using a "foil" type cleaning system, should we leave the door open by saying "screen brush cleaners or comparable devices"? Is "Wedgewire" a trade name? If so, should we use "profile bar"?

18) Did we thoughtfully discuss technologies appropriate for small diversions? Is this within the scope of our Facilities Screening Team?

20) We did discuss the fish lift/pump testing at Red Bluff, and I think we concurred that it was "probable" that a suitable technology could be applied. On the other hand, we also discussed some of the serious problems associated with the scale of the devices being tested at that facility. We should warn CALFED that a comparable scale for fish lift/pump technology may well be inappropriate. This is a fairly serious concern for me, especially given the performance so far. I am confident, however, that an appropriately scaled technology can be successfully applied.

21) How thoroughly did we discuss the desirability of secondary concentrators? Is 5% of the flow really necessary, or even desirable? I suggest making this recommendation more tentative, or qualifying it some way which will leave the door open to secondary concentrators.

22) I suggest closing the loop here with the 5,000 ft long bypass pipe, thus avoiding questions on this length specification of the Team.

23) I am pretty sure I don't like this recommendation, the way it is worded. Storage in the delta is generally conceived as being a flooded island or series of islands which can be drawn down to supply water either directly (through a pipe/siphon/canal system) or indirectly (by dumping water into the delta waterways) to the export system. Water users have VERY SERIOUS AND SPECIFIC CONCERNS AND OBJECTIONS to this approach without strong assurances that water so stored will NOT be subject to wind-induced sediment resuspension during drawdown (this requires a MINIMUM dead storage of about 10 ft) or dissolved organic enhancement from storage over peat soils or

porewater contamination during drawdown from levees. Canal storage or south-of-delta storage is another matter, since these problems can be avoided. I strongly suggest rewording this recommendation to make the water quality issues (forgive me) crystal clear.

25) Again, this recommendation needs a clearly-worded caveat: "...given existing aquatic habitat and hydrodynamic conditions in the central/northern delta". Please add this.

25) It might be helpful to refer CALFED back to point #5.

28) I don't understand the reference in the first sentence to "extreme flow". Does this mean that "extreme flow" conditions at Hood, which will have to be taken into account for a diversion there, will not be a factor in the southern delta? Or does this mean that the "episodic" operational style needed in the shallow and more tidally influenced south delta requires greater intake Q's at the entrance to the CCF. This needs to be clarified. To what extent would the greater stage excursion in the Sacramento River at Hood (given extreme river stage conditions compared to "base flow" conditions) offset the "big gulp" design needs at the entrance to CCF? I think I get the reference to the debris concern, that particular problem is more severe in the southern delta. To what extent are these two design considerations offsetting in terms of cost and facility "size"?

30) I'm not sure that an isolated conveyance facility, with its canal storage capacity (with a gate at the lower end, I like this) would "minimize" the screen oversizing requirement; it would reduce it significantly. The requirement would also be significantly reduced by changes in the tidal stage/salinity relationships as modeled in an altered delta configuration very similar to Alternative 2E. Which approach would result in the greatest reduction has yet to be determined. If a "dual facility" is considered, with hydrodynamic changes in the central/north delta roughly akin to those in Alternative 2E, then "minimization" might actually be achieved. The increased stage of low tide with Alternative 2E or something similar to it is quite significant, and will greatly reduce the number of minutes of each low tide cycle during which local agricultural siphons would be at risk of being "broken". Add this to canal storage, and we may not have much of an oversize requirement. Also, please consider the option of operating "out of spec." for a certain percentage of the time, subject to "real time monitoring" for sensitive species (in terms of approach velocities). This could be a very important element in contributing to operational flexibility...and we did talk about out of spec. operations, even if we didn't reach a "conclusion" about recommending it.

32) Although less important here than elsewhere, I suggest reiterating the caveat: "...assuming existing aquatic habitat and hydrodynamic conditions in the central/north delta".

33) I thought we agreed (mostly) that a larger screen could be built, but it would be expensive, and the feasibility would be "enhanced" through reductions in the size of the "big gulp", either through canal storage in a "dual facility" approach or through approach channel improvements or hydrodynamics changes resulting in higher low tides.

