

Discussion of Water Quality Issues That Should Be Considered in Evaluating the Potential Impact of Delta Water Diversions/Manipulations on Chemical Pollutants on Aquatic Life Resources of the Delta

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In response to comments made during the NAS NRC review of the Bay Delta Biological Opinion, we submitted, to the review panel, a summary of our two decades of work on Delta water quality issues that may adversely impact the aquatic life resources/fish of the Delta. That submission is available at:

Lee, G. F., and Jones-Lee, A., "Comments on Water Quality Aspects of NAS NRC Meeting on 'Sustainable Water and Environmental Management in the California Bay-Delta,' January 24-28, 2010," Letter to S. Parker, Director NRC Water Science & Technology Board, Washington, DC, January 26 (2010). <http://www.gfredlee.com/SJR-Delta/NAS-NRCDeltaRev.pdf>

That listing was prepared quickly to provide the review panel with a listing of papers and reports on the potential role of toxics and other chemicals (potential pollutants) that should be considered in review of the statements made at the public review of the Biological Opinions of the Delta Pelagic Organism Decline and other aquatic life resources in the Delta. The following discussion is updates and provides more descriptive discussion of the papers and reports listed in our original submission. It also provides a discussion of issues that SWRCB should incorporate into its developing new flow criteria to comply with California Legislature's Senate Bill No 1 for developing public trust for protection of Delta ecosystem resources.

In our original submission we stated, "*I wish to bring to the attention of the review panel some of Dr. Anne Jones-Lee's and my writings on Delta Water Quality issues that could be expected to adversely influence fish populations in the Delta. From our considerable work on Delta water quality, it is our conclusion that toxic pollutants have not been a major factor in the recent decline of the SJR salmonid populations.*

While pollutants have not been found to directly cause Delta POD [pelagic organism decline], it is not possible to rule out regulated, and most important unregulated and unmonitored potential pollutants, as contributing to adverse impacts on the aquatic resources of the Delta. Whatever the impact of contaminants, it is clear that the export of Delta waters by DWR and the Bureau of Reclamation export projects is adverse to the aquatic life resources of the Delta and likely to listed fish species as well."

As discussed herein, the manifestations of many of the known and potential water quality impacts caused by chemical pollutants the Delta have been aggravated by the DWR and USBR South Delta water export projects. As part of developing public trust flows to protect the Delta

ecosystem/aquatic life resources of the Delta, the SWRCB needs to ensure adequate flows of high-quality Sierra runoff water to dilute pollutants discharged to the Delta and its tributaries and also to reduce pollutant residence time in the Delta. This will require the maintenance of substantial positive flows of Sierra-derived water through Old River and Middle River in the western and South Delta.

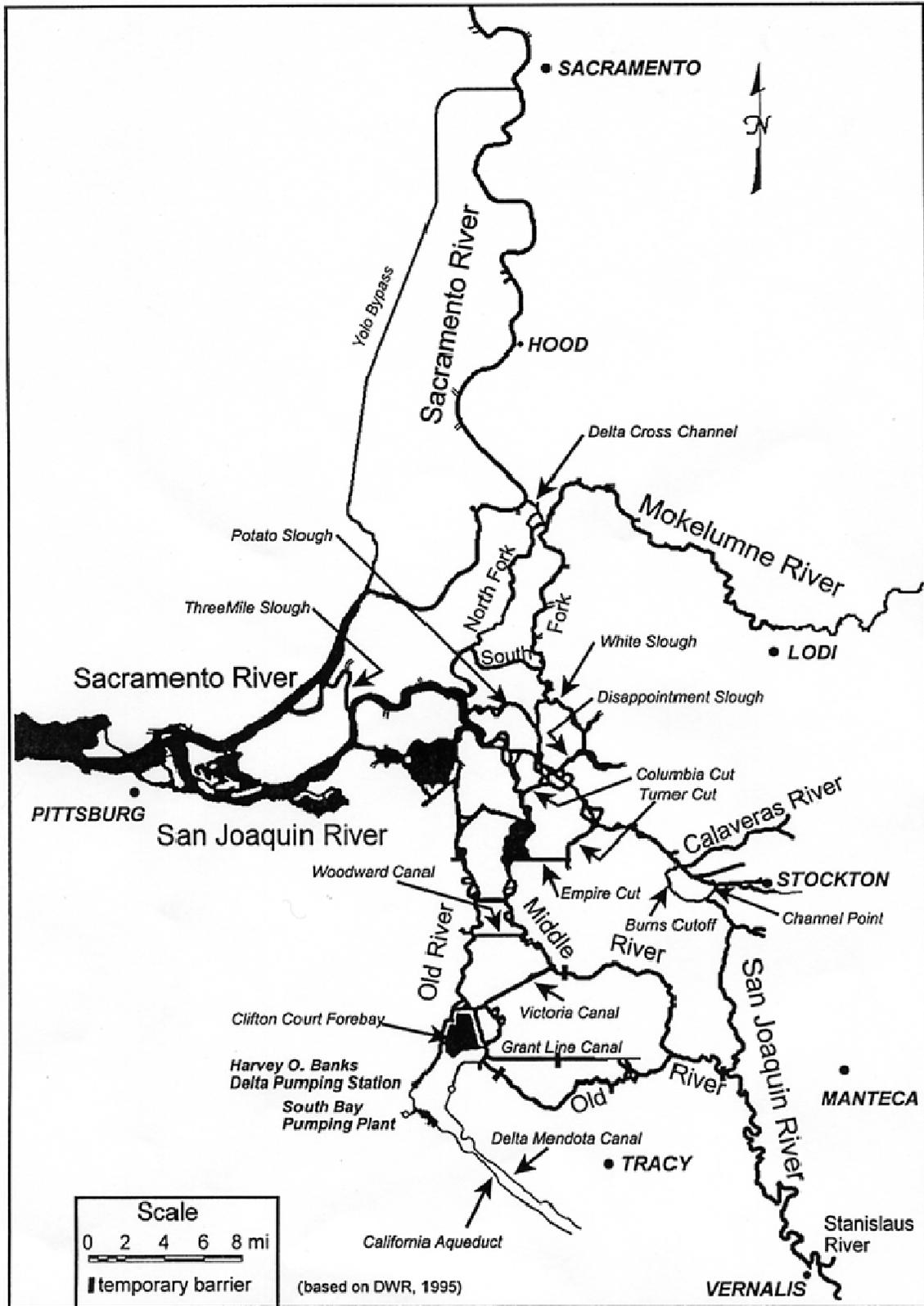
We offered those conclusions with an accompanying overview of our professional background and experience relevant to our studies on Delta water quality issues. After obtaining my (Dr. Lee) PhD degree in environmental engineering and environmental sciences, with emphasis in aquatic chemistry and public health, from Harvard University in 1960, I taught and conducted research in university graduate programs at several US universities for 30 years. During that time I supervised the masters and PhD degree research and thesis/dissertation work of about 100 students; I conducted about \$5 million in research on water quality issues and developed about 500 papers and reports. In 1989, I retired from university teaching and research and expanded my consulting activities to a full-time activity through my firm, G. Fred Lee and Associates, which provides specialty consulting to governmental agencies, industry, and public groups on issues of water supply water quality, water and wastewater treatment, water pollution control, and solid and hazardous chemical/wastes and their management. I was joined in consulting by Dr. Anne Jones-Lee who also had held university graduate-level teaching and research positions; we continue to be the firm's two principals. Since leaving our academic positions we have continued to develop papers and reports on issues of concern; many of our approximately 1150 papers/reports are available on our website, www.gfredlee.com. Additional information on our expertise and experience is available on that website.

