

## Synopsis of G. Fred Lee and Anne Jones-Lee's work on Domestic Water Supply Water Quality & TOC Issues in the Sacramento/San Joaquin River Delta

Dr. Lee began his work on the chlorination of domestic water supplies in 1955 when he was a graduate student at the University of North Carolina Chapel. There, his master's degree work was concerned with reactions of chlorine dioxide. He continued his work on chlorination in his PhD degree program at Harvard University; he studied the chlorination of phenol as it relates to taste and odor production in domestic water supplies and earned his PhD degree from Harvard in 1960. Over the years since, Dr. Lee has served as a consultant to water utilities on the use of chloramines to control THM formation.

Dr. Lee began his work on TOCs in ambient waters in the 1960s when he held the position of Professor of Water Chemistry and Director of the Water Chemistry Program at the University of Wisconsin, Madison. In the late 1960's he published the invited review paper on TOC in various types of waters:

Lee, G. F. and Hoadley, A. F., "Biological Activity in Relation to the Chemical Equilibrium Composition of Natural Water," In: *Equilibrium Concepts in Natural Water Systems*, Advances in Chemistry Series No. 67, Amer. Chem. Soc., pp 319-338 (1967).

Dr. Lee's studies showed that the trophic state of a waterbody did not change the refractory TOC in the waterbody.

Dr. Lee became involved in work on TOC in the Delta in 1989 while he held a Distinguished Professorship in Civil and Environmental Engineering at the New Jersey Institute of Technology. Dr. Lee was a consultant to Delta Wetlands Inc. on water quality in the proposed in-Delta island storage reservoirs. As part of that effort he reviewed the available data on Delta water quality including the DWR studies on the amounts and sources of TOC. This work ultimately led to his presenting the invited paper:

Lee, G. F. and Jones, R. A., "Regulating Drinking Water Quality at the Source," Proc. University of California Water Resources Center Conference: "Protecting Water Supply Water Quality at the Source," Sacramento, CA, 39pp, April (1991). Part of this paper has been published in the proceedings as: Lee, G. F. and Jones, R. A., "Managing Delta Algal Related Drinking Water Quality: Tastes and Odors and THM Precursors," pp. 105-121, April (1991). <http://www.gfredlee.com/wswqsour.htm>

During the period 1999-2004 Drs. Lee and Jones-Lee were highly involved in the low DO studies in the SJR Deep Water Ship Channel. That work included serving as a PI for the \$2 million CALFED grant that involved 12 investigators. Dr. Lee and Jones-Lee developed the project 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>

That report presents a synthesis of the results of the four-year effort and represented the findings of about \$3 million of studies. Data collected in that study included TOC and DOC in the SJR and several tributaries.

They have developed a series of papers and reports on these studies that are available on their website, [www.gfredlee.com](http://www.gfredlee.com) in the Watershed Studies San Joaquin River Watershed subsection.

During 2003 under contract with support from the US EPA and the SWRCB/CVRWQCB through the CSU Fresno Water Research Institute, Drs. Lee and Jones-Lee develop two major reports on issues pertinent to controlling nonpoint source pollution. Those reports addressed developing a non-point source water quality monitoring program that included information on TOC/DOC:

Lee, G. F. and Jones-Lee, A., “Issues in Developing a Water Quality Monitoring Program for Evaluation of the Water Quality - Beneficial Use Impacts of Stormwater Runoff and Irrigation Water Discharges from Irrigated Agriculture in the Central Valley, CA,” California Water Institute Report TP 02-07 to the California Water Resources Control Board/ Central Valley Regional Water Quality Control Board, 157 pp, California State University Fresno, Fresno, CA, December (2002).  
<http://www.gfredlee.com/Agwaivermonitoring-dec.pdf>

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).  
[http://www.gfredlee.com/BMP\\_Rpt.pdf](http://www.gfredlee.com/BMP_Rpt.pdf)

The latter report specifically addressed what is known about agricultural runoff of TOC and BMPs for its control. As discussed at this time there is essentially no information on this issue in the Central Valley or nationally.

Drs. Lee and Jones-Lee introduced into CALFED and the CVRWQCB the issue of refractory and labile TOC. They developed the report,

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](http://www.gfredlee.com/TOC_update.pdf)

During the past year Dr. Lee and Jones-Lee developed a comprehensive review of Delta water quality issues which has been published as,

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>

That review includes information on Delta TOC issues.

Several months ago Dr. Lee attended a CBDA Independent Science Board meeting at which the CBDA Science USGS team made a presentation of their work on DOC. Dr. Lee and others who have been familiar with TOC issues in the Delta concluded that little progress has been made by CALFED Science in understanding the TOC issues in the Delta and its tributaries from what was known in the early 1990s.

Since the 1960s Dr. Lee has been involved in developing information on the impact of land use in a domestic water supply's watershed on raw water quality. In the late 1970s/early 1980s, he served as chair of the American Water Works Association national committee for Quality Control in Reservoirs. The focus of his domestic water supply watershed work has been the development of nutrient export coefficients that relate land use within a watershed to the N and P in the runoff from those lands (mass/unit area/time). In the 1970s as part of the US OECD Eutrophication program and under contract with the US EPA, Dr. Lee and his associates developed national nutrient export coefficients based on data from about 100 watersheds. Those export coefficients can be used to predict how changes in land use in a domestic water supply watershed impact raw water quality. An example of how they can be used was provided in:

Archibald, E. M. and Lee, G. F., "Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas," J. Am. Water Works Assoc. 73:590-599 (1981).

Dr. Lee has recommended in references cited above the need to develop TOC/DOC export coefficients for runoff from various types of land use in rural and urban areas. This information can become the basis for developing programs for evaluation and control of TOC/DOC in rural and urban runoff.

If there are questions or comments on any of these publications please contact me.

G. Fred Lee