35) I suggest a stronger statement regarding the desirability of eventually tying the two facilities together, with a common, screened intake on the north side of the CCF.

General Management Questions and Goals

I suggest adding a question about the interplay between the assumed effectiveness of ecosystem restoration and degree of flexibility/effectiveness of facility operations. I think this is very important from the water users' perspective.

Fish Species

This is where CALFED should be asked to consider the "out of spec." question, possibly tied to "real time monitoring" or some sliding scale criterion. I believe this is very important.

Set Screen performance Goals and Criteria

This needs to be much more specific! Challenge CALFED to specify, quantitatively, the degree of effectiveness (i.e. percent of exposed fish successfully excluded and/or bypassed or relocated) for the whole system, including an imputed end-of-the-pipe loss. This is extremely important, in my view.

Hydraulic Data

Modeling should include the hydrodynamics of the entire delta, for reasons I have tried to make clear above. This modeling should include real-tide information with a time step of about 15 min. and an OUTPUT of about 1 hour, so that individual tidal ebb/flood patterns can be appreciated. Assumptions regarding movement of fish into and out of the delta are generally based on average tidal day flow patterns, and this is not what the fish experience. I am concerned that we are making faulty assumptions which feed into some of our recommendations, and I see this kind of detailed modeling as the only way to correct the general lack of appreciation for actual (real time) tidal flow patterns.

Criteria

This is another good place to specify the need for consideration of the frequency and/or duration of out-of-spec. operations.

Darryl, I hope these comments help. I have tried to be thorough, and I hope you don't mind! Please call and discuss, if you can.

Jim Buell

Part II - Comments from Jim Buell, dated May 30, 1997

Darryl,

I just read Marcin's comments; I agree with them (for the most part) and want to underscore a few of them.

I strongly agree with the first suggestion to add a recommendation about the lack of "zero impact" (overall) facilities in our experience. This is especially important for CALFED to hear, especially since Buer at one point said to "assume" a zero impact facility. I think Buer was quickly "tuned up", but this may be symptomatic of some naive thinking out there.

I feel that Marcin's comments on 19/20 may need a little modification. I completely agree that fish-friendly lifts/pumps are experimental at the SCALE we are discussing, but smaller versions work quite well, and I don't think they are still "experimental" in the sense that the Red Bluff devices are. Just a "picky" point...ignore it, as appropriate.

I think Marcin's question regarding 31 probably deserves a "yes" answer. There is clearly more risk associated with the improved kind of salvage operation we envision...or think we do.

I strongly agree with Marcin's comment on 35. Although I understand the strength of the desire of the Bureau to upgrade their facilities, it should be within an overall facilities context. I'm not sure CALFED will appreciate this nuance unless we point it out.

That's it!

Buell

D-007163

Comments from Ken Bates, dated May 28, 1997

I'm here in Sydney Australia reading your CALFED comments. Have hope; the situation is much more grim here than in the Delta. All of the fish here are catadromous or potodromous; 1% of the thousands of weirs have fishways and there are no screens. Screens are less of an issue for these migrations.

Anyway; a few comments:

13 Mention the desirability of off river facility for maintenance and the need for individual bays that can be isolated.

14, 15 Rather than state baffles (they are a minor add-on) state the need for uniform hydraulics and for a physical model of anything approaching the 15k cfs scale. I wonder what other information needs we have; we haven't discussed this in detail. Do we have enough debris information and larvae real time monitoring capabilities?

26, 31 Make it clear that hauling fish may be a fatal flaw for any facility in the south delta that is more than a back-up or operational flexibility feature of the north delta facility.

35 Update of the Tracy facility makes me nervous. I know our intentions are good. Might this become _the_ south delta facility once we sink a bunch of money into it? The south facility will likely be the last built when money starts getting scant in the program; folks will be looking for ways to save. Just a thought; how do we prevent this and get the necessary best available technology?

later;

Ken

Comments from Brent Mefford, dated May 28, 1997

A few last minute comments for you,

#8 decrease in place of increase ?

#`10 Can we say economic? Also saying 15,000 cfs North Delta conflicts somewhat with statement #6. You may want to qualify this statement to reflect the possibility of diversions on both rivers.