One of our major professional education-focused activities is the publication of our Stormwater Runoff Water Quality Newsletter in which I discuss timely topics and issues pertaining to evaluation and management of stormwater runoff and wastewater discharges. Now in its 13th year of publication, this email-based newsletter is sent, at no-cost, at approximately monthly intervals, to its more than 10,400 subscribers. An index and past newsletters is available at, <http://www.gfredlee.com/newsindex.htm>. A number of the newsletters have specifically addressed Delta water quality issues including NL-10-10/11, 10-12, 11-5, 11-7/8, 12-4, and 12-5.

In the spring of 1989, while I held a Distinguished Professorship of Civil and Environmental Engineering at the New Jersey Institute of Technology (NJIT), I became a consultant to Delta Wetlands, Inc. on water quality issues associated with the proposed development of water supply reservoirs on Delta Islands. That work marked the beginning of Dr. Jones-Lee's and my two decades of involvement in Delta water quality issues. Dr. Jones-Lee's and my decision to move from New Jersey to the Davis, California area in 1989 was, in large part, to aid work for that client as well as on other projects on which I had begun to work in California, including impacts of the development of the Lake Tahoe watershed on lake water quality, and impacts of a proposed expansion of a large municipal solid waste landfill in the San Gabriel Basin in Southern California on behalf of the Metropolitan Water District of Southern California.

Figure 1 presents a map of the Delta showing its tributaries and primary channels.

Figure 1 Map of the Delta



As discussed below the SWRCB water rights decisions regarding altering the flow of the Sacramento River (SacR) and San Joaquin River (SJR) into the Delta and within the Delta channels have been made largely without regard to the impact on Delta water quality and its aquatic life resources. Of particular importance is the Department of Water Resources (DWR) and US Bureau of Reclamation (USBR) South Delta export projects that have allowed large amounts of Delta water to be exported south and west of the Delta for urban and agricultural use. These projects have been highly detrimental to Delta water quality on the Delta's aquatic life resources. Impact of DWR USBR South Delta Export Projects on Delta DO Resources

Beginning in 1989, with support from William Jennings (DeltaKeeper) derived from litigation settlements and with the consent of the litigants, we served as technical advisors to the San Joaquin River (SJR) Deep Water Ship Channel (DWSC) dissolved oxygen (DO) TMDL Steering Committee. We later became the principal investigators for a \$2-million, two-year CALFED project devoted to investigating the causes of, and proposed approaches for controlling, the low-DO conditions that develop in first seven miles of the SJR DWSC near the Port of Stockton. We developed an initial report and then synthesis reports (copies of which are available on our website as listed):

Lee, G. F., and Jones-Lee, A., "Synopsis of Issues in Developing the San Joaquin River Deep Water Ship Channel DO TMDL," Report to SJR DO TMDL Steering Committee and the CVRWQCB, G. Fred Lee & Associates, El Macero, CA, August (2000).
<http://www.gfredlee.com/SJR-Delta/SJRsynopsis.pdf>

Lee, G. F., and Jones-Lee, A., "Synthesis and Discussion of Findings on the Causes and Factors Influencing Low DO in the San Joaquin River Deep Water Ship Channel near Stockton, CA: Including 2002 Data," Report Submitted to SJR DO TMDL Steering Committee/Technical Advisory Committee and CALFED Bay-Delta Program, G. Fred Lee & Associates, El Macero, CA, March (2003).
<http://www.gfredlee.com/SJR-Delta/SynthesisRpt3-21-03.pdf>

Lee, G. F., "Impact of San Joaquin River Deep Water Ship Channel Watershed and South Delta Flow Manipulations on the Low-DO Problem in the Deep Water Ship Channel," Submitted to the US Bureau of Reclamation OCAP Biological Assessment, Sacramento, CA, Report of G. Fred Lee & Associates, El Macero, CA, July 10 (2003).
<http://www.gfredlee.com/SJR-Delta/FlowImpact.pdf>

Lee, G. F. and Jones-Lee, A., "Supplement to Synthesis Report on the Low-DO Problem in the SJR DWSC," Report of G. Fred Lee & Associates, El Macero, CA, June (2004).
<http://www.gfredlee.com/SJR-Delta/SynthRptSupp.pdf>

Lee, G. F. and Jones-Lee, A., "San Joaquin River Deep Water Ship Channel Low DO Problem and Its Control," PowerPoint slides presented at SETAC World Congress Portland, OR, November 2004. Updated December (2004).
<http://www.gfredlee.com/SJR-Delta/LowDOSummaryDec2004.pdf>

CALFED-supported low-DO project was undertaken because previous studies conducted by the CA Department of Fish and Game staff,

Hallock, R. J.; Elwell, R. F. and Fry, D. H., "Migrations of Adult King Salmon *Oncorhynchus tshawytscha* in the San Joaquin Delta, as Demonstrated by the Use of Sonic Tags," State of California Department of Fish and Game, Fish Bulletin 151 (1970).

concluded that the low-DO problem in the DWSC acted as a barrier to home stream migration of fall-run salmon to upstream waters that are tributaries to the SJR. The CALFED project consisted of 12 component projects, conducted by different investigators, directed toward understanding various aspects of the low-DO problem in the DWSC near the Port of Stockton. Drs. Anne Jones-Lee and G. Fred Lee provided administrative support for the project overall for CALFED, and developed a synthesis report that summarized and integrated the findings of each of the investigator's project report, and included our experience from extensive work of projects of this type in other areas.

The synthesis report provided a quantitative and comparative assessment of the significance of the various sources of oxygen demand contribute to the low DO concentrations that violate the water quality objective. Those sources included upstream aquatic plant nutrients (N and P compounds) discharged to the SJR and its tributaries by irrigated agriculture in the SJR DWSC watershed. Nutrients from those sources stimulate the growth of planktonic algae that enter the DWSC and die; bacterial decomposition of those algae consumes DO. Also contributing to oxygen demand in the DWSC is ammonia discharged in the city of Stockton domestic wastewaters just upstream of the DWSC; the nitrification of that ammonia in the DWSC consumes DO.

A major contribution that we made to increased understanding of the low-DO issue was that the relative significance of these sources of oxygen demand was determined not only by the magnitude of the respective loads of oxygen demanding materials in the form of nutrients/algae from upstream of the DWSC and the city of Stockton domestic wastewater discharge to the DJR just upstream of the DWSC, but also, and most importantly, the flow of the SJR through the DWSC. We found that the DWR and USBR South Delta export projects at Tracy (Jones) and Banks greatly influenced the amount of SJR flow that passed through the DWSC and therefore the magnitude of the DO problem. As those projects draw SJR water through the Head of Old River to the export pumps they decreased the SJR water flow through the DWSC; this, in turn, increases the hydraulic residence time of the oxygen demand in the DWSC upstream of Turner Cut where the SJR water is mixed with SacR water. Increased residence/travel time of SJR water through the DWSC allows more of the oxygen demand to be exerted before dilution by low-oxygen-demand SacR water at Turner Cut. We found that there would be no DO problem in the DWSC, even with no change in the upstream oxygen demand loads, if the DWR and USBR export projects, upstream SJR reservoir releases, and SJR diversions upstream of Vernalis, all totaled would allow at least about 1200 cfs of SJR water to pass through the DWSC.

