Stormwater Runoff Water Quality Science/Engineering Newsletter Devoted to Urban/Rural Stormwater Runoff Water Quality Management Issues

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Volume 6 Number 4
March 24, 2003

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This issue of the Newsletter is devoted to an overview of the problems of controlling the **excessive bioaccumulation of legacy pesticides (such as DDT, dieldrin, chlordane, toxaphene, etc.), PCBs and dioxins/furans (OCls) in fish** and other aquatic life to a sufficient extent to be a threat to the health of those who eat these organisms. Organochlorines (OCls) are of concern since they are regulated as carcinogens and, therefore, are a threat to cause cancer in those who consume fish with excessive concentrations of the chemicals over extended periods.

These pesticides are called "legacy" pesticides since their legal use in the USA has been banned for, in some cases, over 20 years. However, these organochlorine compounds are extremely persistent in the environment and tend to have high octanol water partition coefficients, which causes them to strongly sorb to soil and sediment particles and to be taken up by aquatic life, especially those with a high lipid content. This group of chemicals is herein referred to as the organochlorines (OCls). While the sources of the legacy pesticides are typically agriculture, this is also a problem in some urban areas where these chemicals have been used on residential and commercial properties.

The author became involved in this issue through his work on a project originated by the Central Valley Regional Water Quality Control Board, in which he was asked to develop guidance that could be used to develop a TMDL to control the excessive bioaccumulation of OCls in Central Valley, California, waterbodies. There are 11 waterbodies in the Central Valley where one or more types of fish contain excessive OCls compared to human health (US EPA and California Office of Environmental Health Hazard Assessment – OEHHA) guideline values.

This Newsletter contains the Executive Summary from a report developed by Lee and Jones-Lee (2002). As discussed in the report and its Executive Summary, it is not possible to develop a TMDL at this time, since there are several information gaps that must be filled before the technical base of information is available that would enable formulation of a program to control excessive bioaccumulation of OCls in Central Valley waterbody fish. While the focus of this Newsletter is Central Valley, California, the issues discussed are applicable to other parts of the USA where widespread use of these compounds has occurred.

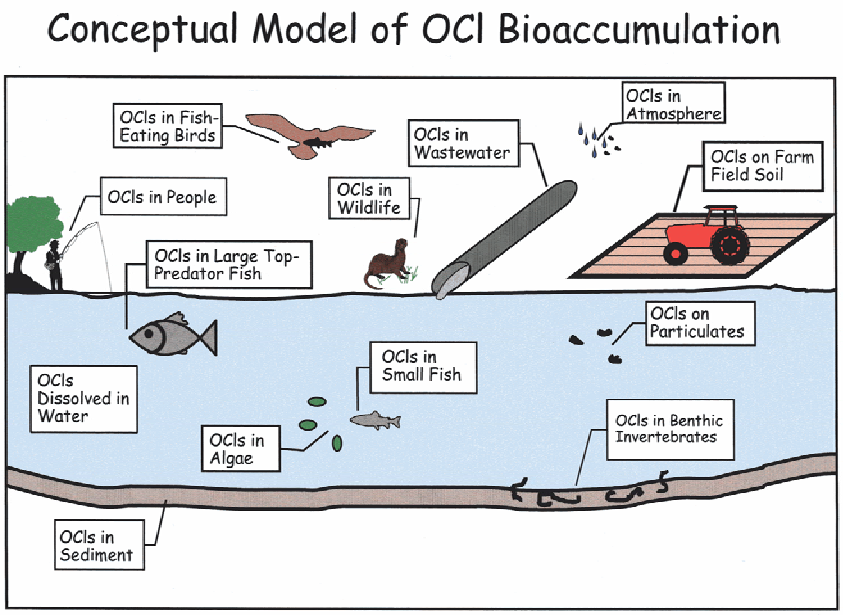
References

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

CALIFORNIA WATER INSTITUTE

Report TP 02-06

Organochlorine Pesticide, PCB and Dioxin/Furan Excessive Bioaccumulation Management Guidance



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December 2002

This publication is a technical report by staff of the California Water Institute to the California State Water Resources Control Board and the Regional Water Quality Control Board, Central Valley Region. No policy or regulation is either expressed or intended.

Disclosure Statement

Funding for this project has been provided in part by the U.S. Environmental Protection Agency (US EPA) pursuant to Assistance Agreement No. C9-989268-99-0 and any amendments thereto which has been awarded to the State Water Resources Control Board (SWRCB) for the implementation of California's Nonpoint Source Pollution Control Program. The contents of this document do not necessarily reflect the views and policies of the US EPA or the SWRCB, nor does mention of trade names or commercial products constitute endorsement or recommendation for use. State funding was used for the Total Maximum Daily Load (TMDL)-related report prepared pursuant to this project (SWRCB Agreement #00-219-150-0).