D-007164

#22 The team concurs that the diversion must be designed and operated such that a particle released from the bypass will not recirculate into the diversion intake channel. (Just wording suggestions)

#30 spell out CCF as this is the first appearance

#32 "some level of pumping" may want to qualify with "some level of backup pumping"

That is all I have,

Brent

Comments from Ted Frink, dated May 27, 1997

OK, here are my ideas and comments.

1) Is the smaller bays an issue of construction techniques that make it infeasible to build larger bays or an hydraulics issue so that individual bays can be closed off if needed?

3) Do we need to define what we mean by best available technology? I'm not sure what it means relative to our task. It makes me wonder what the best available tech. will be if and when any of this happens. It could mean a completely different design possibly than what is acceptable now.

4) One inch or is it 20 mm (a little bit smaller)? Doesn't current criteria start at 20 mm? Again in the future we don't know now if there will be something that could protect eggs and larvae. So we are defining our design limitations based on current knowledge and screening capabilities -- back to the definition of best available tech.

5) This seemed like the idea that provides the most flexibility for operation of a system trying to divert water from a sensitive ecological system. I would equate this to squeezing delta smelt out of a cucumber.

7) I assume this is referencing the idea #6 above, I could combine these two items into one recommendation.

8) This seems to be inconsistent. I think it was meant to say "decrease potential delays in downstream fish migration". Also, as I read it, this could be inferred as supporting the "no action alternative" by the fact that if we have no new facilities, particularly in the North Delta, we automatically minimize bypass fish handling and decrease potential downstream delays. I think we just need this to be stated more directly and not so nebulous. That we support new state of the art fish facilities that work to keep fish in the river and Delta as much as possible with as little delay as possible for fish passing through the facility.

9) Does this mean we support a diversion facility in Shasta Lake?, about as far upstream as we could go. Do we need to put some specific boundaries into this statement? As it is stated it could be open to interpretation.

10) Do we have the economics part figured out that this alternative is economically better as opposed to through Delta transfers which do not require construction of a canal? And what the economic impacts to farming and fisheries in the central Delta would be if they have poorer water quality?

11) Modify the last sentence to say: Impact of through Delta transfers may include delays, downstream and upstream passage, straying, and temperature related stresses. We have some potential impacts to upstream migrants with an isolated fish facility also in the form of the bypasses and handling effects at a facility. We may need to elaborate on the magnitude of impacts for each type of facility to show that one may have fewer impacts on fish than the other. Then we still have the issue of water quality impacts of an isolated facility on central Delta fish populations that are not an issue with a through Delta conveyance.

12) Recommend dropping "but should have success with most species" because you say already that it is an unknown.

13) This goes back to #3 about using best available technology. Feel that this is the best available tech. right now or is it just what is most familiar and has been applied up to now. How about rotary drum screens or the MIS which still needs to be evaluated further, are those best available tech?

14) Instead of using the tern Vee screen, should we just say that individual bays of a diversion facility should be gated to isolate them individually.

15) This has been done for a Vee screen concept but not for drum or MIS screens. Can we assume that this modeling will hold true for those screen styles too or would that require separate modeling?

16) This only pertains to a Vee screen concept, it would be very different requirements for an MIS or drum screens. Maybe it just needs to be stated that any screen facility will require clean screens for proper function and there are different ways to achieve that depending on the screen design implemented (best available technology).

18) Unclear how this is different than previously discussed design options? Maybe define "on river" and why this is different for 5,000 cfs vs 15,000 cfs?

21) Include how we came to this decision for 5000 ft /5% total flow, what went into figuring this out? This is based on a diversion site at Hood, what if the diversion was further upstream? Should it say that we want to see diversion pipe facilities no longer than 5000 ft?

22) This seems like a better, more generalized statement that applies to any diversion site. We could use #21 as an example or subheading under this (#22) statement, of what would be required for a bypass sited at Hood.

26) In #'s 6 & 7 above, we state that we support options that have facilities at both north and south sites to have added flexibility in diversions that accommodate seasonal changes in fish distribution and abundance and therefore can be more protective of aquatic resources. WE don't recommend this as the only diversion facility in the system, but it may have to be part of an overall system that could ultimately meet water delivery needs and help protect fish in the Delta.