We also reported that the depression of dissolved oxygen in the DWSC water to levels below the water quality objective was adverse to fish growth in the channel and at times caused fish kills. We concluded that there was need to conduct additional studies of the role that DO depletion played in fall-run salmon home-stream migration to better-define the magnitude of the blockage of home-stream waters by low DO and its impact on fish spawning, as well as the

potential role of elevated SJR DWSC temperatures on salmon home-stream migration. As discussed in our synthesis report questions remain about whether the depression of DO by couple of mg/L in the DWSC results in a significant barrier to the home-stream migration of fall-run salmon.

Following the completion of the CALFED-supported project, and without outside support, we continued work on the low-DO problem in the DWSC and expanded our scope to examine the South Delta water quality problems as influenced by the DWR and USBR export projects, and additional review of the impacts of the South Delta export of water on the SJR DWSC low-DO problem. Those studies confirmed the significant adverse impact of the DWR and USBR export of South Delta water on the DO conditions in the DWSC.

With boat time and crew provided by the DeltaKeeper we conducted several cruises during July, August and September 2003 of South Delta channels to examine the impact of drawing of SJR water through the Head of Old River to the export pumps, and the drawing of SJR DWSC water down Turner Cut and Columbia Cut to Middle River/Old River in the northern part of the South Delta to the export pumps. Those studies showed that the export projects' pumping of South Delta water did not cause low-DO problems in Turner Cut or Columbia Cut. This is because the export projects also draw large amounts of SacR water to those Cuts which dilutes the residual oxygen demand in the SJR DWSC that reaches the Cuts.

The South Delta export projects pumps at Tracy and Banks withdrew water from some South Delta channels faster than it could be replaced by SJR flow through the Head of Old River and upstream sources of SacR water through reverse flow of Middle River and Old River. This led to low water levels in some of the South Delta channels. The cruise on Old River in the southern part of the South Delta on August 5, 2003 showed that the barriers constructed by DWR on the South Delta channels to keep water levels sufficient to enable the agricultural interests in the south Delta to continue to pump irrigation water from the channels, lead to stagnant water areas in some channels; that created low-DO problems in those channels. DWR had established continuous DO and some other parameters monitoring stations on several of the South Delta channels which records the low DO that occurs in some South Delta channels. The synthesis report presented some of those data in its examination of the impact of the DWR USBR export pumping of South Delta water.

On the day of the South Delta cruise on Old River near the Tracy Blvd Bridge there were many thousands of dead threadfin shad floating on the surface of the channel that had died the night before, apparently, based on data from the DWR monitoring station at that location, due to low DO. That area of the Old River channel is a well-established null (no flow) zone as a result of the barrier constructed at the west end of the channel; the algae develop to large numbers in the channel upstream of the barrier and, at times, die and exert an oxygen demand resulting in low DO and fish kills.

Reports on that series of cruises is available on our website, www.gfredlee.com in the Watershed Studies, San Joaquin Watershed Delta CALFED subsection at, <http://www.gfredlee.com/psjriv2.htm>.

Monsen et al. published a paper,

Monsen, N, Cloern, J., and Burau, J., “Effects of Flow Diversions on Water and Habitat Quality: Examples from California’s Highly Manipulated Sacramento-San Joaquin Delta,” San Francisco Estuary & Watershed Science [Internet], Volume 5, Issue 3, July (2007).[<http://escholarship.org/uc/item/04822861>]
[<http://repositories.cdlib.org/jmie/sfews/vol5/iss3/art2>]

discussed the impact of the federal and state south Delta water export projects on the Delta’ river and channel flows on Delta water quality. Their review of the impact south Delta water diversions project reported on some of the same impacts as reported on by Lee and Jones-Lee in their 2003 and 2004 reports referenced above.

The monitoring of the west branch of Old River by the Contra Costa Water District (CCWD) has shown that the DWR and USBR export projects at Tracy and Banks draw ocean water salinity into the western Delta during the fall. This is associated with the reverse flow of Old River caused by the export projects. This reverse flow is not only important for entrainment of larval fish in the export projects screens and pumps and increased salinity in the western Delta but also because the sea water drawn to the export pumps brings in bromide. Bromide is particularly import/potent precursor for brominated trihalomethane which are import carcinogens when the water supply is treated with ozone. The drawing of sea water and its associated bromide into the south Delta has contaminated the USBR Delta Mendota Canal water with bromide and since this water is used for irrigation on the west side of the SJR, the SJR has also been contaminated by bromide due to irrigation water tailwater releases that reach the SJR. The situation where SJR water is drawn to the USBR export pump has led to a somewhat closed loop for salinity build up on the SJR and South Delta.

One of the consequences of the export projects drawing SacR water to the South Delta is the dilution of the pollutants in the South Delta channels that are derived from the SJR watershed. The development of a peripheral canal to divert SacR water around or through the Delta will eliminate this dilution thereby changing the location and magnitude of the water quality problems in many of the Delta channels. One of the most pronounced effects of this type will be that the un-exerted oxygen demand that is now diluted to a non problem by the SacR at Turner Cut. With the peripheral canal potentially diverting large amounts of SacR water the location of the low DO problem in the DWSC will be shifted downstream (north and west) of Turner Cut and Columbia Cut. This will be especially important during high SJR flows through the DWSC.

Impact of Export Projects on SJR Fall Run Salmon Home Stream Spawning Migration

During the cruises on the northern part of the South Delta on Turner Cut and Columbia Cut and other nearby channels, we observed impacts of the South Delta export pumping projects’ drawing SacR water to the export pumps. Such pumping creates reverse flows in Middle River that are responsible for drawing young fish to the export pumps. It was found on the cruises that it was possible to distinguish between SJR water and SacR water by electrical conductivity (EC) measurements; the SJR water has a much higher EC than Sacramento River water. Electrical conductivity measurements made on water in the various channels showed that much of the water in Turner Cut was SacR water. It was also found that all of the water in the channels

north and west of Turner Cut during the summer after VAMP through the fall and early winter, was SacR water.

We suggested to DWR staff that EC measurements be made during the DWR IEP D-1641 sampling runs conducted at about two-week intervals from August through early December on the SJR DWSC channel between the point of its mixing with Sacramento River water near Prisoner Point to the Port of Stockton Turning Basin. These sampling runs were initiated by DWR to examine the DO situation in the DWSC through its length. Our synthesis report presents these data for the period up to the development of the synthesis report. The DWR D-1641 sampling runs in which DO is measured along the SJR DWSC showed that the DO problem in the SJR DWSC is restricted to upstream of Columbia Cut and Turner Cut. EC measurements would enable the examination of the relative contribution of SJR water and SacR water in the SJR DWSC throughout its length. Our cruise data and the DWR D-1641 sampling run data clearly demonstrated that there is no SJR water in the SJR DWSC upstream of Turner Cut/Columbia Cut after the end of VAMP in May through December of each year. That finding has important implications for the migration of fall-run salmon through the Delta to their home stream water in the SJR watershed.

In a CALFED meeting of several years ago in which salmon spawning in the SJR tributaries was discussed it was pointed out that based on genetic signatures, those fish exhibited large amounts of straying from their home-stream waters for spawning. While on the faculty at the University of Wisconsin, Madison I supervised a graduate student's conduct of MS thesis studies on Coho salmon migration to home-stream waters in tributaries of Lake Michigan. We published findings of that research in:

Cooper, J. C., Lee, G. F. and Dizon, A. E., "An Evaluation of the Use of the EEG Technique to Determine Chemical Constituents in Homestream Water," *Trans. Wisc. Academy Sciences, Arts, and Letters*, LXII:165-172 (1974).

