Comment Letter COT

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EXHIBIT A

Attached are pages 1 – 5 from the US Army Corps of Engineers Public Notice dated January 31, 1996.

000217

Public Notice

US Army Corps
of Engineers

Sacramento District
1325 J Street
Sacramento, CA 95814-2922

Public Notice Number: 199600027
Date: January 31, 1996
Comments Due: March 1, 1996

In reply, please refer to the Public Notice Number

TO WHOM IT MAY CONCERN:

SUBJECT: Application for a Department of the Army permit under authority of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act to continue the Temporary Barriers Project for five years by installing four temporary barriers in south delta channels during the 1996 through 2000 irrigation seasons as shown in the attached drawings.

APPLICANT: Department of Water Resources
ATTN: Ms. Kathlin Johnson
Chief, Division of Planning
P.O. Box 942836
SACRAMENTO, CA 94236-0001

PURPOSE: The applicant has stated that the purpose of continuing the Temporary Barriers Project (TBP) for five years is to:

1. Physically test the Grant Line Canal Barrier;
2. Continue elements of the current monitoring program that warrant additional studies;
3. Protect San Joaquin River salmon migrating through the delta; and
4. Provide an adequate agricultural water supply in terms of quantity, quality and channel water levels to meet the reasonable and beneficial needs of water users located within South Delta Water Agency.

During the initial five year test period, the TBP purpose was to test for effectiveness of the barriers in improving water levels, water quality and water circulation in south delta channels. The purpose of the Head of Old River barrier was to protect San Joaquin River salmon migrating through the delta. Biological information about the barriers' effects on vegetation and fisheries was also gathered. The applicant states that continuation of the TBP for five years will allow DWR to complete further monitoring of the effects of the project on fisheries and vegetation. This information will be used in evaluating and finding solutions to fisheries resources and water use problems in the south delta.

Although a barrier has never been installed in Grant Line Canal, the applicant states that

000217

DWR modeling has shown significant improvements in water level and circulation resulting from barrier installation.

Already completed are: 1) the negotiations for the long-term contract (South Delta Water Agency and DWR have approval to sign and U.S. Bureau of Reclamation is awaiting congressional approval); 2) a draft EIR/EIS for permanent barrier facilities; 3) an Initial Study and Negative declaration for the TBP; 4) a Biological Assessment; and 5) yearly and comprehensive monitoring reports.

A plan for permanent facilities will be developed using information from the TBP. The plan will be developed in accordance with provisions of the proposed South Delta Contract between DWR, USBR and South Delta Water Agency. This action will be coordinated and consistent with Interim South Delta Program alternatives. Test information will be used to determine the best design and operation of structures to meet provisions of the South Delta Contract and minimize environmental and recreational impacts.

Further information about the project or monitoring program can be found in the 1995 Initial Study, the 1995 Comprehensive Monitoring Report, the 1995 Biological Assessment and the Interim South Delta Program draft EIR/EIS released in August of 1995. These documents can be obtained from DWR.

LOCATION: The names of the four barriers and their locations are as follows: **Head of Old River Barrier (HOR)** is in Old River at the San Joaquin River; **Middle River Barrier (MR)** is in Middle River near Victoria Canal, about 0.5 miles south of the confluence of Middle River, Trapper Slough and North Canal; **Old River near Tracy Barrier (ORT)** is in Old River approximately 0.5 miles east of the Delta Mendota Canal; **Grant Line Canal Barrier (GLC)** is in Grant Line Canal 420 feet east of the Tracy Boulevard Bridge.

AREA DESCRIPTION: Three of the barriers have been installed in previous years. The barriers at HOR, MR and ORT are located in the same spot as previous barriers. These areas are disturbed and virtually unvegetated. The MR barrier abutments are currently in place during the processing of this permit application. If the five year continuation is not permitted, the abutments shall be removed.

No barrier has ever been installed at the GLC site. The GLC location has established riparian vegetation on the south bank. The north bank has some sparse herbaceous vegetation.

PROJECT DESCRIPTION: The HOR barrier is proposed to be installed during the spring season. (This barrier will also be installed in the fall under Department of the Army Permit number 190109706.) The spring barrier was first installed in April of 1992 and 1994. It was not installed in 1993 or 1995 due to high San Joaquin River flows. The HOR barrier is proposed to be installed as early as March 1 and be removed by June 1 of each year. The barrier will be solid rock with boat portage facilities to allow boat traffic to pass. The barrier is 200 feet long and 70 feet wide at the base with a crest elevation of 10 feet mean sea level.

2

It is composed of approximately 2,300 cubic yards of rock. The boat portage consists of a boat ramp with docks on both sides of the barrier and a 4-wheel drive vehicle with a universal trailer that can handle boats up to 25 feet long.

The MR barrier is proposed to be installed as early as March 1 and will remain in place until the fall HOR barrier is removed. (The fall HOR barrier is installed by September 1 and removed by November 30 and is permitted through 1997. The fall HOR barrier can remain in the river until December 30 if low flows in the San Joaquin River persist.) If the fall HOR barrier is not installed, the MR barrier will be removed by October 15. The barrier is composed of rock with six culverts that have flap gates on the upstream end to prevent flows from travelling downstream. It is 270 feet long and 50 feet wide at the base and is composed of approximately 2,300 cubic yards of rock. There is a 140 foot notch in the center of the barrier with an elevation of 1 foot mean sea level. The remaining abutments have an elevation of 3 feet mean sea level. The abutments and the culverts are proposed to remain in all year long during the life of the permit.

The ORT barrier is proposed to have the same installation and removal time frames as the MR barrier. The barrier is composed of rock with nine 48 inch culverts with flap gates on the upstream end to prevent flows from traveling downstream. The barrier is 250 feet long and 60 feet wide at the base and is composed of approximately 2,500 cubic yards of rock. There is a 75 foot notch in the center of the barrier with an elevation of 2 feet mean sea level. The remainder of the barrier crest will be at elevation 4 feet mean sea level. The ORT barrier will also have boat portage facilities to allow boat traffic to pass. The portage consists of a boat ramp and docks on both sides of the barrier and a 4-wheel drive vehicle with a universal trailer that can handle boats up to 25 feet long.

The GLC barrier is proposed to be installed when the spring barrier at HOR barrier is removed and removed in October of each year. The GLC barrier composed or rock with six 48 inch culverts. It is 300 feet long and 140 feet wide at the base with a 180 foot wide notch in the center of the barrier. The barrier is composed of approximately 11,481 cubic yards of rock. The notch will be constructed to elevation -1 foot mean sea level and the remainder of the barrier crest will be at elevation 1 foot mean sea level. The weir elevation may be altered during operation of the barrier to: 1) allow sufficient circulation to avoid accumulation of salt in Grant Line Canal and upper Old River; 2) prevent adverse impact to the dispersion and flushing of effluent from Tracy.

All four rock barriers shall be installed and removed using an excavator and a barge or truck mounted crane.

Under past permits, the MR and ORT barriers were not installed until April 15 each year. This application requests earlier installation because March has been one of the worst months historically for water level and salinity problems affecting south delta water users. A study done by Resources Management International, Inc. investigated impacts that would result from this earlier installation. The report, titled Final Feasibility Assessment March 1 Installation of

000217

South Delta Barriers, concluded the following and is available for review from DWR: 1) A March installation of the MR and ORT barriers would create no additional risk to delta smelt, winter run chinook salmon smolt or Sacramento splittail relative to their loss at the State Water Project pumps. 2) The potential risk of the MR and ORT barriers impeding adult splittail migration through the south delta appears to be minimized. 3) Placement of the MR and ORT barriers is not likely to adversely impact the salmon smolt migration through the south delta. In fact, there should be a benefit to the smolt by moving them more rapidly through the south delta. 4) The placement of the MR and ORT barriers appears to cause an equal or greater number of salmon smolts to be salvaged at the CVP pump station (via Grant Line Canal) as would occur with no barriers in place.

ADDITIONAL INFORMATION: The applicant has proposed a conceptual mitigation plan for the replacement of 0.31 acres of waters of the United States. This acreage was calculated as a result of the direct footprint of each barrier and the rise of tidal waters behind each barrier. Of the 0.31 acres of waters proposed to be impacted, 0.001 acre is riparian scrub, 0.059 acre is non-native grassland and 0.25 acre is low tide emergent marsh. A total of 0.93 acre of waters will be created: 0.33 acre of low tide emergent marsh; 0.6 acre of tule marsh; and 0.01 acre of riparian scrub. The location of the proposed wetland mitigation is along the south east side of Sherman Island in Sacramento County. The banks of the levee in the mitigation area are rip rapped with some vegetation establishment in the rip rap. The areas of vegetation establishment are localized with a few native woody species growing on the upper banks and some wetland emergent vegetation in the tidal area. The mitigation shall be created where no wetland currently exists. The mitigation plan, titled Conceptual Wetland Mitigation and Monitoring Plan for the South Delta Temporary Barriers Program, is available for review from the Corps of Engineers or DWR.