29) See #28 above. I question whether we want to jump in with this kind of recommendation before other designs have been fully evaluated as to their benefits and drawbacks. We can say this is an example of what would be required if Vee screens were to be used in the south. Maybe we should look at what would be required for each type of screen design then come up with a recommendation based on all factors: cost, debris handling, tidal capabilities, maintenance, fish protection and handling, sizing, maximum design capacity for flow, etc.

33) Should state here that a screen facility of up to 26,000 cfs would need to be constructed to meet a 15,000 cfs demand under the extreme tidal conditions at the current fish facilities and channel capacities. And then state what the drawbacks are of a facility in the south Delta operating at that volume, ramifications to water quality, fish and debris handling, channel scour, sedimentation (it would be a giant Delta vacuum)

34) CCF WILL be required to be enlarged to meet demands, but we have stated that this is a preferred option to increase storage capacity in the system because it will help during periods of time when fish abundance is a concern.

INFORMATIONAL NEEDS

Species to be protected are all of the native fishes, major sports fish, which includes all of our listed T&E species and the species listed in the CVPIA fish doubling plan. We need to be proactive about protection of mostly native species in the rivers and Delta, and accommodate protection of economically important species. And all life stages should be considered for protection that we can provide with the best available technology. The more eggs and larvae we can save or not kill, the more juveniles we have in the system that may grow to be adults, and the shorter the population recovery time is.

Ted Frink

Comments from Michael Lee, dated May 30, 1997

Darryl:

My comments follow. The comment numbers refer to the item numbers in your document. Some of my comments will reflect information provided by the CALFED "Phase II - Alternative
Descriptions" which I received last week for review.

19. Is the low head pumping plant for providing a bypass flow for returning fish to the originating channel as outlined in item 20 or is this for moving the diverted water into the conveyance feature?

23. In the Through-Delta Alternative and Isolated Conveyance Alternative, several storage schemes have been identified. Depending on the scheme, some of the storage "facilities" will need screening to keep fish (outmigrating and spawning) out of the facilities (entrance and exit), otherwise, some of the fish will get lost in the delta channels in trying to find their respective rivers for spawning.

28. Also, with a longer fish screen structure, there is a longer exposure of the fish to the screen. NMFS and DFG do have requirements for limiting exposure of fish to the screens when swimming past the screens.

30. With the addition of fish screens to the intake of the Clifton Court Forebay and the amount of inflow into the forebay, there may not be much of a sweeping flow across the face of the fish screen. This issue of sweeping flows would have to be addressed as well as providing effective fish bypasses.

31. Is the transporting concept presented here for returning the fishes to the watercourse by trucking? If so, should we consider releasing trucked fishes during receding tides only so as to reduce the possibility that the fish will be exposed to the diversion a second time.

34. If an intertie (interconnection) is constructed between the Tracy Pumping Plant and the Banks Pumping Plant and the Clifton Court Forebay is operated as it is presently, the Clifton Court Forebay will definitely need to be enlarged to store the amount of water that both pumping plants will pump between tides. We would be looking at increasing withdrawals from the Forebay from 8,500 cfs presently from Banks alone to 13,500 cfs from both Banks and Tracy. We would be looking at an increase of 50 percent capacity in the Forebay as well as a correspondingly larger screen structure. If this intertie were constructed in association with an isolated conveyance structure, the Forebay would probably not need to be enlarged.

If you need any more information, call me at (916) 979-2266.

Michael Lee

Comments from Dennis Dorratcague, dated May 29, 1997

Verbal comments to Darryl Hayes received May 28, 1997, relating to fish pumps, and other items. All comments incorporated. Written comments to come.....

Comments from Charlie Liston, dated June 3, 1997

General

I generally agree that a large facility at Hood could alleviate numerous problems of handling fish and debris, would potentially impact fewer Delta species, and would not experience major problems with upstream migrating adult anadromous fish. Considerable testing and technology development would be needed (i.e., fish pumps/lifts combined with new bypass configurations and screens, etc) to get to construction stage. I also agree that work on an improved south Delta facility, albeit potentially smaller than a Hood facility, should go forward to improve functions needed to salvage and transport fish effectively (improvements should address trash booms and racks with cleaning devices; screens and cleaners , perhaps in combo with louvers

D-007169

upstream to assist trash removal?; pumps that can move debris and fish through bypasses with minimal harm towards above-ground debris and fish separators; transport mechanisms that allow seasonal flexibility; and stocking site flexibility.

