Summary Information on
Drs. G. Fred Lee and Anne Jones-Lee's Water Quality Evaluation Experience in the Sacramento-San Joaquin River Delta and the San Joaquin River Watershed

Drs. G. Fred Lee and Anne Jones-Lee's work on Delta water quality issues began in the summer of 1989 as part of reviewing the expected water quality in the Delta Wetlands, Inc., proposed in-Delta water storage reservoirs. Beginning in the mid-1990s Dr. Lee became involved in the details of water quality issues in both the Sacramento and San Joaquin River watersheds. At that time he began to work with the California Central Valley Regional Water Quality Control Board (CVRWQCB) staff as well as William Jennings (formerly the DeltaKeeper) as a volunteer technical adviser to help the CVRWQCB and the DeltaKeeper focus their activities on technically correct positions on water quality management of the Delta and its tributaries.

These activities provided Dr. Lee with an opportunity to become involved in a variety of areas that are of particular significance to the CVRWQCB's and the DeltaKeeper's efforts to improve the quality of science and protection/enhancement of water quality of the Delta and its tributaries. Dr. Lee's work with the CVRWQCB and the DeltaKeeper included addressing such issues as managing aquatic life toxicity in the Central Valley and Delta due to pesticide runoff/discharges from agricultural and urban areas, reviewing and managing excessive bioaccumulation of organochlorine legacy pesticides and PCBs in Central Valley waterbodies and the Delta, review of the potential environmental impacts of aquatic pesticides used for aquatic weed control in the Central Valley and Delta, impact of aquatic plant nutrients on Delta water quality, impact of flow management in and from the South Delta on water quality, providing guidance on environmental aspects of dredging and dredged sediment management in the Delta, etc.

Publications on Website

As part of their activities, Drs. Lee and Jones-Lee have developed a number of papers and reports that discuss evaluation and management issues related to the water quality of the Delta and its tributaries. These publications are available on their website (www.gfredlee.com) in the Watershed Studies - San Joaquin River Watershed Program - Delta section (http://www.gfredlee.com/psjriv2.htm). In addition, other sections of the website contain papers and reports pertinent to water quality evaluation and management of the Delta and its tributaries. Presented below is a summary of their Delta and Delta Tributaries water quality evaluation/management activities. Included are references to specific papers/reports that are representative of their work in various areas of activity. Additional information in a number of these areas is available on their website.

Domestic Water Supply Water Quality

One of Dr. Lee's major areas of professional activity is the evaluation and management of domestic water supply water quality issues. Of particular concern is the impact of various types of land use activities in a water supply watershed on the quality of water available to a water utility. During the late 1970s-early 1980s, Dr. Lee served as Chair of the American Water Works Association's national committee on Quality Control in Reservoirs, where he developed several guidance documents on water quality

management in a water supply reservoir's watershed. Several of these documents are available from his and Dr. Jones-Lee's website in the Domestic Water Supply section (http://www.gfredlee.com/pdwswq2.htm).

Shortly after moving to El Macero (near Davis), California, in 1989, Dr. Lee was asked by the organizers of a University of California Water Resources Center conference devoted to water supply source water quality issues to develop a paper concerned with a review of Sacramento-San Joaquin Delta water quality issues. This resulted in Drs. Lee and Jones-Lee's publication of a paper and report:

> Lee, G. F. and Jones, R. A., "Managing Delta Algal-Related Drinking Water Quality: Tastes and Odors and THM Precursors," Published in "Protecting Drinking Water Quality at the Source," proceedings of a Conference, Univ. of California Water Resources Center, Report no. 76, October (1991).
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> Lee, G. F. and Jones, R. A., "Regulating Drinking Water Quality at the Source," Presented at Univ. of California Water Resources Center Conference, "Protecting Drinking Water Quality at the Source," Sacramento, CA, April 3-4 (1991). http://www.gfredlee.com/wswqsour.htm

These publications specifically discuss issues of how land use within and upstream of the Delta influences the quality of the domestic water supply derived from the Delta. Further, as part of the CA/NV AWWA Section Source Water Quality Committee, Drs. Lee and Jones-Lee developed a review for the committee on the impact of the late 1980s - early 1990s drought on domestic water supply water quality:

> Lee, G. F. and Jones, R. A., "Impact of the Current California Drought on Source Water Supply Water Quality," Presented at CA/NV AWWA Fall conference, Anaheim, CA, 30pp, October (1991). Available upon request from gfredlee@aol.com.

This paper reviewed the importance of how the algal related quality of the water derived from the Delta adversely impacts domestic water supply water quality through taste and odors and increased THM precursors.

More recently Dr. Lee has been involved in developing guidance on approaches that need to be considered in developing control of total organic carbon (TOC)/dissolved organic carbon (DOC) in the Delta and its tributaries as it relates to controlling THM precursors in water utilities that utilize Delta water as a raw water source. He and Dr. Jones-Lee have developed two reports on this issue:

> Lee, G. F., "G. Fred Lee and Anne Jones-Lee's Work on Domestic Water Supply Water Quality, and TOC Issues in the Delta," Report of G. Fred Lee & Associates, El Macero, CA (2004).
> http://www.members.aol.com/annejlee/GFL-DeltaTOCWork.pdf

Lee, G. F. and Jones-Lee, A., "Issues that Need to Be Considered in Evaluating the Sources and Potential Control of TOC that Leads to THMs for Water Utilities that Use Delta Water as a Water Supply Source," Report of G. Fred Lee & Associates, El Macero, CA, May 27 (2003).
http://www.gfredlee.com/TOC_update.pdf

These reports stress the importance of focusing total organic carbon control on sources of refractory (non-degradable) TOC rather than total TOC, since appreciable parts of TOC in the Delta tributaries can be present in a labile (degradable) form that would not persist in the tributary and Delta to a water supply intake.