Through that study I became familiar with the importance of the chemical signal in salmon migration to home-stream waters for spawning. After observing that the DWR USBR South Delta export projects in the South Delta eliminated all SJR home-stream chemical signal from the northern western Delta in the fish migration to the SJR, I discussed the impact of Delta flow manipulations on SJR home-stream water signal through the Delta during the summer, fall, and early winter in:

Lee, G. F., and Jones-Lee, A., "SJR Deep Water Ship Channel Water Not SJR Watershed Water below Columbia Cut," Report of G. Fred Lee & Associates, El Macero, CA (2003). Submitted for publication in the IEP Newsletter, October (2003).
<http://www.gfredlee.com/SJR-Delta/IEP-SJR-Delta7-24-03Final.pdf>

we submitted that paper to the IEP Newsletter for publication. After several months passed with no response to the submission, we resubmitted the paper. We were familiar with the appropriate approach for publication of papers in the IEP Newsletter since we had previously had several papers published in this Newsletter on SJR DWSC low DO problem. It became apparent that since we had received no response to either submission of that particular paper, and since DWR staff are responsible for developing the IEP Newsletter, we concluded that DWR management would not allow the publication of a paper in its IEP Newsletter that demonstrated that the DWR export project at Banks was potentially adversely impacting the spawning of fall-run salmon. As a follow-up on those issues we developed the following comments:

Lee, G. F., and Jones-Lee, A, “Review of Impacts of Delta Water Quality and Delta Water Exports on the Decline of Chinook Salmon in the SJR Watershed,” Comments submitted to NMFS Southwest Fisheries Science Center, NOAA, Santa Cruz, CA, by G. Fred Lee & Associates, El Macero, CA, August (2008).

<http://www.gfredlee.com/SJR-Delta/Salmon-NOAAcom.pdf>

It is our conclusion in this submission that toxic pollutants have not been a major factor in the recent decline of the SJR salmonid populations. However, the export projects may be a major contributor to the decline of SJR anadromous fish populations.

It is clear that the DWR USBR South Delta export projects are adversely impacting fish and other aquatic life resources in the South Delta and are likely significantly adversely impacting fall-run salmon home-stream migration to SJR tributaries for spawning. It will be important that the SWRCB developing new flow criteria for the SacR and the SJR flow into the Delta and through the Delta channels consider these issues. Further it will important that any new flow criteria for the Sacramento River in developing diversions around and or through the Delta work to eliminate the existing do not create new water quality problems in the Delta.

Review of Delta Water Quality Issues

During the development of the SJR DWSC synthesis report on the low-DO problem in the DWSC, we became aware of the large number of CVRWQCB identified water quality problems in the Delta though the CWA 303(d) listings of water quality standards/objectives violations in Delta channels. In 2004 Dr. Jones-Lee and I completed the first comprehensive report on Delta water quality issues:

Lee, G. F. and Jones-Lee, A., “Overview of Sacramento-San Joaquin River Delta Water Quality Issues,” Report of G. Fred Lee & Associates, El Macero, CA (2004).

<http://www.gfredlee.com/SJR-Delta/Delta-WQ-IssuesRpt.pdf>

That report was updated and issues discussed at a CALFED Science Conference:

Lee, G. F., and Jones-Lee, A., “Overview—Sacramento/San Joaquin Delta Water Quality,” Presented at CA/NV AWWA Fall Conference, Sacramento, CA, PowerPoint Slides, G. Fred Lee & Associates, El Macero, CA, October (2007).

<http://www.gfredlee.com/SJR-Delta/DeltaWQCANVAWWAOct07.pdf>

Lee, G. F., and Jones-Lee, A., “Delta Nutrient-Related Water Quality Problems,” PowerPoint Slides Presented at CALFED Science Conference, Sacramento, CA, October 24 (2008). http://www.gfredlee.com/SJR-Delta/CALFED_SciConf10-08.pdf

That report was dedicated to William Jennings for his many years of work on Delta water quality and aquatic resource issues. As part of developing that report we sent the various drafts of the report to more than 100 individuals who had been identified as having an interest in, and knowledge of, Delta water quality. Comments received were incorporated as appropriate into the final report.

Our report lists and discusses violations of water quality standards (objectives) that have been identified by the CVRWQCB, SWRCB, and US EPA. Many of those violations are related to excessive concentrations of chemicals that are potentially toxic to aquatic life or adverse to

health due to excessive bioaccumulation of hazardous chemicals in fish that are used as human food.

That report addressed, for the first time, potential impacts of the DWR USBR South Delta export projects on Delta water quality standards/objectives violations that result from importing more SJR and SacR water-associated pollutants into areas of the Delta where they would not occur or would not occur to as great an extent, if the export projects did not take water from the South Delta. The operation of the projects also impacted the location and magnitude of Delta sources of pollutants that led to water quality standards/objectives violations.

Often salinity in the Delta is discussed at regulatory agency meetings as the primary water quality standard of concern. As shown in Figures 2 and 3 there are several other water quality standards/objective violations that occur in the Delta that are impacted by the SJR and USBR export projects. All of these violations and other impairment of the beneficial uses of the Delta need to be evaluated and managed as part of altering the flows of the SacR and SJR into and through the Delta channels as part of the SWRCB developing new flow criteria for the SacR and SJR into and through the Delta channels to comply with public trust to protect the Delta ecosystem and aquatic life resources of the Delta.

Figure 2 presents a listing of the water quality objectives in Delta channels and the chemicals responsible for the CWA listing.

Figure 2

2006 CWA 303(d) List of "Impaired" Delta Waterbodies (SWRCB, June 2007)

Pollutant/Stressor	Location (see key below)														Potential Sources (see key below)				
	CD	ED	SE	ND	NW	SD	SC	WD	SJ	MS	OR	MR	MDR	Ag	R/S	SU	AM	Other	
Chlorpyrifos	X	X	X	X	X	X	X	X						X	X				
Diazinon	X	X	X	X	X	X	X	X						X	X				
DDT	X	X	X	X	X	X	X	X	X					X					
Group A Pesticides (legacy)	X	X	X	X	X	X	X	X	X					X				Formerly-used pesticides	
EC/TDS			X		X	X		X	X					X					
Exotic Species	X	X	X	X	X	X	X	X								X			
Mercury	X	X	X	X	X	X	X	X	X								X		
Unknown Toxicity	X	X	X	X	X	X	X	X	X					X		X			
Dioxin/Furan							X											Point source; McCormick/Baxter; Contaminated sediment	
Pathogens							X			X					X			Non-boating recreation; tourism	
PCBs				X			X									X		Point source	
Low DO							X				X				X			Hydromodification	
									X						X			WWTP ammonia	
Copper												X					X		
Zinc												X					X		
Boron									X					X					
Toxaphene								X								X	X		

Location Designations
CD - Central Delta
ED - Eastern Delta
SE - South Delta export area
ND - North Delta
NW - Northwestern Delta
SD - Southern Delta
SC - Stockton Ship Channel
WD - Western Delta
SJ - Lower San Joaquin River
MS - Mormon Slough
OR - Old River - South Delta
MR - Lower Mokelumne River
MDR - Middle River

Group A Pesticides
aldrin
dieldrin
chlordane
endrin
heptachlor
heptachlor epoxide
hexachlorocyclohexane (incl. lindane)
endosulfan
toxaphene

Pyrethroids
bifenthrin
lambda cyhalothrin
efenvalerate/redvalerate
permethrin

Source Designations
Ag - Agriculture
R/S - Urban runoff/Storm sewers
SU - Source unknown
AM - Abandon mine
WWTP - Domestic wastewaters

CWA - Clean Water Act
 * Violates water quality objective

Our report on Delta water quality highlighted the potential for the large number of unregulated and unmonitored potential pollutants being discharged to the Delta from domestic wastewater sources and agricultural activities in the Delta watershed to adversely impact Delta water quality. One of the major unknowns in Delta water quality is the role of unmonitored, unregulated chemicals that are discharged to the Delta and its tributaries. We have addressed this concern in several issues of our Stormwater Runoff Water Quality Newsletter including NL-7-3, 8-5, 9-3, 10-7, 11-7/8, 11-11, 12-6, 13-1. Our most recent issue (NL-13-1) available at, <http://www.gfredlee.com/newsindex.htm> provides current information on the large number of unmonitored, unregulated chemicals that can be introduced into the Delta, as well as other waterbodies, that can adversely impact Delta aquatic life resources.