Further Comments (Associated with your numbered bullets):

1) Regarding 3,000 cfs as the largest screening example - isn't there something larger in the PN somewhere? A large "v" screen with greater capabilities? Maybe Ken Bates knows of it.

3) Best Available Technology everywhere - agree, but conditions are quite different in the South Delta compared to Hood, and the BAT may be different.

4) Eggs and larvae - we are presently gaining insight into the effectiveness of screening larvae with angled screens at Red Bluff by sampling screened and unscreened water simultaneously. I wouldn't be surprised to see some level of protection afforded for larvae, albeit not 100%. We should not assume that all larvae will be lost with screening technology aimed at protecting 1 inch fish. More data will help.

5) In the south Delta facility, it may be more desirable to quickly remove fish from local river waters near trashracks and quickly get them back to Delta waters than to keep them in the local river.

6) Agree. One value of a south Delta facility is flexibility of water removal. This may relate to water quality and to protection of larval fishes.

8) I think you meant to "decrease" potential delays, not increase?

10) A bit troubled by the implicated exclusive 15,000 cfs diversion at Hood above all others. All the eggs in one basket syndrome?

18) I don't understand why "on-river" facilities should be considered for < 5,000 cfs facilities. Is this for really small diversions?

20) Use of "fish friendly" pumps/lifts (some say Archimedes are really lifts, not pumps): I agree that this technology is looking very promising for the Delta. Archimedes will require large civil works compared to, say, internal helical-type pumps. We are planning to incorporate testing with stainless-steel lined, smaller helical pumps at Tracy Facility for potential bypass systems. Hopefully, enough testing can be accomplished to answer questions for Delta species important to installations other than Tracy also. I think all research staff involved at Red Bluff are optimistic for broad application of fish friendly pumps for bypasses. More work needs to be done on potential fish disorientation, and bypass behavior following pump passage. Also, we need to test the outer limits of fish size that

can be effectively pumped, as well as species more delicate than juvenile salmon.

21) A bypass with 5% of the diverted flow? I'm not sure about this. At Red Bluff, we're running around 10%.

23) Added storage - could an isolated conveyance be built with isolated side reservoirs also? Maybe a good idea.

28) A south Delta facility of the same type as designed for the north? Maybe not. Given the very different conditions in the south delta compared to Hood, I doubt that it is reasonable to apply the same type of facility. I believe there is opportunity in the near future to test various facility designs and operations as we try to tailor facilities to local conditions there. The goal is to protect fish at the same level at both facilities. The process of getting there may be quite different given the different conditions.

29) I don't think we are ready to prescribe the new facility for the south Delta yet. Considerable evaluation of options probably lies ahead.

30) Jumps ahead here, regarding screens at head of CCF?

35) Agree with all of this paragraph regarding a functional Tracy Facility. Given time frames for constructing new diversion facilities and conveyances such as at Hood, the Tracy facility will need to function for many years. We hope for an accelerated program of technology development, improvement/replacement, and change in all Tracy functions (from trashrack to fish stocking procedures), with all agencies participating. These developments should be valuable for other Delta screening designs and decisions also.

Comments on Information Needs:

Operational Flexibility of Facilities - the more the better, within criteria, engineering and common sense constraints.

Species and life stages protected - All fishery resources appear to be valued enough for protection; the 1 inch size fish sets the criteria for length, however if new screen developments afford a measure of protection for even smaller forms, so much the better. At least in the south Delta facilities, I think enough is known on species, sizes and seasonal abundance to guide screen technology development.

Screen Criteria and Performance - agreed that these are very important to establish. Criteria may be different for a south delta facility compared to a Hood facility?

Darryl - hope this helps a little for your work with CALFED. I am happy to be a

participant with this process. I expect that much of my contributions in the future may come from continued assisting in technology development such as the pumps at Red Bluff and Tracy, but I would like to attend every meeting that I can with the fish facilities group.