Excessive Bioaccumulation of Hazardous Chemicals

A key issue in water quality of the Delta and its tributaries is the excessive bioaccumulation of hazardous chemicals in fish and other edible organisms in Delta waters. On behalf of the CVRWQCB Drs. Lee and Jones-Lee developed a comprehensive review of excessive bioaccumulation of hazardous chemicals in fish in Central Valley waterbodies, including the Delta:

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/OClTMDLRpt12-11-02.pdf

This report includes information on the need for an updated monitoring program, the results of which would serve as the basis for a regulatory program to control excessive bioaccumulation of hazardous chemicals in Central Valley fish.

With support provided by the CVRWQCB through the DeltaKeeper, Drs. Lee and Jones-Lee, with the assistance of Dr. Scott Ogle, conducted a demonstration study on the bioavailability of PCBs in Smith Canal. Smith Canal is a city of Stockton slough that has been found to contain some fish with excessive PCB concentrations. Their report,

Lee, G. F., Jones-Lee, A. and Ogle, R. S., "Preliminary Assessment of the Bioaccumulation of PCBs and Organochlorine Pesticides in *Lumbriculus variegatus* from City of Stockton Smith Canal Sediments, and Toxicity of City of Stockton Smith Canal Sediments to *Hyalella azteca*," Report to the DeltaKeeper and the Central Valley Regional Water Quality Control Board, G. Fred Lee & Associates, El Macero, CA, July (2002).
http://www.gfredlee.com/SmithCanalReport.pdf

demonstrates how the procedures developed by the US EPA for assessing bioavailable forms of bioaccumulatable chemicals in water and sediments can be applied to determining the need to remediate contaminated sediments which are serving as a significant source of hazardous chemicals for edible organisms.

Aquatic Life Toxicity

Also, on behalf of the CVRWQCB, Drs. Lee and Jones-Lee developed a review of the aquatic life toxicity monitoring that had been conducted in the city of Stockton's waterways (sloughs) that are part of the Delta waters. Beginning in the mid-1990s the CVRWQCB staff had conducted an aquatic life toxicity monitoring program of stormwater runoff into city of Stockton sloughs. Drs. Lee and Jones-Lee were issued a contract to review these data and prepare a comprehensive report:

> Lee, G. F. and Jones-Lee, A., "Review of the City of Stockton Urban Stormwater Runoff Aquatic Life Toxicity Studies Conducted by the CVRWQCB, DeltaKeeper and the University of California, Davis, Aquatic Toxicology Laboratory between 1994 and 2000," Report to the Central Valley Regional Water Quality Control Board, G. Fred Lee & Associates, El Macero, CA, October (2001). http://www.gfredlee.com/stockton-txt_0401.pdf

Subsequently, the CVRWQCB requested that Drs. Lee and Jones-Lee develop a draft TMDL to control the city of Stockton sloughs' aquatic life toxicity:

> Lee, G. F. and Jones-Lee, A., "City of Stockton Mosher Slough and Five Mile Slough Diazinon and Chlorpyrifos Aquatic Life Toxicity Management Report," California Water Institute Report TP 02-08 to the California State Water Resources Control Board/Central Valley Regional Water Quality Control Board, 44 pp, California State University Fresno, Fresno, CA, December (2002). http://www.gfredlee.com/StockDiaTMDL12-14-02.pdf

Drs. Lee and Jones-Lee's work on aquatic life toxicity caused by pesticides in the Delta and its tributaries led to the development of what they call a proactive approach to regulating the use of new or expanded-use pesticides in agriculture and urban areas.

> Jones-Lee, A. and Lee, G. F. , "Proactive Approach for Managing Pesticide-Caused Aquatic Life Toxicity," Report of G. Fred Lee & Associates, El Macero, CA, October (2000). http://www.gfredlee.com/proactivepest_1000.pdf

> Lee, G. F., "Proactive Approach for Managing Pesticide-Caused Aquatic Life Toxicity," PowerPoint Presentation to the Sacramento River Watershed Program Toxics Subcommittee, Sacramento, CA, September 26 (2001). http://www.gfredlee.com/ProActivePest.pdf

These reports provides guidance on the deficiencies in current US EPA and California Department of Pesticide Regulation pesticide registration programs in which pesticides are registered for use that can cause aquatic life toxicity in stormwater runoff/discharges. The proactive approach would supplement current registration requirements by site-specific field studies conducted prior to large-scale use of a new or expanded-use pesticide.