Figure 3

Delta Impaired Waters Not Listed on CWA 303(d)

Should Be Listed	Known Impairments
Nutrients - N & P	Excessive growth of algae & macrophytes
TOC/DOC	Trihalomethanes formed in water treatment
Pyrethroid pesticides used in agriculture & urban areas	Watercolumn & sediment toxicity
Could Be Listed - Need Investigation for Potential Impacts	Sources
PBDE - polybrominated diphenylethers	Domestic wastewater discharges
PPCP - pharmaceutical & personal care products	Domestic wastewater discharges
Pharmaceuticals & hormones	Dairy & animal husbandry operations
Other unregulated chemicals	Various

As

noted above, based on our experience and expertise, while pollutants have not been found to directly cause Delta pelagic organism decline (POD), it is not possible to rule out regulated, and most importantly, unregulated and unmonitored potential pollutants, as contributing to adverse impacts on the aquatic life resources of the Delta. Whatever the impact of contaminants, it is

clear that the export of Delta waters by DWR and the Bureau of Reclamation is adverse to the aquatic resources of the Delta and likely to listed fish species as well.

While the CVRWQCB staff are aware of the water quality problems in the Delta, the budget provided to the Central Valley Regional Board by the SWRCB and the state legislature did not allow it to conduct the studies needed to better define the magnitude of the known problems, and begin to address the unknown/unidentified water quality problems, in the Delta. This situation began to change to a limited extent when pollutants were identified as a possible cause of or contributor to the pelagic organism decline problem although the budget provided for these studies is far less than that needed to begin to adequately address this issue.

We have also developed follow-up discussions of Delta water quality issues, including:

Lee, G. F., and Jones-Lee, A., "Water Quality Issues That Could Influence Aquatic Life Resources of the Delta," Comments submitted to CALFED Science Program, Sacramento, CA, by G. Fred Lee & Associates, El Macero, CA, November 28 (2005).
<http://www.gfredlee.com/SJR-Delta/POD-Com.pdf>

Lee, G. F., "New & Updated Presentations/Publications on Delta and SJR Water Quality Issues," Comments to J. Grindstaff, Director CALFED, Sacramento, CA, G. Fred Lee & Associates, El Macero, CA, October 2 (2007).
<http://www.gfredlee.com/SJR-Delta/PubsPresentsDeltaSJR.pdf>

Lee, G. F., "Comments on the CVRWQCB Review of Delta Water Quality Issues," Comments submitted to K. Longley, Chair Central Valley Regional Water Quality Control Board, by G. Fred Lee & Associates, El Macero, CA, March (2008).
<http://www.gfredlee.com/SJR-Delta/DeltaIssuesLongleyMarch08.pdf>

Lee, G. F., and Jones-Lee, A., "Delta Water Quality Standards Violations" and "Comments on Water Quality Sections of the Delta Vision Strategic Plan, Third Staff Draft – dated August 14, 2008," Submitted to Delta Vision Blue Ribbon Task Force, Sacramento, CA. Report of G. Fred Lee & Associates, El Macero, CA, September 1 (2008). <http://www.gfredlee.com/SJR-Delta/DeltaVisionWQViolations.pdf>

Overall, it was found the CALFED, IEP, and DWR attempted to ignore our 2004 and follow up reports on Delta water quality issues apparently because it, and the DeltaKeeper, were critical of their inadequate efforts to address Delta water quality issues and the impact of the DWR and USBR South Delta export projects on Delta aquatic life resources and water quality.

Impact of Delta Export Project on Chemical Pollutants Impacts in the Delta

Fish in many Central Valley waterbodies contain sufficient concentrations of organochlorine "legacy" pesticides such as DDT, dieldrin, and toxaphene and the industrial chemical, PCBs, to cause them to be a health threat to those who eat large amounts of the contaminated fish. The SWRCB has been monitoring the concentrations of those chemicals in fish tissue since the 1970s. On behalf of the Central Valley Regional Water Quality Control Board we developed the following reports about that issue:

Lee, G. F. and Jones-Lee, A., "Organochlorine Pesticide, PCB and Dioxin/Furan Excessive Bioaccumulation Management Guidance," California Water Institute Report TP 02-06 to the California Water Resources Control Board/Central Valley Regional Water Quality Control Board, 170 pp, California State University Fresno, Fresno, CA, December (2002). <http://www.gfredlee.com/SurfaceWQ/OCITMDLRpt12-11-02.pdf>

Lee, G. F., and Jones-Lee, A., "Excessive Bioaccumulation of Organochlorine Legacy Pesticides in Central Valley Fish," Report of G. Fred Lee & Associates, El Macero, CA, September 23 (2007).

<http://www.gfredlee.com/SJR-Delta/LegacyPestCentralValleyFish.pdf>

Those reports presented a comprehensive review of the data that had been collected since the late 1970s and from the updated sampling in 2007. They show that fish in the SJR and the SacR as they enter the Delta and within the Delta contain excessive organochlorine legacy pesticides and PCBs. The DWR and USBR South Delta export projects affect the location and likely the magnitude of the excessive bioaccumulation of legacy organochlorine pesticides and PCBs in Delta fish, by impacting the flow patterns of the SJR and SacR water into and through the Delta channels. In an effort to further define that situation, we, together with another investigator, and in cooperation with the CVRWQCB staff, submitted a research proposal to CALFED Science Program. Our project was not supported; a reviewer claimed that the issue of the human health hazards of excessive bioaccumulation of organochlorine pesticides and PCBs in the Delta was a human health issue and thus not the responsibility of CALFED to address.

SJR Water Quality Issues

Table 1 presents a listing of CWA 303(d) water quality impairments for the SJR.

Table 1

2006 CWA 303(d) List of Water Quality Limited ("Impaired") Reaches of San Joaquin River (SWRCB, June 2007)

Pollutant*/Stressor	River Reach (see key below)							Potential Sources (see key below)		
	FMP	MPB	BMS	MSM	MTR	TRS	SDB	Ag	SU	RE
DDT		X	X	X	X	X	X	X		
Group A Pesticides (legacy)		X	X	X	X	X	X	X		
EC/TDS		X	X	X				X		
Exotic Species	X								X	
Mercury			X	X	X	X	X			X
Unknown Toxicity		X	X	X	X				X	
Boron		X	X	X				X		
Toxaphene							X		X	
Selenium				X				X		

River Reach Designations
FMP - Friant Dam to Mendota Pool
MPB - Mendota Pool to Bear Creek
BMS - Bear Creek to Mud Slough
MSM - Mud Slough to Merced River
MTR - Merced River to Tuolumne River
TRS - Tuolumne River to Stanislaus River
SDB - Stanislaus River to Delta Boundary

Group A Pesticides	
aldrin	heptachlor epoxide
dieldrin	hexachlorocyclohexane
chlordan	(incl. lindane)
endrin	endosulfan
heptachlor	toxaphene

Source Designations
Ag - Agriculture
SU - Source unknown
RE - Resource Extraction

CWA - Clean Water Act
 * Violates water quality objective

Figure 4 presents a map of the SJR watershed.