Charles Liston

Comments from Ned Taft, dated May 28, 1997

Comments from Ned Taft, Alden Research Laboratory, Inc.
CALFED Fish Facility Team Recommendations for Phase II Alternatives
Ref.: E-mail from Darryl Hayes dated 5/25/97

GENERAL

1) I concur that there are no technical limitations to a facility with a flow rate as high as 15,000 cfs. Breaking the facility into smaller units (e.g., 3,000 cfs) would also allow phased construction, assuming that time is not of the essence. Experience from operation of the first, smaller unit could then be factored into improved designs for facilities added at a later date. This comment applies to large facilities installed anywhere in the Delta.

2) This is a key element of a successful, balanced facility. Every attempt should be made now to identify what further information might become available and how such information might warrant changes in facility operation and function.

3) I concur that positive barrier screens should be used. I would add that supplemental protection afforded by behavioral systems (if they attain state-of-the-art status as a result of ongoing research) should be considered, where appropriate. While they will never be 100 percent effective, behavioral barriers could prevent a portion of the fish populations at risk from entering a new screening facility at all.

4) I concur, although some fish slightly less than 1-inch will have the swimming stamina to divert under optimum hydraulic conditions.

5) I strongly concur. Behavioral barriers may be well-suited for use in keeping fish in their native river at the point of flow withdrawal.

6) Based on information I obtained at the February IEP Symposium in Asilomar, it appears that the natural tidal and river flows, coupled with man-made withdrawals, strongly influence the direction and magnitude of flows in the Delta. This is a highly complex environment that has been greatly impacted in the past. The proportion of flow withdrawn from each source should be based on the goal

D-007172

of restoring/maintaining as "natural" a regime as possible.

7) I concur.

8) While I agree with this recommendation in general, it is not clear what the specific intent of this recommendation is. In our previous meetings, I thought we agreed that on-river screens could not be made to function and that "positive barrier screens" would be the Vee design with bypasses and probably pumps. If this is the case, a screen facility at any location will involve fish handling and potential passage delays. Again, behavioral barriers located at the entrance to a diversion could provide some level of "in-river" passage.

NORTH DELTA DIVERSION SCREENS

9) I concur. Items 9 through 23 address the North Delta Diversion only. I thought there was a desire on CALFED's part to reconsider diversion(s) at in the area of the Delta Cross Channel. Do we need to address this location by summarizing our discussions?

10) I concur. The North Delta isolated diversion has many environmental, as well as economic and performance, advantages over other alternatives.

11) I concur.

12) I believe false attraction is a major negative of through-Delta options and may represent a fatal flaw. I agree that fish passage options are available; however, the ability of ladder and lift options to pass fish at all, much less without delay and stress, is unproven for many species. It is not clear to me how facilities would be designed to permit periodic screen openings, particularly if a low-head pumping plant is included (Item 19).

13-17) I concur.

18) I do not recall that on-river concepts were considered viable for any flow rate. Perhaps this option was discussed at the May 1 meeting.

19-20) I concur.

21) I concur. At our recent Fish Passage Workshop in Milwaukee, I learned of several model studies that have been conducted on the Columbia River to identify the optimum location for placing bypass discharges. We should obtain more information to determine if such studies are warranted for the Delta.

22) I concur.

D-007173

23) I concur. I believe that additional storage would represent a major environmental enhancement to any alternative.

SOUTH DELTA SCREEN FACILITIES

24) I concur.

25) I strongly concur.

26) While I agree that the need for fish transportation is a disadvantage of a South Delta facility, I do not feel that it is a fatal flaw. As the Bureau proceeds with upgrading of the existing facilities to provide better fish handling, it may be learned that reasonable survival to the release point can be achieved.

27) I agree that debris is a major concern. However, I also believe that effective debris management is achievable using modern debris handling and conveyance technologies.

28) I agree with the facility type. I do not believe that cost should be considered as an important factor at this time. All of the alternatives will be very costly.

29-31) I concur.

32) The idea of constructing a "strawman" facility to screen a portion of total diversion is a good idea. I still believe that some level of state-of-the-art screening in the South Delta will be a practical reality with whatever alternative is eventually agreed upon. The strawman approach will bring us one step closer to that reality and provide much useful information on facility design and operation in the process.