SJR DWSC Low DO

One of Drs. Lee and Jones-Lee's major areas of work has been on the San Joaquin River Deep Water Ship Channel (DWSC) low-DO problem. Beginning in 1999, Dr. Lee worked closely with the SJR DO TMDL Steering Committee as well as the Central Valley Regional Water Quality Control Board staff in helping to formulate and implement higher-quality science and engineering in the San Joaquin River DWSC low-DO TMDL program. The support of their activity as advisors to the SJR DO TMDL Steering Committee was derived from funds made available through the DeltaKeeper. Their activities included Dr. Lee's being awarded a contract with the CVRWQCB, to develop an "Issues" report of the issues that need to be addressed as part of formulating a TMDL to control the low-DO problem in the San Joaquin River DWSC. This Issues report is available as,

> Lee, G. F. and Jones-Lee, A., "Issues in Developing the San Joaquin River Deep Water Ship Channel DO TMDL," Report to Central Valley Regional Water Quality Board, Sacramento, CA, August (2000).
> http://www.gfredlee.com/sjrpt081600.pdf

Dr. Lee worked closely with the Central Valley Regional Water Quality Control Board lead staff (Dr. Chris Foe) in developing a two-million-dollar proposal, which was funded by CALFED. Dr. Lee served as the coordinating principal investigator for 12 projects that were conducted under this proposal. This work resulted in a synthesis report,

> 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 and CALFED Bay-Delta Program, G. Fred Lee & Associates, El Macero, CA, March (2003).
> http://www.gfredlee.com/SynthesisRpt3-21-03.pdf

This report presents a summary/synthesis of approximately four years and four million dollars of studies on the SJR DWSC low-DO problem. Since completion of the synthesis report in March 2003, Drs. Lee and Jones-Lee have continued to be active in the SJR DWSC DO TMDL issues. They have developed a series of reports on these issues that are available from their website, www.gfredlee.com, in the San Joaquin River Watershed section (http://www.gfredlee.com/psjriv2.htm). They have also developed a synthesis report supplement that presents a review of the various studies that have been conducted pertinent to investigating and managing the low-DO problem in the SJR DWSC. This supplement, as well as other reports pertinent to managing the DWSC low-DO problem, is available from their website at the link cited above.

Delta Water Quality Issues

Beginning in the mid-1990s Dr. Lee was involved with various CALFED activities related to developing a water quality evaluation and management program for the Delta. He repeatedly observed that CALFED had not (and still has not) developed a comprehensive review of known water quality problems in the Delta. This led to Drs.

Lee and Jones-Lee's development of a report on Delta water quality issues, which was published in June 2004:

> 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, June (2004). http://www.members.aol.com/apple27298/Delta-WQ-IssuesRpt.pdf

This report discussed the known water quality problems based on the CVRWQCB's designation of various Delta channel waters as impaired due to violations of water quality objectives by one or more chemicals. This report also discussed the deficiencies in the water quality monitoring program that had been conducted on the Delta and presented recommendations on how this program should be improved to more adequately define the extent and magnitude of existing water quality problems, as well as potential water quality problems that would likely surface through a more comprehensive water quality monitoring program.

Aquatic Weed Control

The Delta receives sufficient amounts of aquatic plant nutrients from upstream and local Delta sources to promote excessive growths of water weeds (hyacinth and Egeria) to impair recreational use of some of the Delta waters. Dr. Lee has been involved in evaluation of the potential water quality impacts of aquatic herbicides used to control excessive growths of aquatic weeds on non-target organisms since the early 1960s. Based on this experience Dr. Lee found that the use of aquatic herbicides in the Delta and its tributaries occurs without adequate monitoring of the potential water quality impacts of the herbicide on non-target aquatic life. In support of the DeltaKeeper's efforts in improving water quality protection associated with the use of herbicides for water weed control, Dr. Lee developed several reports to the California State Water Resources Control Board (SWRCB) on the approach that should be followed in monitoring the impact, fate and persistence of aquatic herbicides. These reports include,

> Lee, G. F. and Jones-Lee, A., "Recommended Pesticide-Caused Aquatic Life Toxicity Monitoring," Report of G. Fred Lee & Associates, El Macero, CA, November 4 (2005). http://www.members.aol.com/annejlee/PestToxMonitor.pdf

Adoption of Dr. Lee's recommended monitoring program would lead to a more technically valid – protective approach to the use of aquatic herbicides in the Delta and its tributaries.

Excessive Mercury Bioaccumulation

In the late 1980s Dr. Lee became a consultant to the American Dental Association on the potential significance of waste mercury discharged to sewers by dentists' offices on water quality in waterbodies receiving discharges of treated domestic wastewater which received dental amalgam in its sewage. More recently Dr. Lee has followed closely the CVRWQCB and CALFED programs to investigate the occurrence, sources and significance of excessive mercury bioaccumulation in edible fish in the Delta and its tributaries. He has participated in the Delta Tributaries Mercury Council and the

CVRWQCB mercury TMDLs programs. He is currently a member of the steering committee for the approximately $4-million CALFED supported study on mercury bioaccumulation in fish in the Delta and its tributaries. As part of his work on mercury he developed,

> Lee, G. F., "Regulating Mercury in the Water Column and Sediments," Report to Dredge Tailings Workgroup, by G. Fred Lee & Associates, El Macero, CA (2003).
> http://www.gfredlee.com/TotalMercuryandDissolvedMercuryStandards-rev.pdf

This report discusses issues pertinent to regulating mercury to control excessive bioaccumulation in edible fish, including the fact that meeting the current mercury water quality criteria/objectives does not prevent excessive bioaccumulation of mercury in fish. Dr. Lee found that the California Department of Fish and Game (DFG) approach based on cooccurrence-based so-called sediment quality guidelines which was being used by DFG was not reliable for evaluation of the allowable mercury in former gold mine tailings that contain mercury as a source of gravel for enhanced habitat for spawning of salmonids. Dr. Lee's report on regulating mercury has direct relevance to the CALFED program of enhanced gravel for fish spawning habitat.