This project was conducted by Drs. G. Fred Lee and Anne Jones-Lee as employees of the California Water Institute, California State University, Fresno. In addition to the support provided to this project by the California Water Institute and the Central Valley Regional Water Quality Control Board, it was supported by G. Fred Lee & Associates, El Macero, California.

Acknowledgment

We wish to acknowledge the assistance provided in developing this report by Les Grober, Jerrold Bruns, Lori Webber and Kelly Briggs of the Central Valley Regional Water Quality Control Board staff; Dr. Val Connor, formerly with the Central Valley Regional Water Quality Control Board now with the State Water Resources Control Board; and William Jennings (the DeltaKeeper). We also wish to acknowledge the assistance of Mary McClanahan of the California Water Institute, California State University, Fresno.

California Water Institute
California State University, Fresno

The California Water Institute was started with seed money provided by the Proposition 13 Water Bond Measure, approved by voters in 2000. The Institute is housed at the California State University, Fresno.

The goal of the Institute is to provide a place where agricultural, urban, and environmental interests can be brought together in an unbiased, open, collaborative process to develop a shared vision of how to best utilize our water resources. It is the stated purpose of the Institute to work on collaborative solutions to pressing water issues facing the State. The staff of the Institute includes economists, chemists, crop water usage specialists, resource specialists, and environmental engineers. In addition, faculty at the California State University, Fresno, collaborate with the Institute in important research efforts.

Executive Summary

There are 11 waterbodies in the Central Valley of CA that have been found to contain excessive concentrations of Group A pesticides, DDT, PCBs and/or dioxins/furans. These include the Delta Waterways (DDT, Group A Pesticides), Lower American River (Group A Pesticides), Colusa Basin Drain (Group A Pesticides), Lower Feather River (Group A Pesticides), Lower Merced River (Group A Pesticides), Natomas East Main Drain (PCBs), San Joaquin River (DDT, Group A Pesticides), Lower Stanislaus River (Group A Pesticides), Stockton Deep Water Ship Channel (Dioxins, Furans, PCBs), Lower Tuolumne River (Group A Pesticides), and Lower Kings River (Toxaphene). These waterbodies are referred to in this report as "Waterbodies." The Group A pesticides include aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexane (including lindane), endosulfan, and toxaphene. In addition, there is concern about excessive bioaccumulation of DDT, polychlorinated biphenyls (PCBs), and dioxins/furans. These pesticides, PCBs and dioxins are referred to herein as "OCls."

Some fish taken from the Waterbodies of concern in this OCl bioaccumulation management guidance report have been found to contain sufficient concentrations of one or more Group A pesticides, DDT, PCBs, and/or dioxins/furans to be a threat to cause cancer in those who use these fish as food. The beneficial uses of these Waterbodies include freshwater habitat. The excessive bioaccumulation of the OCls in edible fish impairs this use. It may also be adverse to aquatic life and waterbody-associated terrestrial life resources.

Each of the Waterbodies of concern in this OCl excessive bioaccumulation management guidance report has received in the past (and may receive, to some extent, today) sufficient concentrations of one or more OCls to lead to concentrations of these chemicals in some of the Waterbodies' fish to be above the California Office of Environmental Health Hazard Assessment (OEHHA) guidelines for the use of the fish as food. The former use of one or more of the OCls (except dioxins/furans) in each of the Waterbodies' watersheds for agricultural and/or urban purposes has led to stormwater runoff transport and, in some instances, wastewater discharges of the OCl(s) to a sufficient extent to lead to bioaccumulation to excessive levels in some of the Waterbodies' receiving the runoff/discharges edible fish. With respect to dioxins and furans, they may have been discharged to the Waterbody or its tributary from former municipal and/or industrial wastewater discharges as well as in stormwater runoff from highways and streets and/or runoff/discharges from areas where low-temperature burning has taken place. They may also have been contaminants in the herbicide 2,4,5-T and could be derived from areas where this herbicide has been used.

The Waterbodies are listed on the federal Clean Water Act's 303(d) list as "impaired" for Group A pesticides, DDT, PCBs, and/or dioxins/furans. The impairment extends throughout the Waterbody and possibly into its tributaries. The 303(d) listing requires development of a Total Maximum Daily Load (TMDL) for the OCl(s) of concern for the listed Waterbodies. The information provided in this OCl management guidance report is designed to be of assistance in developing a TMDL to control excessive OCl bioaccumulation in Central Valley Waterbody fish and other aquatic life.