33) It occurs to me that we never discussed eliminating predation in Clifton Court Forebay if a new facility is NOT constructed in the South Delta. Should control methods be suggested as part of ANY alternative that may be considered under the CALFED process?

34) Could the demands of CVP and SWP be met by developing new storage capacity "downstream" of these facilities rather that enlarging CCF?

35) I strongly concur.

INFORMATION NEEDS

I concur with your questions and statements.

Ned Taft

Comments from Kevan Urquhart, dated May 30, 1997

NOTE: ***The following comments are on a draft "Alternatives Review" portion of an "in-house" report to CALFED. DFG subsequently revised these comments and incorporated them into a memorandum to CALFED outside of the Fish Facilities Team effort.***

Darryl Hayes:

Here are the results of the brainstorming that we did over two half day meetings. Please read and incorporate into your document as appropriate.

Bob, Scott, George, and Kevan; BDD-FFU

BDD Fish Facility Unit's Comments on CALFED Options

Alt 1A

This is really just the no project alternative, and as such, obviously an unacceptable alternative.

Alt 1B&C
Problems

1. Increase transit time across CCF due to northern gates may increase pre-screen loss.
2. Moving Tracy fish facility to in front of pumping plant will increase pre-screen loss whether drawing from canal or CCF.

Solutions

1. Screening CCF will decrease pre-screen losses for both facilities when jointed
2. Any CVP improvements should be done at existing site
3. Given Issue #1, the best solution is combined or common diversion from a screened CCF

Issues

1. When barriers installed, no differential species take will probably occur between sites, thus eliminating the value of separate facilities.
2. 5/8 Draft Appendix description for 1B doesn't mention new northern CCF intake. Should it have?

Alt 2A&B
Should be Alt 2A&B on committee summary sheet

Problems:
1. Same as 1B and C
2. Upstream adult passage problems

Issues:
1. The destruction of Snodgrass and Meadows areas is in direct conflict with the shallow-water improvement goals for North and Central Delta. It destroys the last undisturbed portion of wetlands, and seems irrational or seriously counterproductive.

Alt 2C
Problems:
1 The use of three unscreened isolated conveyances expands the volume of CCF; thus increases the pre-screen loss problem.

Solutions:
1. If fish-friendly pumps are used at the Eastern and North conveyances, then fish screens should be feasible and worthwhile
2. Should screen the heads of all three conveyances and screen the intake of CCF
3. Restoration value of improving Tracy facilities also reduced if Solution 1 and 2 are done.
4. As Dan suggested, the easiest solution is to dump 2C, and go with an improved version of 3I, see later associated comments.

Alt 2D
Problems:
1. Same problems as 2A and B for Hood diversion
2. Same problems as 1B and C for CCF and Tracy FF
3. Maps show HOR Barrier, but not mentioned in text and 2E option
4. Leads to increased straying of Sacramento/Mokolumne spawners.

Solutions:
1. All delta agricultural diversions lost due to levee set-back should be consolidated and screened, before reinstallation..

Alt 2E
Problems:
1. #2 & 3 from Alt 2D, above.
2. As per Dan's comments, if you have discrete opening to off-channel shallow water habitat areas vs. shallow water habitat contiguous with the channel itself (e.g. as achieved with setback levees), there is likely to be loss and straying of both emigrant smolts and immigrant spawners. If the shallow water habitat is not hydraulically contiguous with the main channel on a nearby scale, fish might get lost in these backwaters or be stranded during dewatering, as in the bypasses. For migratory fish, shallow water habitat contiguous with the main channel will

probably be less confusing than habitat segregated behind levees and accessible only through small openings/entrances/exits.