Dr. Lee's work on mercury in Delta tributaries has included providing information to the CVRWQCB on the excessive mercury bioaccumulation in Putah Creek fish. Putah Creek is a tributary of the Yolo Bypass and the Delta. This information was developed from Dr. Lee's serving as the US EPA supported Technical Assistance Grant (TAG) Advisor to the public for the University of California, Davis (UCD), Department of Energy LEHR Superfund site located on the UCD campus in Davis, CA. UCD, under an Atomic Energy Commission research contract, through mismanagement of wastes, polluted soils and groundwaters at the LEHR site with radioactive wastes, chlorinated solvents, heavy metals, pesticides, nutrients, etc. The LEHR site is also polluted by UCD's campus wastes.

A TAG advisor for a Superfund site has the responsibility of advising the public on the adequacy of the regulatory agency (US EPA, CVRWQCB, Department of Health Services - DHS and Department of Toxic Substances Control - DTSC) investigation and remediation of the Superfund site. In connection with the review of the LEHR site investigation, Dr. Lee found that no studies had been conducted on the potential for LEHR stormwater runoff to contain hazardous chemicals that bioaccumulate to excessive concentrations in edible fish. The Agency for Toxic Substances and Disease Registry (ATSDR) supported Dr. Lee's conclusion on the deficiencies in the LEHR site investigation and worked with the US EPA to collect fish from Putah Creek to measure the tissue content of hazardous chemicals in selected fish. It was found that some fish in Putah Creek contained sufficient mercury to be a hazard to those who use the fish as food.

Working with the public (Julie Roth, Executive Director of the Davis South Campus Superfund Oversight Committee – DSCSOC), Dr. Lee provided information to the

CVRWQCB that caused the State Water Board and the US EPA to list Putah Creek as an impaired waterbody due to excessive bioaccumulation of mercury in edible fish. Dr. Lee's work at the LEHR site was also instrumental in having the CVRWQCB require that UCD implement a program to control mercury in LEHR site stormwater runoff that exceeded current water quality criteria. Dr. Lee's reports on LEHR site mercury issues are available on the DSCSOC website, http://members.aol.com/dscsoc/doc.htm.

South Delta Water Quality Issues

As part of the SJR DWSC DO studies Dr. Lee also considered the water quality characteristics of the South Delta since this area also receives San Joaquin River water with its large algal oxygen demand. His review was included in the Synthesis Report for the SJR DWSC Low-DO project cited above. Subsequently, he became involved in review of the salinity issues in the South Delta as influenced by salt input from the SJR and local Delta sources. He has evaluated how the federal (US Bureau of Reclamation - USBR) and state (Department of Water Resources - DWR) water export projects (which, at times, export as much as 13,500 cfs of South Delta water to central and southern California and the San Francisco Bay area) potentially impact water quality of the South Delta as well as the overall Delta. He testified as a SWRCB hearing on the need to require that those responsible for water diversions (through SWRCB Water Rights) should be required to conduct comprehensive studies on the impact of water diversions on water quality. He and Dr. Jones-Lee developed the following reports,

> Lee, G. F., and Jones-Lee, A., "Impact of State and Federal Delta Water Export Projects on Delta Water Quality and Aquatic Resources: Issues That Need to Be Addressed," Report of G. Fred Lee & Associates, El Macero, CA, October (2004). http://www.members.aol.com/annejlee/ImpactDelExpProj.pdf
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> Lee, G. F., and Jones-Lee, A., "Impact of SJR & South Delta Flow Diversions on Water Quality," PowerPoint Slides, Presentation to CA Water Resources Control Board, D1641 Water Rights Review, January 24 (2005).
> http://www.members.aol.com/annejlee/D1641SlidesSWRCBJan2005.pdf
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> 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.members.aol.com/annejlee/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.members.aol.com/annejlee/DeltaWaterExportImpactsPowerPoint.pdf

Dr. Lee has closely followed the DWR South Delta Improvement Project (SDIP). He and Dr. Jones-Lee have provided several sets of comments on deficiencies in the proposed project in evaluating the potential impact of the proposed project on South Delta water quality, including,

> Lee, G. F., "Comments on Scope of South Delta EIS/EIR," submitted to Paul Marshall, Department of Water Resources and Dan Meier, US Bureau of Reclamation, Report of G. Fred Lee & Associates El Macero, CA, October 30 (2002). http://www.gfredlee.com/South-DeltaEIS.pdf
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> Lee, G. F. and Jones-Lee, A., "Comments on 'Draft Environmental Impact Statement Environmental Impact Report, South Delta Improvement Program' Prepared by Bureau of Reclamation for the U.S. Department of the Interior and the Department of Water Resources for the State of California Resources Agency," Report of G. Fred Lee & Associates, El Macero, CA, Submitted to CA Department of Water Resources, Sacramento, CA February 5 (2006). http://www.members.aol.com/annejlee/SDIP-ComFeb06.pdf

As discussed, the DWR SDIP has not adequately evaluated the potential impact of the proposed water manipulations of South Delta water in order to enable the State and Federal projects to export more water from the Delta.