The applicant is currently working with the California Department of Fish and Game to obtain a 1600 agreement.

The latest published version of the National Register of Historic Places and its monthly supplements have been reviewed and there are no places either listed or recommended as eligible which would be affected. No further cultural resources review is warranted because the permit area has been extensively modified by previous work.

The federally listed as endangered winter run chinook salmon, *Oncorhynchus tshawytscha*, the federally listed as threatened delta smelt, *Hypomesus transpacificus*, and the Sacramento splittail, *Pogonichthys macrolepidotus*, which is proposed for listing, are all in the permit area. Consultation under Section 7 of the Endangered Species Act will be entered into with the National Marine Fisheries Service for the winter run chinook salmon and with the U.S. Fish and Wildlife Service for the delta smelt and its critical habitat. Conferencing will be initiated with the Fish and Wildlife Service for the Sacramento splittail.

The District Engineer has made these determinations based on information provided by the applicant and on the Corps' preliminary investigation.

4

CESPK-CO-R Public Notice Number 199600027

000217

Interested parties are invited to submit written comments on or before **March 1, 1996**. Any person may request, in writing, within the comment period specified in this notice that a public hearing be held to consider this application. Requests for public hearings shall state, with particularity, the reasons for holding a public hearing.

The decision whether to issue a permit will be based on an evaluation of the probable impact including cumulative impacts of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered including the cumulative effects thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands, cultural values, fish and wildlife values, flood hazards, flood plain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, consideration of property ownership, and in general, the needs and welfare of the people.

The Corps of Engineers is soliciting comments from the public; Federal, state, and local agencies and officials; Indian Tribes; and other interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the Corps of Engineers to determine whether to issue, modify, condition or deny a permit for this proposal. To make this decision, comments are used to assess impacts on endangered species, historic properties, water quality, general environmental effects, and the other public interest factors listed above. Comments are used in the preparation of an Environmental Assessment and/or an Environmental Impact Statement pursuant to the National Environmental Policy Act. Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

If additional information is required, please contact Simon Kwan at the Department of Water Resources, telephone (916)653-6025, or Karen Shaffer, at the letterhead address, telephone (916) 557-5269.

John N. Reese
Colonel, Corps of Engineers
District Engineer

Enclosures: Drawings (14)

5

000217

EXHIBIT B

Attached are pages vii, 1-2, and 2-1 from the California Department of Water Resources' Biological Assessment for the South Delta Temporary Barriers Project 1996 dated December 1995.

000217

EXECUTIVE SUMMARY

The potential effects of the South Delta Temporary Barriers Project on threatened and endangered species were addressed initially in the *Biological Assessment for South Delta Temporary Barriers Project* (DWR 1992a). New permitting and project approval is needed to continue the Temporary Barriers Project for a second 5-year study interval beginning in 1996. Included in the proposed action for the new permitting are: 1) a continuation of the existing barrier program, 2) the early (March 1) placement of the two agricultural barriers when San Joaquin River flows forecasted for March are less than 10,000 cfs, and 3) the installation of the Grant Line Canal barrier for the period of June 1 through September 1. This Biological Assessment of these proposed actions is intended to satisfy the Section 7 consultation requirements of FESA by addressing potential impacts to federally listed threatened and endangered species. It also satisfies the requirements of the California Endangered Species Act (CESA) by addressing potential impacts to state-listed species that could occur in the project area of influence.

Of the 59 special status species noted for possible occurrence in the project area of influence, the life history, distribution, and potential impacts for 20 of these species are included in this Biological Assessment. The remaining 39 taxa are federal candidate species with no legal status and are not addressed in this report beyond a tabular summary of potential occurrence. An evaluation of the potential impacts of the project's proposed actions to these 20 special status species yielded the following results:

- No effect: nine taxa
- Not likely to adversely affect: nine taxa
- May adversely affect: two taxa

The two taxa that may be adversely affected by the project's proposed actions are the Swainson's hawk and Mason's lilaeopsis.

in December 1992; and b) changes in the location and installation schedule for the Grant Line Canal barrier -- one of four barriers being tested in the program. The 1992-1995 study period was also permitted under a COE 404 Permit and a 1601 Permit issued by the California Department of Fish and Game (CDFG).

1.2 PURPOSE AND SCOPE OF THE BIOLOGICAL ASSESSMENT

New permitting and project approval is needed to continue the Temporary Barriers Project for a second 5-year study interval beginning in 1996. This Biological Assessment is intended to satisfy the Section 7 consultation requirements of FESA by addressing potential impacts to federally listed threatened and endangered species. The assessment also satisfies the requirements of the California Endangered Species Act (CESA) by addressing potential impacts to state-listed species that could occur in the project area of influence.

Table 1.1 lists 57 special status species that have been identified by the FWS as species that could occur in the project area of influence (FWS 1995a). This list includes 18 species that are either federally and/or state-listed as threatened or endangered, or proposed for federal listing. The California black rail has been added to Table 1.1 because of its status (i.e., state listed as threatened) and potential to occur in the project area. The San Joaquin River fall-run chinook salmon, a CDFG Species of Special Concern, has been added to the list because the spring installation of the Head of Old River barrier occurs for the purpose of benefitting this population of fish. The life history, distribution, and potential impacts for these 20 species are included in this Biological Assessment. The remaining 39 species in Table 1.1 are federal candidate species with no legal status. These candidate species are acknowledged as sensitive species that could be listed under FESA or CESA in the future but are not addressed further in this report. Two of these 40 species are classified as federal Category 1, and the remainder are species that were formerly considered as Category 2; however, the FWS recently eliminated the Category 2 designation from their list of candidate species (FWS 1995b).

000217

SECTION 2 SUMMARY DESCRIPTION OF FACILITIES

2.1 HEAD OF OLD RIVER AT SAN JOAQUIN RIVER

The Head of Old River barrier is located at the confluence of Old River and the San Joaquin River (see Figure 1-2). It is installed twice each year, once each spring and again each fall.

For most of the years since 1963, the fall barrier has been in place between September 15 and November 30. USACE Permit 9706 authorizes installation during these months until 1997. The barrier's purpose is to improve dissolved oxygen levels in the San Joaquin River between the Head of Old River and Medford Island to aid salmon migration in the San Joaquin River.

The fall test barrier consists of approximately 1,900 cubic yards of rock and sand. The material is placed across Old River immediately downstream of the confluence with the San Joaquin River. The barrier is approximately 200 feet long and 50 feet at its widest point. Side slopes are 1.5 vertical to 1 horizontal. The barrier allows some flow through a small notch at its center.

In 1992, DFG requested that DWR install a spring barrier facility at the confluence of Old River and the San Joaquin River near Mossdale. The barrier was designed to reduce the loss of out-migrating San Joaquin fall run salmon smolts by significantly decreasing their diversions down Old River, consequently reducing their entrainment at state and federal pumps.

The temporary barrier in Old River near San Joaquin will be installed during the spring because conditions in the South Delta currently result in losses of San Joaquin fall-run chinook salmon. Although the species is not listed as threatened or endangered, population levels have dropped significantly in recent years. All efforts will be made to assure that no additional losses occur and that the problem is not aggravated by the test project.

Without the installation of the barriers during April and June, the fall-run salmon migrate, or are pulled, into the upper reaches of Old River near the San Joaquin River. There, they become more vulnerable to entrainment at federal or state export facilities. The barrier forces the salmon to remain in the main stem of the San Joaquin River where chances for survival are better. Studies by USFWS and DFG indicate that an effect of the fish barrier will be fewer San Joaquin salmon in the area where the pumps can entrain them. Once the juveniles are guided down the San Joaquin River past the Old River split at Mossdale, it is possible that they will be subjected to north-to-south flows in the Central Delta, toward state and federal diversions. If the fish are subjected to north-to-south flows, it is possible that there will be a reduction in the degree of benefits provided by the barrier. However, any impacts that occur as a result of the north-to-south flow will be lessened due to increasing marine salts and tidal actions which guide migrants toward the ocean.

000217

EXHIBIT C

Attached are pages 1-4 and 1-5 from Volume I of Entrix, Inc.'s and Resource Insights' Draft Environment Impact Report/Environmental Impact Statement (EIR/EIS) relating to the Interim South Delta Program (ISDP) and dated July 1996.

000217

In September 1985, DWR signed a letter of intent with SDWA describing conditions in south Delta channels and setting forth the agencies' responsibilities to develop a permanent solution for the water level and circulation concerns affecting SDWA.