Figure 4

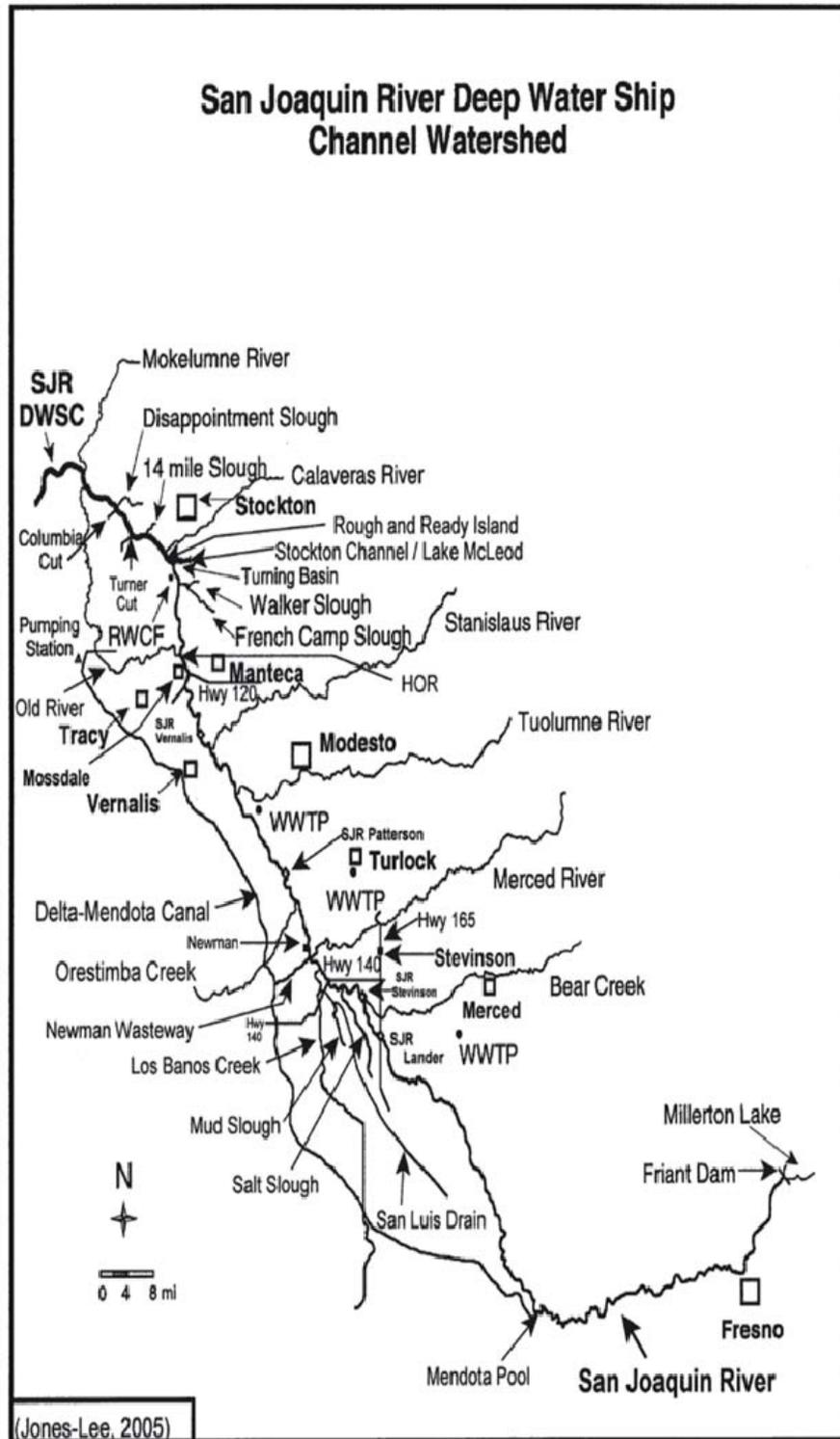


Table 2 presents a listing of current SJR watershed TMDLs and water quality impairments that are potential TMDLs. The potential TMDLs represent water quality impairments that have not been addressed by the CVRWQCB.

Table 2. San Joaquin River Watershed TMDLs

Current (Active)

- Selenium
- Salinity at Vernalis, Total Dissolved Solids (TDS), Electrical Conductivity (EC)
- Boron
- Organophosphorus (OP) Pesticides (Diazinon, Chlorpyrifos)
- Oxygen-Demanding Substances (BOD/Algae, Ammonia, Organic N)

Pending (to be Developed)

- Organochlorine "Legacy" Pesticides (DDT, Chlordane, Dieldrin, Toxaphene, etc.)
- PCBs
- Dioxins/Furans
- Mercury
- Sulfate (Bioaccumulation of Mercury)
- Pathogen-Indicator Organisms, E. coli, Fecal Coliforms
- Toxicity of Unknown Cause
- Salinity Upstream of Vernalis

Potential Future (to be Evaluated)

- Nutrients, Excessive Fertilization (Nitrogen and Phosphorus Compounds)
- High pH, Low DO caused by Excessive Fertilization (Photosynthesis/Respiration)
- Alternative Pesticides to OP Pesticides including the Pyrethroid-Based Pesticides that are Causing Water Column and Sediment Toxicity
- PBDEs
- Total Organic Carbon, and other Chemicals such as Bromide that Develop into Disinfection Byproducts (Trihalomethanes) in Treated Domestic Water Supplies
- Excessive Sediment, Erosion, Turbidity
- Herbicides (toxicity to algae) Diuron etc.
- Aquatic Sediment Toxicity (Pesticides, Nutrients/Algae/Sediment Ammonia, Heavy metals, PAHs and other Chemicals)
- Unrecognized Pollutants
 - Pharmaceuticals and other Unregulated Chemicals Discharged by Confined Animal Facilities (dairies, feedlots, etc.)
 - Domestic Wastewaters and Industrial Chemicals

In 2006 we received a request to discuss SJR water quality issues at a conference on SJR agriculture. In response we developed a comprehensive review of the San Joaquin River water quality issues:

Lee, G. F. and Jones-Lee, A., "An Integrated Approach for TMDL Development for Agricultural Stormwater Runoff, Tailwater Releases, and Subsurface Drain Water," Proc. US Committee for Irrigation and Drainage conference on Helping Agriculture Adjust to TMDLs, pg. 161-172, Denver, CO, October (2002).
http://www.gfredlee.com/SJR-Delta/tmdl_07-2002.pdf

Lee, G. F. and Jones-Lee, A., "An Integrated Approach for TMDL Development for Agricultural Stormwater Runoff, Tailwater Releases, and Subsurface Drain Water," slides presented at the US Committee for Irrigation and Drainage conference on Helping Agriculture Adjust to TMDLs, Sacramento, CA, October (2002).
<http://www.gfredlee.com/SJR-Delta/USCIDSli.pdf>

Subsequently we developed,

Lee, G. F., and Jones-Lee, A., "Water Quality Issues of Irrigated Agricultural Runoff/Discharges—San Joaquin River, Central Valley, California," Presented at Agriculture and the Environment - 2007 Conference, Central Coast Agricultural Water Quality Coalition, Monterey, CA, November (2007).
<http://www.gfredlee.com/SJR-Delta/SJR-WQ-Ag-Monterey.pdf>

Lee, G. F., and Jones-Lee, A., "Potential Water Quality Impacts of Agriculture Runoff/Discharges in the Central Valley of California," Presented at Central Coast Agricultural Water Quality Coalition's 2007 National Conference on Agriculture & the Environment, Monterey, CA, PowerPoint Slides, G. Fred Lee & Associates, El Macero, CA, November (2007).
<http://www.gfredlee.com/SJR-Delta/SJRAgImpactsMontereyNov2007.pdf>

As presented in these figures and tables and discussed in these reports the SJR has many water standards/objectives violations that are projected to be adverse to aquatic life. Also there are many known water quality impairments where the impairment has not resulted in a TMDL that could result in TMDLs when water quality standards/objectives are developed. It is important to understand that the SJR water quality impairments are with few exceptions transported into the Delta.