McCormick & Baxter Superfund Site

McCormick & Baxter operated a wood-treating site on Mormon Slough near the Port of Stockton. The US EPA has placed the McCormick & Baxter area and Mormon Slough on the national Superfund site list due to pollution of soils, surface water and groundwater and Mormon Slough sediments with PAHs, heavy metals and dioxins. Some fish taken from the waters in the Port of Stockton and the SJR Deep Water Ship Channel near the Port contain sufficient dioxins to render them unsafe to consume. The US EPA is the lead agency in conducting the remedial investigation and remediation of this site. Dr. Lee has found that the Mormon Slough remediation approach involving capping the sediments with a layer of sand, while potentially adequate for near-term reduction of the bioaccumulation of dioxins in fish of the area, has significant long-term problems in isolating the sand-capped dioxins in Mormon Slough sediments from the aquatic food web, which could lead to continued excessive bioaccumulation of dioxins in edible fish of the area. Dr. Lee also found that the US EPA has not adequately defined the areas of the Port and DWSC that are contributing dioxins to the food web, which leads to excessive bioaccumulation in edible fish. There is need for comprehensive, long-term monitoring of fish and other aquatic life in Mormon Slough and the Port of Stockton/DWSC which can be reliable in detecting continuing excessive bioaccumulation of dioxins from the sediments of this area, including those that have been capped by a sand layer.

Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Ag Waiver)

The Central Valley Regional Water Quality Board has adopted a conditional waiver of waste discharge requirements for stormwater runoff/discharges based on agricultural interests in the Central Valley conducting a water quality monitoring program to determine whether runoff/discharges from irrigated agriculture cause violations of water quality objectives in the state's waters. This ag waiver monitoring program will provide information on the potential impacts of Delta irrigated agricultural discharges on Delta water quality. Dr. Lee has reviewed the adequacy of the CVRWQCB ag waiver water quality monitoring program in defining the water quality impacts of discharges from irrigated agriculture. These reports,

> Lee, G. F. and Jones-Lee, A., "Comments on 'Draft Conditional Waivers of Waste Discharge Requirements for Discharges from Irrigated Lands - Tentative Table 1 List of Receiving Water Limitations to Implement Water Quality Objective Guidance for Implementing the MRP,'" Submitted to Central Valley Regional Water Quality Control Board, Rancho Cordova, CA, by G. Fred Lee & Associates, El Macero, CA, November (2005).
> http://www.members.aol.com/annejlee/Agwavtable_1_com.pdf
>
> Lee, G. F., "Comments on, CVRWQCB Staff Report January 27/28, 2005 Board Meeting," Report of G. Fred Lee & Associates, El Macero, CA, January (2005).
> http://www.members.aol.com/annejlee/ComCVRWQCBStaffRptJan27-28AgWaiver

discuss the need to further revise the CVRWQCB ag waiver water quality monitoring program to more reliably define the water quality impacts of irrigated agriculture runoff/discharges on receiving water quality.

Dr. Lee was responsible for causing the CVRWQCB to develop the Technical Issues Committee (TIC) for the ag waiver water quality monitoring program. He has been active in the deliberations of this committee, especially in the area of developing guidance on the interpretation of ag waiver nutrient monitoring data. The proper interpretation of ag waiver nutrient water quality data is of particular importance to Delta water quality issues since the Delta and water utilities that import Delta water as a domestic water supply source experience water quality problems due to discharges of agricultural nutrients. He and Dr. Jones-Lee developed the report,

> Lee, G. F., and Jones-Lee, A., "Interpretation of Nutrient Water Quality Data Associated with Irrigated Agricultural Ag Waiver Monitoring," Submitted to Central Valley Regional Water Quality Control Board, Rancho Cordova, CA, by G. Fred Lee & Associates, El Macero, CA, November (2005). http://www.members.aol.com/annejlee/InterprNutrWQData.pdf

They also developed,

Lee, G. F. and Jones-Lee, A., "Nutrient-Related Water Quality Concerns in the Sacramento and San Joaquin Rivers and Delta," Report of G. Fred Lee & Associates, El Macero, CA, September (2006).
http://members.aol.com/annejlee/NutrWQDelta.pdf

Lee, G. F. and Jones-Lee, A., "Assessing the Water Quality Significance of N & P Compound Concentrations in Agricultural Runoff," Invited presentation to the Agrochemical Division, American Chemical Society national meeting, San Francisco, CA, September (2006).
http://www.members.aol.com/annejlee/N-PRunoffACS.pdf

Lee, G. F., and Jones-Lee, A., "Assessing Water Quality Significance of N & P Compound Concentrations in Agricultural Runoff," PowerPoint Slides for Invited Paper Presented at Agrochemical Division, American Chemical Society National Meeting, San Francisco, CA, September (2006).
http://www.members.aol.com/annejlee/N-PSlidesACS.pdf

These papers and reports evolved from Dr. Lee's review of Delta nutrient-related water quality issues and discuss the need to evaluate all downstream waterbodies (such as the Delta) for potential water quality impacts of nutrients discharged from upstream sources.