- *Joint Powers Agreement*

In June 1986, DWR signed a joint powers agreement with SDWA regarding interim mitigation in SDWA channels. This agreement provided for dredging Tom Paine Slough (completed in October 1986), constructing a seasonal low rock weir in Middle River (completed in May 1987), constructing siphons in Tom Paine Slough (completed in June 1989), and developing intake gate operation criteria for Clifton Court Forebay that eliminate diversions during the low-low tide. All appropriate permits and certifications required under regulatory and legislative acts were acquired.

- *Framework Agreement*

In October 1986, DWR, Reclamation, and SDWA entered into an agreement to provide a framework to settle the SDWA lawsuit. All three parties agreed to work together to develop mutually acceptable, long-term solutions to the water supply concerns of water users within SDWA. To facilitate negotiations, the parties agreed to a stay of all actions in the litigation.

- *Draft Settlement Agreement*

In 1990, DWR, Reclamation and SDWA agreed to a draft settlement to the 1982 lawsuit by SDWA against DWR and Reclamation. In a September 17, 1991, election 97 percent of the voters in the SDWA service area approved the agreement. The agencies are now working to get Congressional approval for Reclamation to sign the agreement.

The draft agreement focuses on short-term and long-term actions to resolve the water supply problems in the south Delta. It provides for interim releases by Reclamation from New Melones to resolve the portion of the litigation relating to San Joaquin River flows and sets forth the framework for Reclamation and SDWA to negotiate an amendment to the agreement. It also includes provisions to test and construct barrier facilities in certain south Delta channels. Those facilities would improve channel water levels and provide agricultural water supply of adequate quantity and quality for water users along portions of Old River, Middle River, and Grant Line Canal that lie within SDWA boundaries.

The barriers testing program, referred to as the South Delta Temporary Barriers Project, was initiated in 1991. Its objectives are the short-term improvement of water conditions for the south Delta and the development of data for the design of permanent barriers. The program involves the seasonal installation of four barriers: one in Middle River, two in Old River, and one in Grant Line Canal. Three of the barriers are designed to improve water levels and circulation for agricultural diversions; they are to be in place during the growing season. Of those, the temporary barrier on Middle River was installed in 1992, 1993, and 1994; and the temporary barrier in Old River near Tracy, east of Delta Mendota Canal, was installed in 1991, 1992, 1993, and 1994. The temporary barrier in Grant Line Canal is being delayed until surveying and engineering studies are completed. The fourth barrier, in Old River at the San Joaquin River, is designed to assist fish migration on the

1-4

San Joaquin River. This barrier has been installed during the fall for many years. The Temporary Barriers Project is investigating installing the barrier in the spring to assist out-migrating salmon. It was installed during spring 1992 and 1994 but was not installed in 1993 due to the possibility of high San Joaquin River flows and concerns about delta smelt.

Long-term actions to resolve water supply problems in south Delta are proposed through the Interim South Delta Program. DWR and Reclamation, through the Interim South Delta Program, are proposing the installation of permanent barriers to improve water levels and circulation in the south Delta. Barriers will be designed and operated according to information developed by the Temporary Barriers Project.

1.3.2 Need To Utilize Full Pumping Capacity At Banks Pumping Plant

- *State Water Project Service Area Needs*

Twenty-nine public agencies have long-term water supply contracts with the SWP. Those contracts contain water delivery schedules reflecting the increasing water needs in the SWP service areas through 2035. In most cases, SWP water supplements other imported or local supplies in the individual service areas. Of the total 4.2 MAF entitlements under SWP contracts, 2.9 MAF is for municipal and industrial use, and 1.3 MAF is for agricultural use.

California's population is projected to increase by 15 million people between 1990 and 2020. About half of this increase is expected to occur within the South Coast region, a major portion of the SWP service area. Average-year water supply demands for this area are projected to increase 1.5 MAF by 2020. The estimated increase and supporting studies have been presented in Bulletin 160-93.

- *State Water Project Water Supply Delivery Capability*

Dependable water supplies from the SWP are currently estimated at about 2.9 and 1.9 MAF per year for average and drought conditions respectively. Some of this water comes from Lake Oroville on the Feather River; the majority is developed from excess flows in the Sacramento-San Joaquin Delta. As SWP contract entitlements increase, without new facilities the capability of the SWP to meet its contractual entitlements decreases gradually with time. The ability of the SWP to develop additional water supply also diminishes as non-SWP water use within the area of origin increases. (Areas where water originates have the right to use the water reasonably required to supply its beneficial needs.)

Water needs for the SWP service areas now exceed the delivery capability of existing SWP facilities. Because augmenting SWP yield through new construction has been delayed, DWR has been examining operation strategies to improve average annual delivery capability for the existing facilities. Although currently regulated by State Water Resources Control Board (SWRCB) Decision 1485 standards, DWR is voluntarily meeting the requirements of the 1994 Bay-Delta Accord. While operating to meet the requirements of the 1994 Bay-Delta Accord, the year 2020 delivery capability could increase to 3.2 MAF during an average year and 2.0 MAF during a drought year. (See Section 1.4, Treatment of December 15 State-federal Accord, for a further discussion of the 1994 Bay-Delta Accord and Section 2.4.2, Water Rights, for a further discussion

000217

EXHIBIT D

Attached are pages xi, xiv, 1-1, and 1-7 from the State of California's Resources Agency Department of Water Resources' Comprehensive Monitoring Report for the Proposed Test Program Temporary Barriers Project dated 1995.

000217

EXECUTIVE SUMMARY

The Temporary Barriers Project was initiated to better determine effects of installing permanent barriers in the South Delta. A five-year program began in 1991 and will extend through 1995 to test a facsimile of the proposed barriers. As a condition of its U.S. Army Corps of Engineers (Corps) permit (Army Permit No. 199200860) and California Department of Fish and Game's (DFG) Streambed Alteration Permit, the California Department of Water Resources (DWR) is required to conduct extensive environmental monitoring. This report provides a comprehensive analysis of the project's annual monitoring data for the period of 1991 through 1994.

Locations of the three temporary barriers installed during the period of 1991 through 1994 are:

- Head of Old River (near San Joaquin River)
- Middle River near Victoria Canal (about one-half-mile south of the confluence of Middle River, Trapper Slough, and North Canal).
- Old River near Tracy (about one-half-mile east of the Delta-Mendota Canal).

Monitoring during most of these years included a fourth site, on Grantline Canal about one-quarter-mile east of Old River, which may be considered for a temporary barrier in the future.

The review and analysis of these four years of monitoring data has resulted in the conclusions presented below by study element.

Element 1 – Direct Loss Effects, Juvenile and Adult Fish plus Egg and Larval Entrainment

The results of the annual and comprehensive analyses are inconclusive regarding the effect of barriers on salvage rates. Although changes in salvage rates sometimes coincided with barrier installations, no definitive effects could be isolated. Seasonal shifts in species abundance, variations in year class strength, and inter-annual variation in flow in the Sacramento and San Joaquin Rivers were all confounding factors. Other factors that may complicate the analyses include operation of the Delta Cross Channel gates, operation of the Clifton Court forebay, and shifts in export pumping rates.

However, the results of three consecutive winter-period mark and recapture tests, have been consistent in demonstrating that survival of salmon migrating through the Central Delta is substantially lower than the corresponding survival estimates for salmon remaining within the Sacramento River. Should the Head of Old River barrier be drawing winter-run smolt into the Central Delta or South Delta, it is likely that smolt survival would be reduced.

Element 6 – Water Circulation

- At low-tide, water elevations are raised upstream of the barriers.
- At high-tide, water elevations upstream of the barriers will not be affected by the permanent barriers, but the temporary barriers may cause a slight reduction in elevation due to the evergy loss through the rock weirs and culverts.
- Even though the flow rate during flood tide may be reduced slightly, it is diminished greatly during the ebb tide. The net result is increased water elevation upstream of the barriers.
- Increases in water levels can be as high as 1.5 feet upstream of the barriers.
- Although the low-tide water elevation did not vary downstream of the barriers, the low-low water elevations upstream were raised.
- High tide water elevations downstream of the barriers were not affected by the barriers.

Element 7 – Water Quality

During the four-year monitoring period, water analyses did not identify any significant adverse conditions as a result of the placement of the temporary barriers. There were no major changes in water quality immediately upstream or downstream of the barriers. However, water quality conditions near the barriers were typically very different from stations further upstream or the control station at Grant Line Canal, where electrical conductivity (E.C.), turbidity, and chlorophyll (indicative of suspended algae abundance) were often twice as high during mid-summer. Even these elevated background levels were within the historical range and generally met the water quality objectives of the Basin Plan.