3. As per Dan, abandon 2D & E.

Alt 3 series [A-D]
Problems:

1. Same as 1A and B
2. Open convenience may provide more siphon related problems, when crossing river channels, than piped and pumped transfer.
3. The value to migratory fish of any proposal to divert <50% of the water rights from the Sacramento River at Hood, are significantly diminished by the fact that the fish are again exposed to cross Delta diversion below Hood. For example, the value of diverting 50% of the water at Hood could be reduced by 50% (= to effective screening of only 25% of the diverted flows), if half the water and fish passing Hood are later subject to cross Delta diversion at the Delta Cross Channel or Georgiana Slough (possibly even at Three-mile Slough). Thus diverting a small percentage of the total water withdrawals at Hood (e.g. 5,000 cfs) is only really worthwhile if you can close the Delta Cross Channel and put in radial gates for the same purpose at Georgiana Slough. The latter may be hydraulically infeasible, and of course, creates boating and fish passage problems.
4. Screened water from the Northern intake is combined with unscreened water in the Southern Delta before export.

Solutions:

1. Any channel enlargements and set-back levees should provide opportunities for consolidating and screening delta agricultural diversions, before reinstallation.
2. CCF should also be screened or Northern conveyances should connect after the SWP and CVP fish facilities.

Issues:

1. Why does the Intertie have a 10,300 cfs capacity?
2. Why is the upgraded capacity (10,300 cfs) at Tracy Fish Facility?
3. Why on 3A is there a 5,000 and 10,000 cfs components mentioned for Tracy Pumping Plant?
4. Why in 3C text is there no mention of CCF Intertie and Tracy improvements (as shown on map)?

Alt 3E
This option provides maximum flexibility with minimal central Delta effects, as per Dan Odenweller's comments. Screened water from the Northern intake is combined with unscreened water in the Southern Delta before export.

Alt 3F
Problems

1. More apparent delta disruption for limited benefit.
2. More hydraulic problems with DCC intake
3. Increased aquatic weed problem from expanded, open/unvegetated shallow water habitat in front of the pumps that is essentially on a closed route to the facilities so the weeds can't end up elsewhere, increased probability of higher maintenance costs and chemical treatments as a result.
4. Difficult or impossible to screen a chain of lakes with multiple intakes. Would require a whole and gigantic screen shop to deal with O&M, bigger than any single existing DFG shop. Increased pre-screen loss across what is essentially an expanded CCF. Any fish biomass on the islands has no way to get back to the Delta.

Solution:
Drop this option.

Alt 3G
Problems
1. Adult fish passage and attraction problem with increased flow through Ship Channel, unless this is a sealed conveyance all the way to CCF. The plan shows it may be sealed or may have lock openings in Cache Slough.
2. Also has same problems as in 3A-D.

Issues:
1. Intake location higher in the Sacramento River improves screening hydraulics and reduces entrainment of some sensitive fish species.
2. Screening <50% of the total Sacramento water diverted from this point has the same potential for diminished returns, as it does at Hood, since the fish are again re-exposed to central Delta diversion at GS & D-X-C.

Alt 3H
Same Problems, Solutions, and Issues as on 2E and 3A-D. Screened water from the Northern intake is combined with unscreened water in the Southern Delta before export.

Alt 3I
Problems:
1. Many large unscreened intakes.
2. Adult entrainment can occur at unscreened diversion (also 2C)
3. Increases PSL through the channels becoming effectively an expansion of CCF.
4. Screened water from the Northern intake is combined with unscreened water in the Southern Delta before export.

Solution:

1. Screen all three central and South Delta intakes.

Issues:

1. Why build a 5,000 cfs unscreened diversion that low in the S.J.? What environmental benefits are associated with this feature? Wouldn't the same size or smaller (?3,000 cfs?) Diversion farther upstream in the S.J. be more technically feasible from a screening standpoint and provide better environmental benefits? Potentially, screened water from that canal could be given to South Delta farmers to blend with the irrigation water they pump from the sloughs to ameliorate their water quality concerns.
2. A diversion in the S.J. in the isolated channel upstream of Stockton could worsen the D.O. sag/blockage to adult immigrants or smolt emigrants.
3. The value of multiple unscreened diversion points is totally dependant on the successful implementation of a long term RTM program. To date, the RTM program has failed to provide sufficiently precise data on the small geographic and time scales necessary for such diversion point swapping to be effective. Constructing these facilities is a total waste of $, if RTM cannot address these information needs. This alternative should acknowledge that it will be infeasible, if RTM is not developed sufficiently to meet this proposals management information/decision-making needs.