Recently, Drs. Lee and Jones-Lee's nutrient work has focused on developing approaches for assessing the algal available phosphorus in agricultural stormwater runoff in the Delta watershed. They have developed,

Lee, G. F., "A Proposal for Assessing Algal-Available Phosphorus Loads in Runoff from Irrigated Agriculture in the Central Valley of California," Report of G. Fred Lee & Associates, El Macero, CA, November (2006).
http://www.members.aol.com/annejlee/AlgalAssayAvailP.pdf

This report discusses the approach that should be used to determine whether stormwater runoff of erosion-associated phosphorus is available to support algal growth in the SJR and Delta.

Evaluation of CALFED Effectiveness in Addressing Delta Water Quality Issues

Associated with the Little Hoover Commission review of CALFED, Dr. Lee provided comments on the failure of CALFED to adequately and reliably address water quality problems in the Delta. Of particular concern is the almost complete lack of an aquatic life related water quality evaluation and management program in the Delta. Dr. Lee provided copies of his and Dr. Jones-Lee's reports on Delta water quality issues to the Little Hoover staff.

San Joaquin River Water Quality Issues

In 2006 Drs. Lee and Jones-Lee published a comprehensive review of San Joaquin River (SJR) water quality issues:

Lee, G. F. and Jones-Lee, A., "San Joaquin River Water Quality Issues," Report of G. Fred Lee & Associates, El Macero, CA, June (2006). http://www.members.aol.com/annejlee/sjr-WQIssues.pdf

The key information in this report was summarized in a presentation:

Lee, G. F. and Jones-Lee, A., "San Joaquin River Water Quality Issues," (PowerPoint Slides) Invited Paper Presented at Great Valley Conference, "At the Tipping Point," Sacramento, CA, Sponsored by Great Valley Center, Modesto, CA, May 11 (2006). http://www.members.aol.com/annejlee/SJR-April2006.pdf

The focus of this report/presentation is a discussion of existing TMDLs on the SJR as well as potential TMDLs that could be developed to address existing water quality problems in the SJR. This report also includes updated information on eastern and southern Delta water quality issues, as well as a summary of the information available on the pelagic organism decline (POD) that has occurred in the Delta.

Sediment Quality Issues

As discussed in Drs. Lee and Jones-Lee's papers and reports, Delta sediments contain chemicals that are adversely impacting Delta water quality, including causing low DO and aquatic life toxicity, serving as a source of bioaccumulatable hazardous chemicals and nutrients, etc. Excessive sediment accumulation also impacts navigation in some Delta channels. There is need to better understand the role of Delta sediments in impacting Delta water quality. Dr. Lee has been involved in aquatic sediment water quality issues since the early 1960s. The emphasis of much of his work has been on the role of chemical contaminants in sediments in impacting a waterbody's water quality. In the 1970s he conducted about $1 million in research for the Corps of Engineers devoted to evaluating the water quality impacts of chemical contaminants in dredged waterway sediments on disposal site water quality. Of particular concern was whether the disposal of dredged sediments would cause aquatic life toxicity or lead to excessive bioaccumulation of hazardous chemicals in edible aquatic life. A summary of these studies was published as,

Lee, G. F. and Jones-Lee, A., "Water Quality Aspects of Dredging and Dredged Sediment Disposal," In: Handbook of Dredging Engineering, Second Edition, McGraw Hill, New York, NY, pp. 14-1 to 14-42 (2000). http://www.gfredlee.com/dredging.html

In the early 1990s, Dr. Lee became aware of the problems in permitting dredging projects in the Delta from the CVRWQCB staff. Of particular concern is the permitting of the use of Delta channel dredged sediments to enhance levee stability. In an effort to help address this situation Dr. Lee became active in the California CALFED Delta Levees and Habitat Advisory Committee, a committee set up by the Secretary for Resources in 1993. Working with CVRWQCB staff, Dr. Lee suggested that there is need for demonstration projects that show that Delta channel sediments can be used in permitting levee enhancement without applying US EPA/SWRCB worst case based water quality

criteria/objectives. Such demonstration projects could lead to development of site-specific criteria that would adequately regulate dredged sediment disposal/reuse to be protective of Delta water quality without significant unnecessary overregulation. Based on Dr. Lee's suggestion, the Delta Levees and Habitat Committee obtained funds from CALFED to conduct the studies needed to streamline Delta dredged sediment disposal/reuse permitting. The California Department of Fish and Game used the CALFED funds for other purposes that did not address the issues needed to facilitate the permitting of the disposal/reuse of Delta dredged sediments.

Recently, those interested in maintaining the navigation depth of Delta channels and using Delta dredged sediments for levee enhancement have organized the Delta Long-Term Management Strategy (LTMS) program to streamline Delta dredged sediment disposal/reuse permitting. The Delta LTMS is to accomplish similar results to the San Francisco Bay LTMS, where the permitting of the disposal of San Francisco Bay dredged sediments was more easily accomplished by reducing the amount of disposal in the Bay by disposal in the Pacific Ocean. Dr. Lee has been participating in the Delta LTMS meetings, where he has developed guidance on how more appropriate Delta dredged disposal/reuse permitting should be developed using demonstration projects to evaluate the potential water quality impacts of reuse of dredged sediments. The development of an appropriate approach for regulating dredged sediment management and reuse in the Sacramento-San Joaquin Delta will require an integrated use of technical information in a number of areas, including

- development, use, and appropriate site-specific adjustment of water quality criteria and objectives,
- aquatic chemistry/toxicology/biology,
- human health and ecological risk assessment,
- leaching of chemicals from sediments,
- drinking water quality,
- impacts of various types of pollutants on water quality,
- Delta water quality issues,
- South Delta Improvement Program,
- impact of state and federal export projects on flow patterns in the Delta,
- sediment quality objectives development and utilization in California and in the Delta,
- pelagic organism decline (POD), and low dissolved oxygen problems in the Delta, and
- methylmercury and legacy pesticide/PCB sources and bioaccumulation.