000217

SECTION 1 INTRODUCTION

1.1 BACKGROUND

In 1990, the California Department of Water Resources (DWR) issued the Draft Environmental Impact Report/Environmental Impact Statement for the South Delta Water Management Program. Objectives of the program are to:

- Increase water levels, circulation and water quality in the southern Delta area for local agricultural diversions.
- Improve operational flexibility of the State Water Project to help reduce fishery impacts and improve fishery conditions.

Because of concerns related to both agriculture and the fisheries, the Temporary Barriers Project was initiated to better determine effects of installing permanent barriers in the southern Delta. A five-year program began in 1991 and will extend through 1995 to test a facsimile of the proposed barriers. Because of varying hydrological conditions and hydrodynamic patterns, as well as concerns for endangered species, the actual number of barriers installed and the installation schedule have been different each year of the program. Figure 1-1 defines the South Delta study area, and Figure 1-2 shows the location of all the temporary barriers. Table 1.1 shows the barriers and installation schedule originally proposed, and Table 1.2 and Figure 1-3 show actual installation and removal dates for various years. Table 1.3 summarizes the factors influencing the installation schedule of the barriers.

Table 1.1

Original Installation Schedule for the South Delta Temporary Barriers Project.

	Installation	Removal
Middle River	April 1	September 30
Old River near Tracy	April 1	September 30
Old River at Head	April 1	May 31
Grantline Canal	June 1	September 30

Although the South Delta Temporary Barriers Project has been in place since 1991, the Middle River barrier and the fall placement of the Head of Old River barrier have been installed in earlier years under different programs.

Locations of the three temporary barriers installed during the period of 1991 through 1994 are:

- Head of Old River (near San Joaquin River)
- Middle River near Victoria Canal (about one-half-mile south of the confluence of Middle River, Trapper Slough, and North Canal).
- Old River at Tracy (about one-half-mile east of the Delta-Mendota Canal).

Monitoring during most of these years included a fourth site, on Grantline Canal about one-quarter-mile east of Old River and Salmon Slough, which may be considered for a temporary barrier in the future.

The Temporary Barriers Project is being monitored to document and analyze trends with fish and vegetation in the area during the program and to help verify computer modeling efforts for the southern Delta. Monitoring results for the period of 1991 through 1994 are evaluated in this report. Monitoring results for individual years during this period are described in further detail in the annual monitoring reports for these years (DWR 1991, DWR 1992a, DWR 1994, and DWR 1995a).

1.2 TEMPORARY BARRIER PROJECT OBJECTIVES

Elements of the Fishery and Water Quality Monitoring Program (DWR 1992c) are intended to detect:

- Changes in distribution and direct loss and the Central Valley project and State Water Project export facilities of young striped bass, delta smelt, winter chinook salmon, and other fish species due to barrier-related changes in southern Delta hydrodynamic conditions.
- Changes in survival of fall chinook salmon smolts emigrating from the San Joaquin River drainage.

000217

EXHIBIT E

Attached is page 5 from the State of California's Resources Agency Department of Water Resources' Initial Study Proposed Test Program Temporary Barriers Project dated 1995.

000217

Chapter 2 - Project Purpose

The principal purpose of continuing the Temporary Barriers Project for an additional five years is to: (1) test the Grant Line Canal barrier, (2) continue assessing elements of the current monitoring program that warrant additional studies, (3) protect San Joaquin salmon emigrating through the Delta, and (4) provide an adequate agricultural water supply in terms of quantity, quality, and channel water levels to meet the reasonable and beneficial needs of water users in SDWA.

The goal of the Temporary Barriers project during the initial five year testing period was to test the effectiveness of barriers in improving water levels, water quality and water circulation in south Delta channels, protecting San Joaquin River salmon emigrating through the Delta, and gathering biological information concerning the barriers' potential effects on vegetation and fisheries. This goal was refined due to extensive data collection and increased knowledge of the barriers ability to improve water levels, circulation, and water quality. Water level and water quality monitoring will continue in order to analyze any changes that occur due to the Grant Line Canal barrier installation.

DWR did comprehensive biological data monitoring with regard to the temporary barriers (see Appendix V). Continued installation of the barriers will allow DWR to complete further monitoring, if required, to determine potential effects on vegetation and fisheries. The biological information gathered will be used to assist ongoing activities to evaluate and find solutions to fishery resources and water use problems in the South Delta.

Additional test data will help DWR, USBR, and SDWA develop a permanent solution to SDWA's problems according to provisions of the proposed south Delta Contract and applicable environmental laws. Using temporary barriers will also allow DWR to improve barrier designs and review alternative timing operations for the permanent barriers.

If analysis of the Temporary Barriers Project shows that the temporary barriers have significant negative impacts that cannot be mitigated they will be removed, replaced, or modified.

5

000217

EXHIBIT F

Attached are pages 1 – 11 of the Availability of Adequate Flow in Old River for City of Tracy WWTP Discharge – Preliminary Observations from the SDIP DEIS/EIR DSM2 Results

000217

Availability of Adequate Flow in Old River for City of Tracy WWTP Discharge – Preliminary Observations from the SDIP DEIS/EIR DSM2 Results

This section summarizes the assessment of the impacts of the permanent gate operations as proposed in the SDIP DEIS/EIR on the availability of adequate dilution flow in the Old River for the City of Tracy WWTP discharge. Further, it discusses the available options to potentially mitigate impacts to the dilution capacity of the Old River that may be caused by the proposed operation of the permanent gates.

In brief, a flow of 250 cfs released from the San Joaquin River to the Old River during the period of complete closure appears to mitigate water quality and dilution problems created for the City of Tracy's WWTP effluent discharge due to the proposed permanent gates. The results from the DWR DSM2 simulation of Alternative 2C as proposed in the SDIP DEIS/EIR indicate a potential problem during the VAMP period (April 1 – May 31) when the permanent fish gate at the head of Old River is completely closed. The flow in the Old River at the City of Tracy's outfall does not meet the 250 cfs flow criteria for the adequate in-stream dilution during this period.

DSM2 Model

The Delta Simulation Model (DSM2) is a one-dimensional hydrodynamic and water quality simulation model used to simulate water quality conditions in the Sacramento-San Joaquin Delta. It is the primary planning level tool used to investigate changes in Delta hydrodynamics and salinity. DSM2 is distributed by the Department of Water Resources (DWR) and was used as the basic tool for the analysis of the SDIP alternatives. The model uses an implicit 4-point finite difference scheme that solves a set of simultaneous equations for water velocity and stage throughout the Delta system. The model has been calibrated at several stations throughout the Delta. The calibration results are available to the public on the Interagency Ecological Program website.

1

000217

Temporary barrier operations

The temporary barriers include a fish barrier at the head of Old River and an agricultural barrier each at Middle River, Old River at Tracy Boulevard Bridge and Grant Line Canal East. The SDIP DEIS/EIR noted that historically the temporary barrier operations varied annually. However, the temporary barrier operations used in the SDIP No Action Alternative (Alternative 1) assumed the following:

1. The Head of Old River fish barriers are assumed to be installed between April 16 and May 15 when San Joaquin River flows fall below 5,000 cfs, and between September 16 and November 30 when San Joaquin River flows fall below 5,000 cfs. The barriers are removed when San Joaquin River flow exceeds 8,500 cfs. For the spring installation (April 16–May 15) the barriers are assumed at 10 feet MSL if VAMP flow is less than or equal to 7,500 cfs in dry, below normal, normal years or 11 feet MSL if VAMP flow is greater than 7,500 cfs (wet years). The fall installation (September 16–November 30) included a 32-foot notch in the barrier at 0.0 foot MSL.

2. The agricultural barriers at Middle River, Old River at Tracy Boulevard Bridge, Grant Line Canal East are assumed to be installed between April 16 and November 30 except when San Joaquin River flow exceeds 18,200 cfs or if the head of Old River fish control barriers are not installed between April 16 and May 15, or until the San Joaquin River flow drops below 12,000 cfs if the head of Old River fish control barriers were not installed. These barriers are assumed to have a 20-foot notch cut during the fall (September 16–November 30). The fall notch configuration at Old River at DMC is changed when the San Joaquin River flow is above 5,500 cfs. Finally, the agricultural barriers are removed if the head of Old River fish control barriers are removed as a result of Vernalis flows exceeding 8,500 cfs, unless the barriers are needed to maintain 0.0-foot MSL minimum water levels at three key locations.

2

000217

Permanent Tidal Gate Operations

The proposed permanent gates include a fish tidal gate at Head of Old River and three agricultural tidal gates on Middle River, Grant Line Canal and Old River. The SDIP DEIS/EIR considers several alternatives for operating the permanent gates. The proposed operations of the gates in the SDIP DEIS/EIR under Alternative 2C and all the other alternatives that include permanent gates are described below.