Inadequate Water Quality Criteria/Standards/Objectives

There exist CWA water quality impairments in the Delta and SJR that are caused by TOC, nutrients, and other contaminants for which there are no federal or state water quality criteria/objectives. In addition to there being no water quality criteria for those common water pollutants, there are situations in which the current water quality criteria/standards are well-recognized as not being protective of aquatic life resources. For example, the water quality criterion for selenium in the SJR and Delta is not protective of some aquatic life.

Beginning in the late 1960s, Dr. G. Fred Lee pioneered in the development of approaches for evaluating the water quality/environmental impact of chemicals. His work has focused on the integration of aquatic chemistry and toxicology in evaluating the sources, fate, water quality impact, and control of chemicals in aquatic systems. Dr. Lee has also been involved in the development, evaluation, and implementation of water quality criteria and state standards since the early 1960s. A summary of his experience in those areas is provided at <http://www.gfredlee.com/exp/wqexp.htm>. During the 1960s, while he held the position of Professor of Water Chemistry and Director of the Water Chemistry Program at the University of Wisconsin, Madison he served as an advisor to the Wisconsin Department of Natural Resources on the development and implementation of water quality criteria and standards. During that time and subsequently he has served as an advisor to numerous governmental agencies

including municipalities, industry, and environmental/citizens' groups on water quality criteria issues. During the 1960s through the mid-1970s he served as an advisor to the International Joint Commission for the US-Canadian Great Lakes in developing water quality objectives for the Great Lakes, and in their implementation. His about \$1 million studies in the 1970s served as the basis for the US Army Corps of Engineers development of dredged sediment disposal criteria. These criteria are still being used today by the US EPA and Corps of Engineers to regulated dredged sediment disposal in open waters.

In the early 1970s Dr. Lee served as an invited peer reviewer for the National Academies of Science and Engineering's "Blue Book" "Water Quality Criteria - 1972." In the late 1970s, he served as an invited member of the American Fisheries Society Water Quality Panel that conducted a review of the US EPA's 1976 "Red Book" of water quality criteria. In the early to mid-1980s he served as a US EPA invited peer reviewer for the water quality criteria development approach used for the 1986 "Gold Book" water quality criteria, and for several of the specific chemical criteria. His pioneering work on PCB pollution in the 1960s led to his being selected to head the US Public Health Service committee on developing drinking water standards for PCBs.

It is with this background that Dr. Lee can authoritatively discuss the potential importance of the failure of the existing water quality criteria to address many of the issues that need to be considered in evaluating the potential impacts of chemicals on aquatic life. The current US EPA criteria development approach only considers some and in some cases a small part of the impacts of chemical contaminants on aquatic life. For example,

- the approach currently used to develop water quality criteria does not include additive/synergistic properties of regulated chemicals that occur in concentration below the water quality criteria allowing unanticipated adverse impacts to aquatic life.
- Adverse impacts of chemicals to aquatic life that occur for especially sensitive species, such as zooplankton which serve as larval fish food organism were not included in the development of the water quality criteria.
- These criteria are only applicable to protecting about 90% of the species. Therefore there could readily be fish species in the Delta and its tributaries that are more sensitive to a chemical than those species used to establish the water quality criterion value.
- There is also very limited information on chronic exposure to sublethal impacts of a chemical and mixtures of chemicals to fish populations.
- Another issue is that other stressor such as low DO, ammonia etc. that can impact the lethal and especially sublethal impacts of chemicals.
- It has been well know for over 40 years through biomarker studies that fish and other organism show organisms biochemical responses to chemical exposures at concentrations well below the water quality criterion. The significance of these biomarker responses to an organism or group of organisms is largely unknown.
- Chemicals can adversely impact the health of the fish and other aquatic life that weaken their ability to resist adverse impact of stressors such as low DO, elevated temperature and predation as well to disease. It's been known for over 40 years that very low levels of copper affect the "breathing" rate of some fish.

Overall a water sample that meets all the current water quality criteria/standards should not be considered a suitable habitat for development of unrestricted healthy fish populations with respect to chemical pollutants impacts.

The US EPA water quality criteria development program has had limited support for the development of new or revised water quality criteria for chemicals that have the potential to be adverse to aquatic life. As discussed in our Stormwater Runoff Water Quality Newsletters at <http://www.gfredlee.com/newsindex.htm> as well as in Delta water quality issues reports, many thousands of unregulated chemicals, including pharmaceuticals and personal care products, industrial chemicals, and other potentially hazardous chemicals, are discharged to waterways, including the Delta and its tributaries, in domestic wastewaters, agricultural runoff and waste waters. Some of those are now being found to be adverse to aquatic life; many have yet to be investigated.

In April 2009, a California Ocean Protection Council et al. workshop, "Managing Contaminants of Emerging Concern in California: A Workshop to Develop Processes for Prioritizing, Monitoring and Determining Thresholds of Concern," was held in Costa Mesa, CA; a report on issues and discussions at that workshop was made available in September (2009) [<http://www.nwri-usa.org/pdfs/CACCECReport.pdf>]. That report presents current information on the very large number of unrecognized unregulated chemicals that can adversely impact water quality that are discharged to California coastal waters. Many of these same sources and types of chemicals are sources for the potential pollutants for the Delta.

SWRCB Water Rights Decisions and Water Quality

In response to a request from the DeltaKeeper we developed:

Lee, G., F., and Jones-Lee, A., "Need for Reliable Water Quality Monitoring/Evaluation of the Impact of SWRCB Water Rights Decisions on Water Quality in the Delta and Its Tributaries," Submitted to CA Water Resources Control Board Workshop on D-1641 Water Rights, Sacramento, CA, March 22 (2005).

<http://www.gfredlee.com/SJR-Delta/DeltaWaterExportImpactsPaper.pdf>

Lee, G., F., and Jones-Lee, A., "Need for Reliable Water Quality Monitoring/Evaluation of the Impact of SWRCB Water Rights Decisions on Water Quality in the Delta & Its Tributaries," PowerPoint Slides Submitted to CA Water Resources Control Board Workshop on D-1641 Water Rights, Sacramento, CA, March 22 (2005).

<http://www.gfredlee.com/SJR-Delta/DeltaWaterExportImpactsPowerPoint.pdf>

That presentation discussed the need and legal requirements as set forth in D-1641, for the SWRCB to evaluate the impact of water diversions/manipulations on water quality. In the past as today, SWRCB has not carried out that requirement; as a result, major changes in flow are allowed without evaluating and monitoring the impact of those changes on water quality.