In support of the DeltaKeeper's (Bill Jennings) efforts to provide improved Delta water quality protection from the disposal of SJR DWSC dredged sediment from the Port of Stockton and upper DWSC near the Port, Dr. Lee has been conducting reviews of proposed CVRWQCB permits for dredging sediment disposal projects. This area of the DWSC is the most polluted area of the DWSC, where the sediments are contaminated by a variety of potential pollutants derived from municipal wastewater and stormwater discharges/runoff, as well as discharges/runoff from upstream agricultural areas. Dr. Lee has worked with the CVRWQCB in reviewing the proposed permitting of dredging

projects. He has provided comments on the approach that is needed to properly evaluate the potential water quality impacts of disposal of DWSC dredged sediments.

In the summer of 2004 Dr. Lee became involved with the CVRWQCB/DeltaKeeper in review of the Trapper Slough levee enhancement project in which Port of Stockton DWSC dredged sediments were used to enhance the Trapper Slough levee. Dr. Lee developed,

> Lee, G. F., "Comments on California Department of Water Resources July 26, 2004 News Release and Report on the Potential Impacts of Depositing Polluted Dredged Sediments on the Trapper Slough Levee," Submitted to California Central Valley Regional Water Quality Control Board, Rancho Cordova, CA, Report of G. Fred Lee & Associates, El Macero, CA, August 13 (2004). http://www.members.aol.com/annejlee/DWRDredgSedTrapperSlough.pdf

This report discusses the inappropriate approaches that the DWR used to evaluate the potential for the DWSC dredged sediments to cause water pollution when used for levee enhancement. This report also provides guidance on how this type of evaluation should be conducted.

The California legislature adopted the Bay Protection and Toxic Cleanup Program (BPTCP) that required that the SWRCB develop sediment quality objectives (SQOs) for the enclosed bays and estuaries of the state. As a followup to the SWRCB's BPTCP failed attempts to develop sediment quality objectives, the DeltaKeeper filed a lawsuit to require that the SWRCB comply with the California legislative requirements set forth in the BPTCP of developing sediment quality objectives. The SQOs are to be used to define those sediments that are adversely impacting water quality and therefore require remediation. The SQOs are also to be used to establish the need for revision of dischargers' NPDES permits to control the discharge chemicals that accumulate in sediments that lead to SQO violations. As Dr. Lee discussed during the SWRCB staff's effort to try to development SQOs, the approach adopted by the staff, which was based on a cooccurrence-based approach, was technically invalid. Further, the SWRCB staff devoted much of the funds available to projects that were predicted by Dr. Lee to fail to provide reliable information that is needed to develop appropriate SQOs.

In response to the court order resulting from the DeltaKeeper's lawsuit, the SWRCB made available funds to comply with BPTCP requirements of developing SQOs. This staff/Board initiated a second effort to develop SQOs and, while the BPTCP legislation required that SQOs be developed for the Delta, the SWRCB failed to include the Delta in its retry of developing SQOs. The DeltaKeeper again took this matter to the court and gained an agreement to expand the SWRCB efforts to develop SQOs for the Delta. Dr. Lee has been involved in the SWRCB's current effort to develop SQOs and supports most but not all of the approaches that the SWRCB staff have proposed in developing SQOs based on the triad approach involving an integrated use of sediment aquatic life toxicity, altered aquatic organism assemblages relative to habitat characteristics, and chemical information. Drs. Lee and Jones-Lee developed the paper,

Lee, G. F. and Jones-Lee, A., "Appropriate Incorporation of Chemical Information in a Best Professional Judgment 'Triad' Weight of Evidence Evaluation of Sediment Quality," Presented at the 2002 Fifth International Conference on Sediment Quality Assessment (SQA5), In: Munawar, M. (Ed.), *Aquatic Ecosystem Health and Management* 7(3):351-356 (2004). http://www.gfredlee.com/BPJWOEpaper-pdf

which discusses how chemical information should be used in sediment quality evaluation. The problem with the currently proposed SWRCB SQOs is that the staff have proposed to use total sediment chemical concentrations in evaluating sediment quality. That approach is well known not to be reliable since many potential pollutants exist in sediments in nontoxic forms.

Dr. Lee is serving as an unofficial advisor to the SWRCB staff on developing the SQOs for Delta sediments.