The fish control gate at the head of Old River is closed from April 1 to May 31 and is almost completely closed during October and November unless the San Joaquin River flow at Vernalis is greater than 10,000 cfs. During the summer period (June – September), 500 cfs of flow is diverted under regulation into the Old River by partial gate closure when San Joaquin River flow at Vernalis is between 800 cfs and 2,500 cfs and is completely open if the flow is outside this range.

The three permanent agricultural tidal gates are generally opened during all the flood-tide periods to allow water to pass upstream of the gates during the rising tide. The Middle River and Old River gates are then closed during the ebb-tide periods to force the water to recede back only down Grant Line Canal to provide better circulation. The Grant Line Canal gate is raised to an elevation -0.5 foot during the ebb-tide to allow the water levels in the south Delta channels to be greater than 0.0 feet target elevation. These operations are assumed to occur through out the year during the periods when the head of Old River gate is closed or partially closed. Moreover, the Middle River gate is not closed during the ebb-tide when the San Joaquin River flow is above 2,500 cfs, the Old River gate is not closed when the flow is above 4,000 cfs and the Grant Line Canal gate is fully opened when the flow is above 8,000 cfs.

Flow Circulation

The proposed operation of the permanent agricultural tidal gates under Alternative 2C is intended to provide better circulation in the south Delta channels. This operation allows the water to travel upstream of the gates in the three channels during the flood-tide and allows it to flow out through the Grant Line Canal during the ebb-tide. This operation is expected

3

to provide a flushing mechanism to circulate the standing water out of the south Delta channel system using tidal energy.

Observations based on SDIP DEIS/EIR Alternative 2C Results

This section presents the results based on DSM2 modeling provided by the Department of Water Resources (DWR) for the No Action Alternative and Alternative 2C. CH2MHILL has determined that 250 cfs is the minimum dilution criteria based on water quality objectives to comply with Human Health Effluent Limits for Trihalomethanes (such as Dibromochloromethane and Bromodichloromethane

Figure 1 shows the simulated 16-year mean daily flow in Old River where the City of Tracy outfall is located, under Alternative 2C. The figure demonstrates that there is enough flow to meet the dilution criteria (250 cfs) all year long except during the periods when the head of Old River fish gate is completely closed for the duration of the presumed 60 day VAMP period (April 1 – May 31). Flows in this reach are less than 250 cfs during the VAMP period, except when the head of Old River gate is not closed, i.e. during the wet years 1982 and 1983 and the above normal year 1978, when the flow at Vernalis is above 10,000 cfs.

The mean daily flows from the DSM2 SDIP Alternative 2C simulation were reviewed to evaluate the resulting water circulation pattern in the south Delta channels due to the daily operation of the agricultural tidal gates. Figure 2 shows the mean daily simulated flows for Old River, Grant Line Canal and Middle River upstream of the tidal gates under Alternative 2C. The plot indicates that the flow in fact reverses in the Old River and Middle River whereas the flow continues downstream in the Grant Line Canal. Thus the water is moving in accordance with the circulation pattern defined for Alternative 2C.

To determine the percent of time the flow criteria was met in the reach-of- interest, frequency analysis was performed on the simulated mean daily flows obtained for No Action Alternative and Alternative 2C. Figure 3 shows the percent exceedance for a given flow in the reach-of-interest in Old River. The figure indicates the flow was less than the

required 250 cfs approximately 2% of the time under the No Action Alternative, and less than the required 250 cfs approximately 13% of the time under Alternative 2C.

Potential Solutions to Maintain the Flow Criteria

There are a number of potential options to mitigate the dilution problem indicated during the VAMP period. The easiest solution is instead of completely cutting off the flow from San Joaquin River to the Old River, to allow some flow similar to the months of October and November when the gates are partially opened. This option was tested using the DSM2 model. DWR's Alternative 2C scenario was re-run with the following modification. A flow of 250 cfs was allowed from the San Joaquin River into the Old River when the Head of Old River gate would be completely closed during the VAMP periods. Figure 4 shows the resulting average daily flow from this model simulation in the reach-of-interest for the 16-year period. The flow was above the required 250 cfs for most of the simulation period. Figure 5 shows the frequency analysis of the average daily flow data in the reach-of-interest in comparison to Alternative 2C and the No Action Alternative. The analysis shows that if a flow of 250 cfs is released from the San Joaquin River when the fish gates at the Head of Old river are completely closed then the required flow criteria of 250 cfs is met 99.98% of the time during the 16-year simulation period.

The second option is to install a low head pump at the proposed Middle River permanent gate and pump water during the low tide periods upstream. This may provide the necessary flow to provide adequate dilution near the outfall.

A third option is to modify the current proposed operational criteria of the gates to be adaptive to the real time existing water quality conditions and the required minimum flows. One such option would be to alternate the opening of the Grant Line Canal gate and Old River gate during the ebb-tides instead of only the Grant Line Canal gate being opened every day. This would potentially allow stagnant water present in the Old River near the outfall to be flushed out of the system. The second and third options were not yet tested using the DSM2 model. Further study is needed to assess the potential advantages and impacts of the above proposed options. The DSM2 model simulations would be needed to

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assess the potential feasibility and modifications required for each of the proposed solutions.

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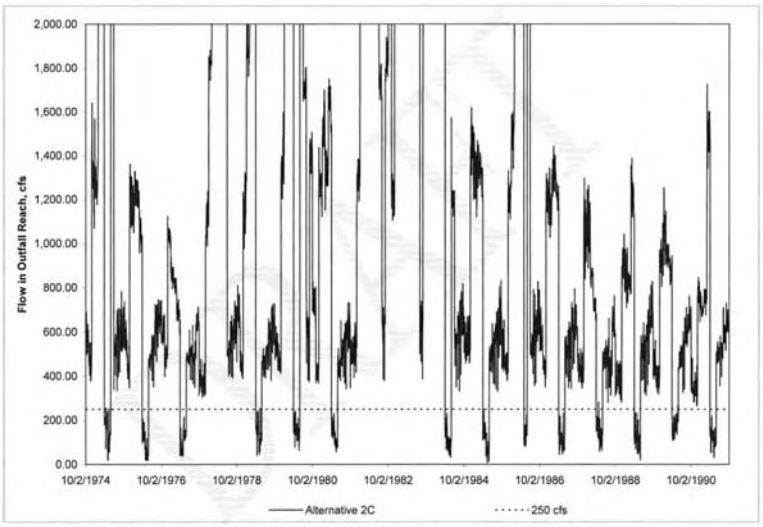

Figure 1. Simulated 16-year mean daily flow in the Old River reach near the City of Tracy outfall under Alternative 2C.

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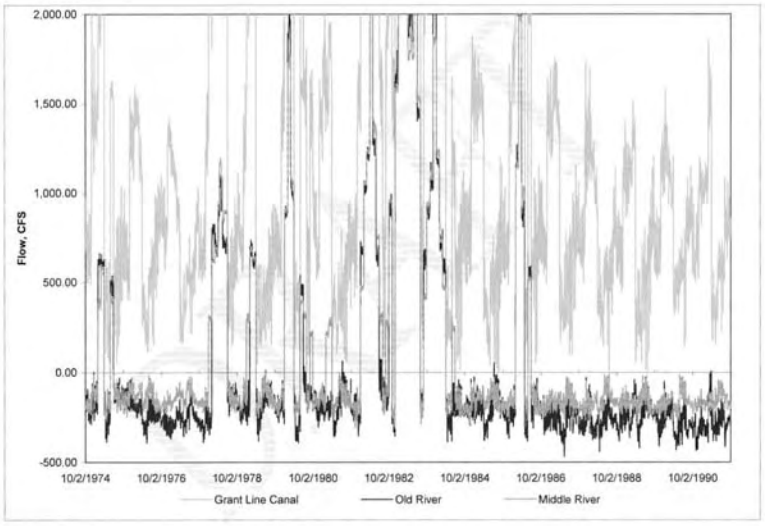

Figure 2. Simulated 16-year mean daily flows (cfs) in the Old River, Grant Line Canal and Middle River upstream of the proposed permanent tidal gates under Alternative 2C.