Each of the Waterbodies' watersheds has its own characteristics and specific sources of the OCls of concern. At this time, specific information on the former activities in each Waterbody's watershed that contributed OCls that have bioaccumulated to excessive levels in fish in the Waterbody is not available. While there are residues of these OCls in soils and possibly waste deposits within the Waterbodies' watersheds that are now continuing to contribute the OCl(s) of concern for that Waterbody to the Waterbody, the most likely current source of the OCl residues in edible fish is the Waterbody's sediments. Aquatic sediments are known to be major "sinks" (storage reservoirs) for the OCls that can, under some conditions, be a source of OCls through the food web for higher-trophic-level organisms that are used as human food. While the focus of this report is to control excessive bioaccumulation of OCls that are a threat to the use of certain fish as food, there is also concern about the potential impacts of OCl residues on higher-trophic-level aquatic organisms and terrestrial organisms, including birds, which acquire OCls through the consumption of aquatic life.

There have been no studies which provide information on the amounts of the OCls contributed to each of the listed Waterbodies from its watershed that are now causing excessive bioaccumulation of one or more of the OCls in the Waterbodies' edible fish. Also, there have been limited studies of the current OCl residues in some of the Waterbodies' sediments which could be serving as a reservoir for excessive bioaccumulation in edible fish. Basically, the situation is one of finding excessive levels of one or more OCls in a Waterbody's edible fish which can likely be attributed to the former use of these chemicals in the Waterbody's watershed. Since many of the Group A pesticides, DDT and PCBs have not been legally used in the Waterbody's watershed for at least one, and for some chemicals, several decades, it is possible that there are no external (to the Waterbody) sources that are significantly contributing to the current Waterbody's sediment reservoir of the OCls that are leading to excessive bioaccumulation in fish. However, as discussed herein, there are areas within the Central Valley where there is sufficient transport of OCls from agricultural lands to be a potentially significant source of OCls leading to their excessive bioaccumulation in downstream waterbody fish. There is also potential for domestic wastewaters to be a current source of OCls that are leading to excessive bioaccumulation of the OCls in receiving-water fish.

There are a variety of factors that influence how OCls in water, soils, or sediments are transported in a waterbody's watershed to a waterbody, and that control the bioaccumulation of the OCl residues in edible fish. One of the more important factors is the total organic carbon of the sediments. Sediments with higher organic carbon tend to reduce the bioavailability of sediment-associated OCls.

Bioaccumulation of OCls in fish depends on the size (length), age, type and lipid content of the fish. The OCl monitoring of fish tissue that has been conducted in the Central Valley since the late 1970s has not provided a sufficient database to critically examine the factors that can influence the OCl tissue residues in Central Valley fish. Future monitoring needs to include assessment of the OCl residues in various types of fish that are used as human food.

There are several management goals that can be used for controlling excessive OCl bioaccumulation, the most important of which are the OEHHA screening values (Table 4) for determining excessive edible fish tissue concentrations for each of the OCls of concern in this

guidance. Also, the California Toxics Rule criteria (Table 2) and the US EPA and OEHHA drinking water MCLs (Table 3) are appropriate management goals to control excessive concentrations of OCls in waterbodies.

In developing a management goal for the OCls, it is suggested that the US EPA recommended approach of using the management goal as the allowable loading capacity (concentration) for the Waterbody be used. This approach focuses on achieving an acceptable edible fish tissue OCl residue concentration. Ultimately, it will be necessary to develop a site-specific biota sediment accumulation factor for each listed Waterbody and each OCl of concern for that Waterbody in order to relate current sediment sources of the chemical leading to excessive bioaccumulation to current OCl tissue residues. This approach can ultimately lead to defining the degree of sediment remediation and current watershed source control needed to eliminate the excessive bioaccumulation of the OCl in a particular Waterbody.

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AWRA Specialty Conference Agricultural Hydrology and Water Quality

The American Water Resources Association will hold a 2003 Spring Specialty Conference devoted to "Agricultural Hydrology and Water Quality" in Kansas City, MO, May 12-14, 2003. This conference will contain several papers that are pertinent to rural stormwater runoff water quality management issues. The conference will consist of 125 oral presentations and 68 poster presentations on the following topics:

- Nutrients Standards and Manure Management, TMDLs, and Water Quality Issues
- CAFOs and Microbial and Antibiotics in Water
- CAFOs and Manure Management/Water Quality Research
- CAFOs and Lagoon Seepage Research
- Pesticide Fate, Transport and Water Pollution
- BMPs for Water Quality Mitigation/Water Resource Protection
- Riparian Buffers and Water Quality
- Policy Issues Related to Water Quality Management
- SWAT and HSPF Modeling Applications

Information on this conference is available www.awra.org.

Drs. G. F. Lee and Anne Jones-Lee will present a paper, "Developing Central Valley, California, Agricultural Runoff/Discharges Water Quality Monitoring Programs," at this conference. A preprint of this paper is available from
http://www.gfredlee.com/AWRA_KC_Pap-Lee-web.pdf
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