Urban Stormwater Runoff Water Quality Impacts

There is concern that stormwater runoff from urban areas in the Delta watershed is having an adverse impact on the water quality of the Delta and its tributaries. Urban stormwater runoff contains several potential pollutants (heavy metals, nutrients, pesticides, oxygen demand, PAHs and other organics, etc.) that have the potential to be adverse to water quality in the receiving waters for the runoff. In the 1960s, while a professor at the University of Wisconsin, Madison, Dr. Lee conducted some of the first studies ever done on urban stormwater runoff water quality impacts. Through the 1960s, 1970s, 1980s and 1990s Dr. Lee has conducted urban stormwater runoff water quality impact studies in cities across the US. His and Dr. Jones-Lee's papers are presented at http://gfredlee.com/pswqual2.htm#runoff. A summary of these studies is presented in,

Lee, G. F. and Jones, R. A., "Suggested Approach for Assessing Water Quality Impacts of Urban Stormwater Drainage," In: Symposium Proceedings on Urban Hydrology, American Water Resources Association Symposium, AWRA Technical Publication Series TPS-91-4, AWRA, Bethesda, MD, pp. 139-151 (1991). http://www.gfredlee.com/storm_wa.html.

While urban stormwater has elevated concentrations of several potential pollutants, as discussed by Dr. Lee, several of his studies have demonstrated that many of these potential pollutants are in nontoxic forms. In an effort to improve the quality of science and engineering used in urban stormwater runoff water quality management, Drs. Lee and Jones-Lee have developed a Stormwater Runoff Water Quality Newsletter. This Newsletter is made available via the Internet at no cost to anyone interested. At this time there are over 8500 individuals on the Newsletter email list. The Newsletter discusses technical issues pertinent to appropriately evaluating the water quality impacts of urban and agricultural stormwater runoff and the development of appropriate management practices to control these impacts. Past issues of the Newsletter are available at

http://www.gfredlee.com/newsindex.htm. Anyone who is interested in being added to the Newsletter email list should contact G. Fred Lee at gfredlee@aol.com.

When CALFED was first organized in the mid-1990s CALFED management awarded a contract to a large engineering consulting firm. This firm assigned an inexperienced staff member to take the lead on developing CALFED's water quality program. This staff member decided that CALFED should require that all cities in the Delta watershed such as Sacramento and Stockton should be required to construct detention basins to remove heavy metals in urban stormwater runoff. This approach was supposed to control aquatic life toxicity caused by heavy metals in the runoff. Dr. Lee pointed out that this approach would not address real significant water quality problems since several studies had demonstrated that the heavy metals in urban stormwater runoff were in nontoxic forms. Eventually, CALFED abandoned this approach and the consulting engineering firm's contract was not renewed. Dr. Lee's studies of urban stormwater runoff have determined that the aquatic life toxicity in this runoff is due to pesticides used on residential properties.

As part of the SJR DWSC low-DO studies, with from the DeltaKeeper, Dr. Lee found that the city of Stockton urban stormwater runoff contained sufficient oxygen demand to contribute to DO water quality objective violations in Stockton sloughs and the DWSC. In some instances fish kills occurred due to low DO. Reports on these studies are available in the SJR DO TMDL synthesis report cited above.

Domestic Wastewater

An issue of increasing concern is the potential water quality impact of domestic wastewater discharges to the Delta and its tributaries. Of particular concern are the Sacramento and Stockton domestic wastewater discharges to the Delta. While these domestic wastewaters generally meet NPDES permit conditions, there is concern about the presence of unregulated chemicals in these domestic wastewaters. There is increasing concern about the presence of pharmaceuticals and personal care products (PPCPs) in domestic wastewaters. As Dr. Lee has discussed in the Delta Water Quality Issues review, there is increasing evidence that PPCPs are potentially causing adverse impacts on aquatic life. There is need to conduct studies on the potential impacts of these chemicals in Sacramento and Stockton wastewaters on aquatic life related water quality within the Delta.

Recently Dr. Lee has participated in the CVRWQCB/DWR meetings devoted to evaluating the potential impact of the cities of Tracy and Mountain House domestic wastewater discharges to the Delta in the South Delta Old River. While the focus of these studies is increasing salinity, there are several other water quality issues that also need to be addressed with regard to Tracy and Mountain House domestic wastewater discharges to the Delta.

Groundwater Protection Issues

Dr. Lee has been involved in groundwater protection issues in California since the early 1980s. At that time, while holding a professorship in the University of Texas system, Dr.

Lee served as an advisor to the California State Water Resources Control Board in the development of revised landfilling regulations. Since returning to California in 1989 he has followed the approach that has been adopted by state regulatory agencies in permitting land surface activities that will in time pollute groundwater. In December 2006 Drs. Lee and Jones-Lee completed a comprehensive review of groundwater quality protection issues in California:

> Lee, G. F. and Jones-Lee, A., "Groundwater Quality Protection Issues," Report of G. Fred Lee & Associates, El Macero, CA, December (2006).
> http://www.members.aol.com/annejlee/GWProtectionIssues.pdf

This report discusses the failure of the state regulatory agencies to implement the requirements set forth in the Porter-Cologne Water Quality Control Act for protection of groundwater quality, with the result that the State's groundwaters have been and are still being degraded.

Background and Future

The reports developed by Drs. Lee and Jones-Lee are made available as part of their ongoing efforts to improve the quality of science and engineering used in water quality management. Prior to finalization their reports are made available to 50-100 individuals in draft form for review and comment. These reports are updated periodically as additional information is made available. Comments on these reports are welcome.

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