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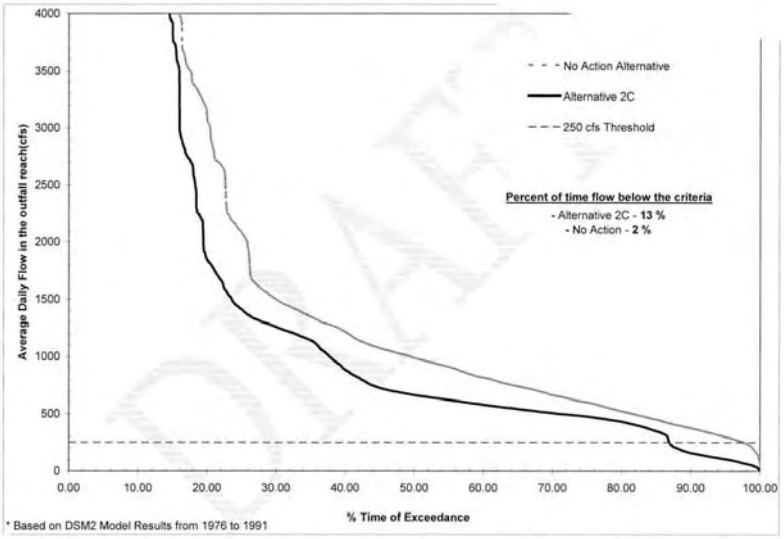

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...alysis of the simulated mean daily flows for Alternative 2C and No Action Alternative.

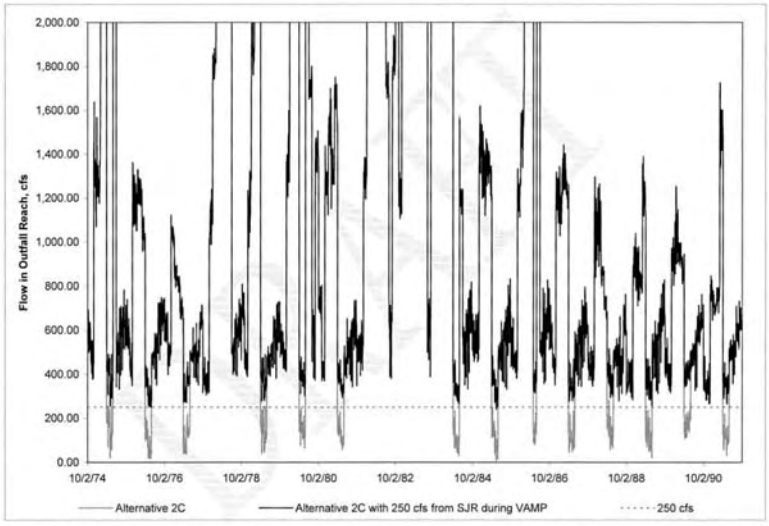

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Figure 4. 16-year average daily flows in the Old River reach near the City of Tracy outfall from Alternative 2C and Alternative 2C with 250 cfs flow from San Joaquin River during VAMP.

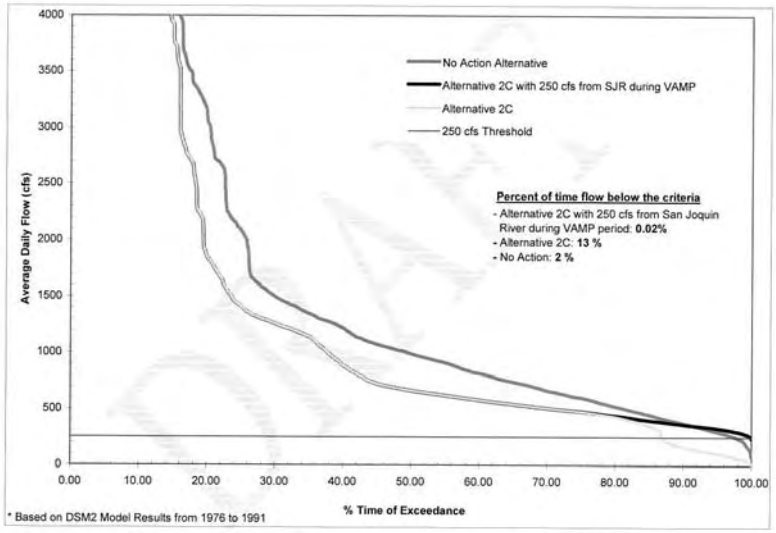

Figure 5. Comparison of results from the frequency analysis of the simulated mean daily flows for Alternative 2C scenario with 250 cfs from the San Joaquin River during the VAMP, Alternative 2C scenario and No Action Alternative.

11

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Comment Letter SLDMWA

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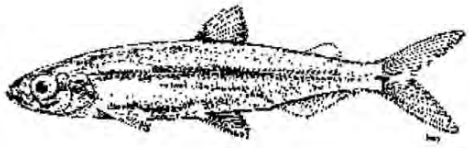
ATTACHMENT 1

FEB 07 2006

The State of the Delta:
What is Killing the Delta Smelt?

By Dr. B.J. Miller



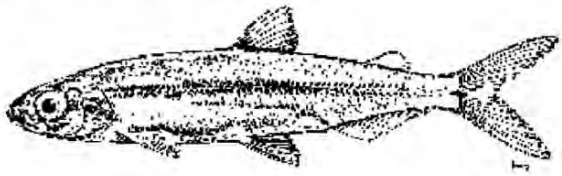
January 2006

The State of the Delta: What is Killing the Delta Smelt?

Introduction

Recent declines in delta smelt, a pelagic (open water) fish of the San Francisco Bay Delta ecosystem, have generated significant interest in the scientific community. Delta smelt are designated as a threatened species under both the state and federal Endangered Species Acts. Some of these small fish enter state and federal pumping facilities in the southeastern Delta from which water is exported to farms and cities throughout California. Exports are curtailed when too many delta smelt enter the pumping plants, making this small fish among the most important in California.

The focus on the delta smelt has highlighted the fact that, despite decades of data collection by state and federal fish agencies and hundreds of millions of dollars spent on habitat restoration, we know little about the major determinants of the abundance of fish residing in the Delta. Only now, with the delta smelt abundance index[1] at its lowest point in 40 years, are we beginning to understand the interactions between flows, fish, food and water quality in the vast and complex Delta ecosystem.



What we now know, based on research described in this paper, is that the delta smelt's declining abundance appears to be closely linked to localized declines of an alien (non-native) zooplankton called Pseudodiaptomus that has been the delta smelt's primary food source in the summer. When Pseudodiaptomus are scarce in the areas of the Delta where smelt congregate during the critical late summer and early fall period, the subsequent fall abundance index is low. What causes these localized declines in Pseudodiaptomus remains unclear, although there are indications that the decline is linked to alien species, including consumption by the Amur River clam, contamination by toxins produced by an alien blue-green algae, Microcystis, or competition with another alien zooplankton, Limnoithona. Contamination by a new class of pesticides, less harmful to humans but more harmful to fish, is another possibility.

This new research further demonstrates that despite years of exhaustive research, scientists have yet to identify any link or correlation between water exports – the water sent by aqueduct to farms in the San Joaquin Valley and cities throughout California – and abundance of delta smelt.

1. State and federal fishery managers do not use population estimates in connection with delta smelt. Instead, they use an "abundance index" to estimate whether there are more or less of the fish in the Delta than in previous surveys. The "official" index of abundance for delta smelt is the Fall Midwater Trawl index of sub-adult abundance, obtained from surveys made in September through December.

The State of the Delta: What is Killing the Delta Smelt?

Delta smelt background

The delta smelt is a fragile fish that typically grows to only two to three inches as adults, although some have been recorded with lengths up to five inches. Delta smelt have a bluish hue and appear almost translucent. They are found only in the Sacramento-San Joaquin Delta and have been found as far upstream as the mouth of the American River on the Sacramento River and Mossdale on the San Joaquin River. They extend downstream into San Pablo Bay. Delta smelt live primarily in brackish water with salinity around two parts per thousand.

FEB 07 2006

Delta smelt California Department of Fish& Game

During the late winter to early summer, delta smelt spawn throughout much of their range. Females produce approximately 1,000 to 2,600 eggs that sink to the bottom and attach to plants and other material. Larvae hatch 10 to 14 days after the eggs have been released. Delta smelt are fast growing with the majority of growth in the first seven to nine months of life. Most smelt die after spawning in the early spring although five percent or so survive to a second year.

Fish abundance and recent declines

Since 1967, California Department of Fish and Game biologists have conducted surveys of fish species at numerous locations throughout the Delta. These surveys provide a nearly 40-year record of abundance trends for delta smelt and several other species. These surveys show wide swings in abundance from year to year, with some species showing recent declines while others appear to be doing well. Indeed, recent swings in the abundance index for delta smelt (Exhibit A), recorded in surveys between 1998 and 2003 are less dramatic than changes to the abundance index recorded in the early 1980s and early 1990s. However, because the most recent swing brought the abundance index to a historically low point, scientists have focused on determining what caused this change.