Impact of Nutrients on Delta Water Quality

In response to a request from the CVRWQCB with US EPA support we developed the report:

Lee, G. F., and Jones-Lee, A., "Managing Nutrient (N & P) Water Quality Impacts in the Central Valley, CA," [Excerpts from: Lee, G. F. and Jones-Lee, A., "Review of Management Practices for Controlling the Water Quality Impacts of Potential Pollutants

in Irrigated Agriculture Stormwater Runoff and Tailwater Discharges,” California Water Institute Report TP 02-05 to California Water Resources Control Board/Central Valley Regional Water Quality Control Board, 128 pp, California State University Fresno, Fresno, CA, December (2002)], Report of G. Fred Lee & Associates, El Macero, CA (2002). <http://www.gfredlee.com/SJR-Delta/CentralValleyNutrientMgt.pdf>

It presents information on water quality problems that are caused by the discharge of nutrients (N and P compounds) from domestic wastewater and urban and agricultural sources, and on suggested approaches for managing those problems.

In 2007/8 on behalf of the California Water Environmental Modeling Forum (CWEMF), we organized a Delta Nutrient Workshop:

“Overview of Delta Nutrient Water Quality Problems: Nutrient Load – Water Quality Impact Modeling,” Agenda for Technical Workshop sponsored by California Water and Environmental Modeling Forum (CWEMF), Scheduled for March 25, 2008 in Sacramento, CA (2008).

http://www.gfredlee.com/SJR-Delta/CWEMF_Workshop_Agenda.pdf

Lee, G. F., and Jones-Lee, A., “Synopsis of CWEMF Delta Nutrient Water Quality Modeling Workshop – March 25, 2008, Sacramento, CA,” Report of G. Fred Lee & Associates, El Macero, CA, May 15 (2008).

http://www.gfredlee.com/SJR-Delta/CWEMF_WS_synopsis.pdf

About 100 individuals attended that workshop; based on workshop evaluations, it was well-received. The workshop speakers discussed each of the major nutrient-related water quality problems (including growth of planktonic and attached algae, floating macrophytes - water hyacinth, and macrophytes attached to the sediments - *egeria*) that are occurring in the Delta and in downstream water supply reservoirs. We also presented information on how manipulations of SJR and SacR flows into and through the Delta by the DWR and USBR South Delta export projects impact the nutrient-related water quality problems in the Delta. Overall there are major water quality impairments in the Delta due to the discharge of aquatic plant nutrients to the Delta in its tributaries and within the Delta that result in sufficient aquatic plant growths to impair water quality and to be adverse to the desirable aquatic life resources of the Delta. While the impact of excessive aquatic plant growths has to some extent been considered for impacts of the use of Delta water as a domestic water supply source, the many other significant water quality impacts of excessive aquatic plants growths on Delta resources has not been addressed and the role of nutrients on leading to these growths.

A key issue that we discussed in the workshop synopsis was the need to evaluate the impact of altering the nutrient loads to the Delta on primary production and fisheries resources. That discussion was based on work we conducted:

Lee, G. F. and Jones, R. A., "Effects of Eutrophication on Fisheries," Reviews in Aquatic Sciences, 5:287-305, CRC Press, Boca Raton, FL (1991).

<http://www.gfredlee.com/Nutrients/fisheu.html>

As we discussed, altering the phosphorus loads to the Delta will affect fish production in the Delta by impacting the primary production in the Delta waters.

Jassby in,

Jassby, A., "Phytoplankton in the Upper San Francisco Estuary: Recent Biomass Trends, Their Causes and Their Tropic Significance," San Francisco Estuary & Watershed Science [Internet], Volume 6, Issue 1, February (2008).

[<http://escholarship.org/uc/item/71h077r1>] or

[<http://repositories.cdlib.org/jmie/sfews/vol6/iss1/art2>]

has discussed the relationships between nutrients and phytoplankton biomass in Delta waters.

Urban Stormwater Runoff Water Quality Impacts

The California Bay Delta Conservation Plan (BDCP) draft documents discussed the need to treat urban stormwater runoff discharged to the Delta and its tributaries as part of controlling pollutants in the Delta. However no quantitative information was provided on the role of urban stormwater runoff-associated chemicals in affecting Delta water quality. Beginning in the 1960s Dr. Lee pioneered in conducting studies of the water quality impacts of urban stormwater runoff water quality impacts. We have extensive experience in evaluating the water quality impacts of urban stormwater runoff-associated potential pollutants; many of our papers and reports on this issue are available on our website in the "Surface Water" section, "Urban Stormwater Runoff" subsection at

<http://gfredlee.com/pswqual2.htm#runoff>. Our most recent published paper on this issue is:

Jones-Lee, A., and Lee, G. F., "Modelling Water Quality Impacts of Stormwater Runoff: Why Hydrologic Models Are Insufficient," Chapter 4 IN: Modelling of Pollutants in Complex Environmental Systems, Volume I, ILM Publications, St. Albans, Hertfordshire, UK, pp.83-95 (2009).

<http://www.gfredlee.com/Runoff/HydrologicModelsInadeq.pdf>

That paper discusses the need to incorporate aquatic chemistry transport and thermodynamic and kinetic transformations with aquatic toxicology/biology information in the evaluation of the impact of pollutants on water quality from any source, especially urban stormwater runoff. Based on our extensive experience in evaluating urban stormwater runoff water quality impacts over the past 40 years there is need for extensive studies to define the real significant water quality impacts on Delta water quality, and aquatic life resources.

Impact of Diverting Sacramento River Flow around the Delta

The BDCP steering committee has proposed to divert Sacramento River flow around the Delta in order to provide a high-quality source of water for downstream water users and to eliminate the capture of young fish in the intake screens of the South Delta export pumps. Based on discussions by the BDCP steering committee, we find that inadequate attention has been given to the impact of a peripheral canal to transport SacR water around the Delta to supply water users in the Central Valley, San Francisco Bay area and southern California, on Delta water quality. Some of the issues that need to be addressed are discussed in our report:

Lee, G. F., and Jones-Lee, A., "Review of Need for Modeling of the Impact of Altered Flow through and around the Sacramento San Joaquin Delta on Delta Water Quality Issues," and "Summary: Water Quality Modeling Associated with Altered Sacramento River Flows in & around the Delta," Report to CWEMF Stormwater Committee, by G. Fred Lee & Associates, El Macero, CA, March (2009).

<http://www.gfredlee.com/SJR-Delta/Model-Impact-Flow-Delta.pdf>

Of particular concern is the discharge of SJR water with of its associated pollutants into the South Delta under conditions of limited Sacramento River in the Central and South Delta on Delta water quality.

Revised Sac Regional Wastewater NPDES Permit Renewal

In response to a request for comments we developed:

Lee, G. F., and Jones-Lee, A., “Comments on ‘NPDES Permit Renewal Issues Drinking Water Supply and Public Health <http://gfredlee.com/pswqual2.htm#runoffSacramento> Regional Wastewater Treatment Plant’ dated 14 December 2009,” Report of G. Fred Lee & Associates, El Macero, CA, January 20 (2010).
<http://www.gfredlee.com/SJR-Delta/SacRegPermitCom.pdf>

In those comments we discussed the basis for our conclusion that the CVRWQCB “issue” paper covering the renewal the NPDES wastewater discharge permit did not adequately address many of the issues concerning impacts of Sac Regional wastewater discharge that need to be evaluated before a new NPDES permit is issued for that discharge.

If there are questions or comments on these issues please contact me at gfredlee@aol.com.

G. Fred Lee and Anne Jones-Lee