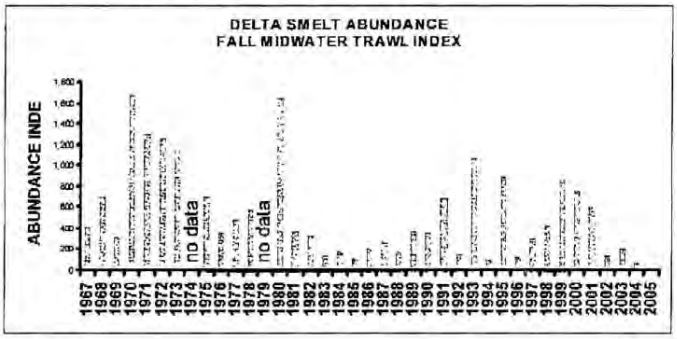


Exhibit A California Department of Fish & Game

The complex nature of the Delta ecosystem is further highlighted by the recovery that appears to be underway by anadromous salmon, also surveyed extensively by the Department of Fish and Game since 1952 (Exhibits B and C). From these data it is clear that whatever factors caused the decline in delta smelt did not have a similar effect on salmon.

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The State of the Delta: What is Killing the Delta Smelt?

Salmon abundance 1952– 2004
San Joaquin River and Sacramento River

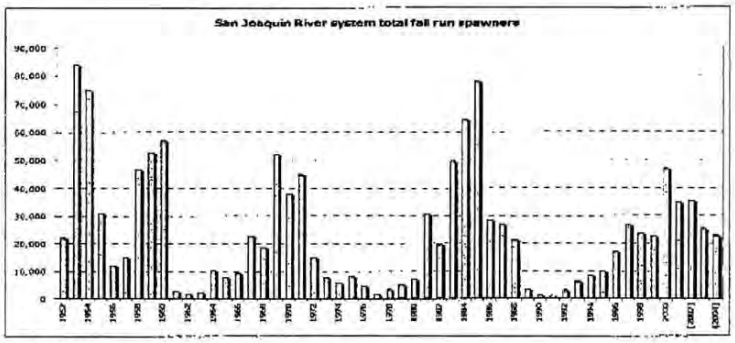

Exhibit B

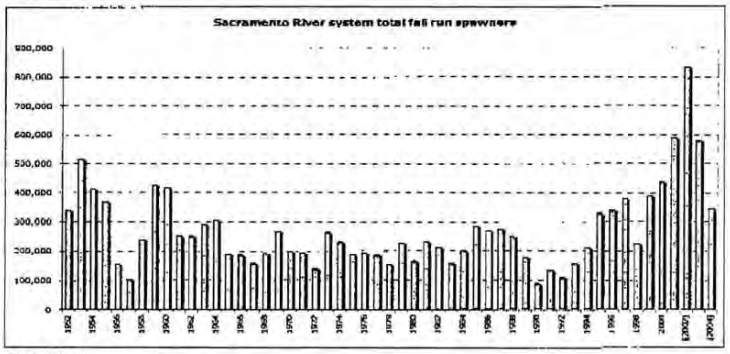

Exhibit C

Factors that influence delta smelt mortality

Export Operations

As the scientific community looked at the delta smelt's life cycle, the focus immediately turned to water export operations. For decades, water exports have been suspected as a major cause of fish mortality in the Delta, especially with regard to delta smelt. Consequently, state and federal fishery managers have regularly curtailed exports in the belief and hope that doing so would help the species recover.[2]

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2. The focus on exports as a fishery management strategy has been an evolving issue within the scientific community. Once believed to have significant effects on salmon populations, exhaustive research and data analysis have led to a growing consensus among scientists that exports have very limited to no effect on salmon. Consequently, export curtailments are no longer viewed as an effective means of managing salmon populations on the Delta.

The State of the Delta: What is Killing the Delta Smelt?

To better understand the relationship between exports and delta smelt, I and other scientists began looking for correlations to help us determine how exports affect the fish species.[3] Fortunately, there was a robust body of data to aid in this research. Since the late 1960s, the Department of Fish and Game has conducted an annual Fall Midwater Trawl survey of several pelagic fish species that make the Delta and Suisun Bay their home. Additionally, the California Department of Water Resources and the United States Bureau of Reclamation have extensive records of the amount of water exported daily from the Delta.

We first looked for a correlation between export volumes from the Central Valley Project (CVP) and the State Water Project (SWP) and the numbers of sub-adult smelt counted during annual surveys conducted each fall by the Department of Fish and Game. Surprisingly, we were unable to find any correlation between export volumes and the delta smelt abundance index (Exhibit D). In other words, in some years when exports were high, the delta smelt abundance index also was high. In other years, a low volume of exports was followed by a low fish abundance index.

Export volumes compared to delta smelt abundance index
No correlation

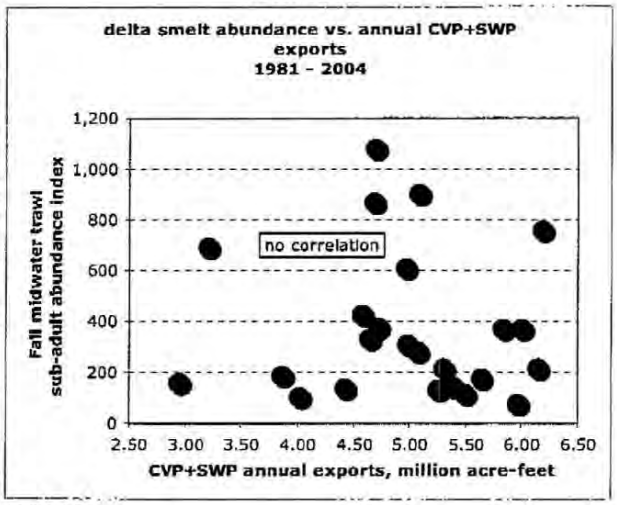

Exhibit D

We then conducted more exhaustive analysis. Rather than look only at export volumes, we looked for correlations between the numbers of adult delta smelt salvaged (or counted) at export pumping facilities and the subsequent Fall Midwater Trawl. We also looked at the numbers of larval and juvenile delta smelt entrained (or killed) at export facilities during pumping operations and the subsequent abundance index found in the Fall Midwater Trawl. This investigation followed a logical assumption that significant numbers of delta smelt, especially larval and juvenile fish, killed or trapped at export pumps during the spring when export volumes are at their highest, would result in low adult abundance indices during the following Fall Midwater Trawls.

In both adult and juvenile studies, we were unable to find any correlation (Exhibits E and F). In years when very few adult and/or juvenile delta smelt were counted or killed at export pumping facilities, there was an equally good chance that the subsequent Fall Midwater Trawl would record high abundance indices as low abundance indices.

3. While correlations do not tell the entire story, they are an important and useful indicator of the major determinants of causation. When we find correlations between actions and effects, we can and should conduct additional research to better understand how those relations should be reoriented. However, the absence of correlations or clear relationships suggests that research resource may be better focused elsewhere.

The State of the Delta: What is Killing the Delta Smelt?

Correlation analysis of delta smelt juvenile and adult salvage at export facilities 1994—2005

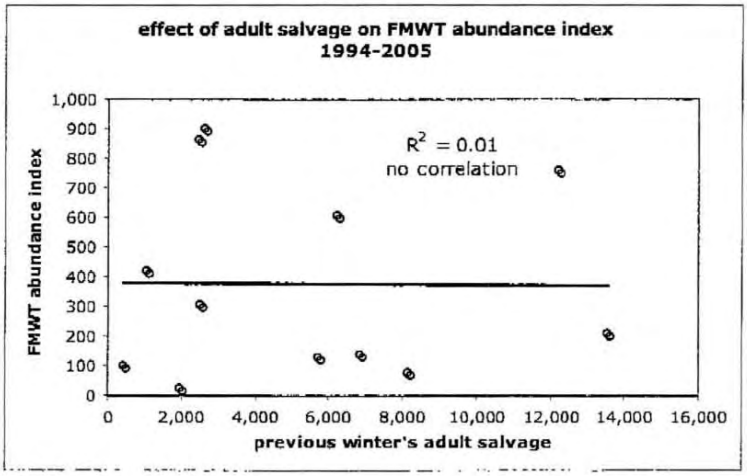

Exhibit E

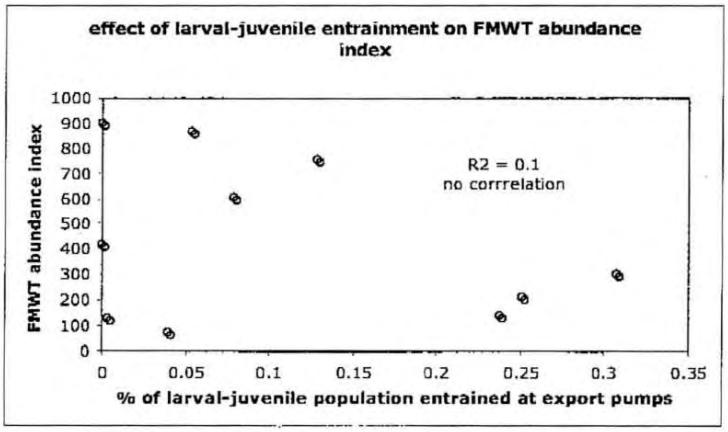

Exhibit F

Finally, we estimated the percentage of the total population of delta smelt in the Delta counted at export facilities during numerous years to determine if high percentages of fish counted at these facilities was followed by a low abundance index during the subsequent Fall Midwater Trawl. Again, we were unable to find any correlation, suggesting again that exports do not have a significant effect on delta smelt abundance (Exhibit G).

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The State of the Delta: What is Killing the Delta Smelt?

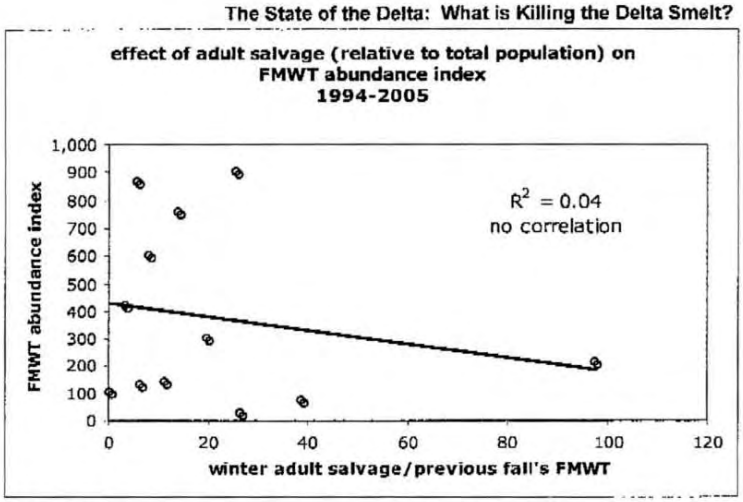

Exhibit G

od Abundance

Having ruled out exports as a major factor in the smelt's mortality, we then turned our attention to food sources. One of the earliest indications that od deprivation is important for delta smelt occurred in 1999. Dr. Bill Bennett f the University of California at Davis, Bodega Marine Laboratory, analyzed a arge number of delta smelt caught in the Delta in an effort to determine the ause of high rates of mortality between the fish's juvenile and adult stages. Dr. Bennett found large numbers of the fish with significant signs of malnourishment in the late summer and early fall. Put simply, the fish were starving to death.

With the focus shifting to food deprivation, it became important to understand what delta smelt eat. All indications are that delta smelt historically have relied primarily on two zooplankton for their food, both of them non-native or alien species.

During most of the 20th Century, the delta smelt's primary food source appears to have been *Eurytemora affinis*, a zooplankton (small floating animal). Although the origins of Eurytemora are not known, some researchers believe it was introduced into the Delta in the latter part of the 19th Century along with striped bass.

In 1986, the voracious Amur River clam (*Corbula amurensis)* was introduced into the Delta from the bilge water of ocean going vessels. Within two years, the Amur River clam took over large portions of Suisun Bay and the western Delta, and with the ability to filter nutrients from enormous volumes of water, the Amur River clam essentially eliminated Eurytemora during parts of the year.[4]

4. In the deeper water regions of the Delta, the Asian clam can filter the entire water column over the channels more than once per day and over the shallows almost 13 times per day.

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Fortunately for the delta smelt, another alien zooplankton, *Pseudodiaptomus forbesi*, made its appearance in the Delta from China about the same time as the Amur River clam. As the population of Eurytemora plunged, the population of Pseudodiaptomus increased dramatically, and it rapidly became the delta smelt's primary food source (Exhibit H).

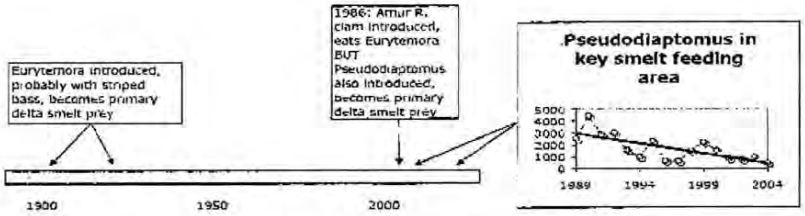

Exhibit H

For many years, biologists from the Department of Fish and Game have sampled the Delta in numerous locations and recorded the presence of zooplankton and other fish food sources in the water. Again, this survey data going back many years provides a rich resource to help us determine when and where the delta smelt's main food supply is found in the Delta.

It became clear to us that the abundance of delta smelt in the fall (as measured by the Fall Midwater Trawl abundance index) did not depend simply on their abundance in the summer. Nor did it depend simply on the summer abundance of prey (primarily Pseudodiaptomus). It seemed that abundance in the fall depended on the right combination of delta smelt and prey in the summer. In other words, it did no good to have lots of smelt where there was little prey or lots of prey where there were no smelt. Delta smelt juveniles and their prey had to co-occur in the summer to produce high abundance of delta smelt sub-adults in the fall.

Following this line of reasoning, we found an excellent correlation between the co-occurrence of smelt juveniles and their prey in July and the subsequent abundance of sub-adults in the fall (Exhibit I). As of now, this is the only correlation that anyone has found between the Fall Midwater Trawl index and any other factor using data from the last quarter of a century.

We also found that the three areas where delta smelt and prey typically co-occurred in July were the lower Sacramento River, from just upstream of Threemile Slough to the confluence with the San Joaquin River, the area around and just downstream of the confluence of the two rivers, and farther downstream in Suisun Bay. The lower Sacramento River area was by far the most important.

The State of the Delta: What is Killing the Delta Smelt?

What has been going on with delta smelt prey in those areas? What factors control prey abundance there? We have an answer to the first question: Prey abundance has been declining and is trending down toward zero. As for the second question, we have not been able to identify the cause of the decline in prey abundance.

We found no correlations between prey abundance and either river flow, salinity, water clarity, or water temperature. We and others continue to search for the cause of the prey decline in the key areas of co-occurrence in the summer.

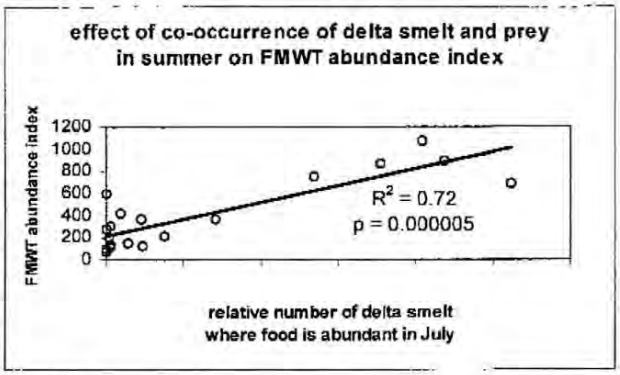

Exhibit I

Export operations and food supply

A logical question that arises from these findings is, to what extent do export operations effect Pseudodiaptomus in the Delta. While this may be an area worthy of additional research, the co-occurrence analysis suggests it

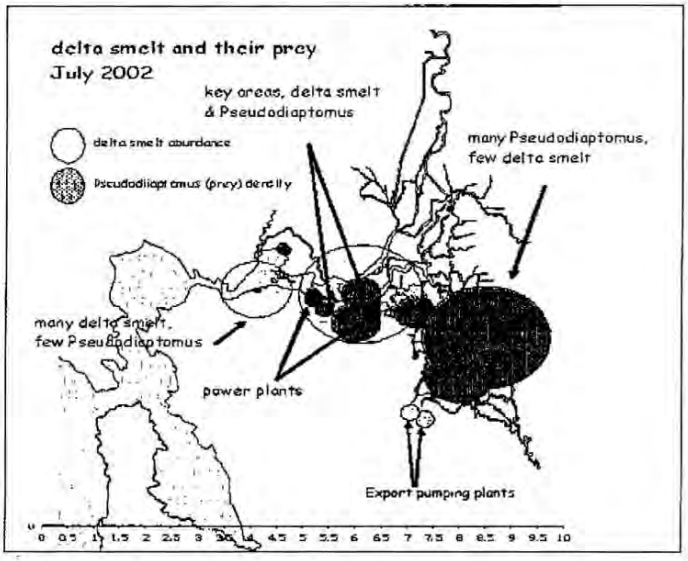

Exhibit J

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February 7, 2006

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