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

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This issue of the Stormwater Runoff Water Quality Newsletter is devoted to a review

- an OEHHA report on **PBDEs** as environmental pollutants,
- Proceedings of US EPA 2005 National Fish Forum on Contaminants in Fish,
- US EPA report on **higher density development and water quality** protection,
- US EPA meeting on "**Designated Uses and Use Attainability Analyses,"** and
- a discussion of the importance of assessing the **water quality impact of pesticides** based on biological responses.

A discussion of each of these areas is presented herein.

US EPA Releases New Report on Density and Water Resources

The US EPA has released a new report entitled, *"Protecting Water Resources with Higher-Density Development for water quality professionals, communities, local governments, and state and regional planners who are grappling with protecting or enhancing their water resources while accommodating growing populations."*

According to that report, *"The US Census Bureau projects that the U.S. population will grow by 50 million people, or approximately 18 percent, between 2000 and 2020. Many communities are asking where and how they can accommodate this growth while maintaining and improving their water resources. Some communities have interpreted water-quality research to mean that low-density development will best protect water resources. However, some water-quality experts argue that this strategy can backfire and actually harm water resources. Higher-density development, they believe, may be a better way to protect water resources. This report helps guide communities through this debate to better understand the impacts of high- and low-density development on water resources."*

That report is available for downloading at www.epa.gov/smartgrowth/water_density.htm. For hard copies, please send an e-mail to ncepimal@one.net or call (800) 490-9198 and request EPA publication 231-R-06-001. Further information on this report is available from Lynn Richards USEPA--Office of Policy, Economics, and Innovation Smart Growth Program 1200 Pennsylvania Ave., NW [MC 1807T]; Washington, DC 20460 T: 202-566-2858; F: 202-566-2868; E: richards.lynn@epa.gov.

PBDEs as Potential Stormwater Pollutants

Newsletter NL-7-3 presented a discussion of unrecognized environmental pollutants. One of the types of chemicals mentioned was the polybrominated diphenyl ethers (PBDEs). Recently, the California Office of Environmental Health Hazard Assessment (OEHHA): News and Information Listserv announced the availability of a report, *"Polybrominated Diphenyl Ethers: Recommendations To Reduce Exposure in California" Report of the Cal/EPA PBDE Workgroup*

California Environmental Protection Agency Sacramento, California February (2006). The executive summary from that report is presented below.

Executive Summary

"The manufacture, distribution and processing of products containing pentabrominated diphenyl ether (pentaBDE) and octabrominated diphenyl ether (octaBDE) flame retardants will be prohibited in California as of June 1, 2006 (California Health and Safety Code Sections 108920 et seq.); only products manufactured after June 1, 2006, are subject to the prohibition. This prohibition was prompted by findings that exposures to polybrominated diphenyl ethers (PBDEs) are widespread, and may pose health risks. However, the manufacture, distribution and processing of products containing the most commonly used PBDE mixture, decabrominated diphenyl ether (decaBDE), has not been prohibited. PentaBDEs and octaBDEs are ubiquitous and Californians will continue to be exposed to them after June 1, 2006. On May 27, 2005 the California Environmental Protection Agency (Cal/EPA) Secretary directed the formation of a workgroup of representatives from Cal/EPA Boards, Departments and Office (BDO) to consider the nature and extent of the PBDE problem and to recommend actions Cal/EPA could take to mitigate exposures to reduce risks of potential PBDE health effects. The California Department of Health Services (DHS) also contributed expertise and provided representatives to the Cal/EPA PBDE Workgroup. This report was prepared in response to the Cal/EPA Secretary's directive.

The principal focus of this report is to address continuing exposures of Californians to PBDEs after June 1, 2006. The report provides information on PBDEs and briefly summarizes past and ongoing Cal/EPA BDO and DHS activities related to PBDEs. Based on this preliminary evaluation, the Cal/EPA PBDE Workgroup proposes specific steps to be taken by Cal/EPA BDOs and DHS to reduce PBDE exposures. PBDEs have been widely used as flame retardants in home and office building materials, motor vehicles, electronics, furnishings, textiles, high-temperature plastics and polyurethane foams. The general public is exposed to PBDEs through the use of consumer products in homes, offices, cars and schools.

Exposures to PBDEs in some occupational settings, e.g., in computer recycling facilities, can be much higher than those of the general public. As consumer products are used and after they are discarded, PBDEs are released into the environment where they can bioaccumulate in wildlife and food animals. PBDEs have been measured in house and office dust, indoor air, plant and animal-based foods, terrestrial and marine animals, and in human breast milk, blood and fat.

The levels of PBDEs measured in humans in the US and Canada are typically at least 10 times higher than those in Europe, and appear to be doubling every few years. Cal/EPA scientists have reported the highest tissue concentrations of PBDEs measured in the world in California wildlife (shorebird eggs and fish), and rapid accumulation of PBDEs in the tissues of San Francisco Bay harbor seals.

PBDEs have structural similarities to polybrominated and polychlorinated biphenyls (PBBs and PCBs), and to certain other persistent polyhalogenated organic pollutants. In the limited toxicity testing to date, PBDEs have produced some of the toxic effects and physiologic changes typical of many persistent polyhalogenated organic pollutants, in particular the PBBs and PCBs. These effects include developmental and nervous system toxicity, as well as mimicry of estrogen and interference with the activity of thyroid hormone. These effects are observed in experiments with octaBDE and pentaBDE. DecaBDE has been shown in one study in mice to cause similar toxic effects on the developing nervous system as pentaBDE. Although PBBs and PCBs are both carcinogenic, neither pentaBDEs nor octaBDEs have been tested for carcinogenicity. DecaBDE is not affected by the recent legislation and its use and release into the environment will continue unabated. Direct exposure to decaBDE appears to pose lower human health risks than those of the other PBDEs, due to its lower toxicity, absorption, and generally lower environmental concentrations. Still, decaBDE is the predominant PBDE measured in

house and office dust, and the risk from such exposures requires further evaluation. Also, levels of decaBDE found in sewage sludge suggest that decaBDE from the indoor environment is released through municipal sewage systems into the environment. Use of decaBDE may result in human exposure to lower brominated PBDEs of greater toxicological concern, such as the pentaBDEs and octaBDEs. Recent studies indicate that decaBDE breaks down by the actions of sunlight, heat, and bacteria to these and other PBDEs that contain fewer bromine atoms. Such compounds are also formed through metabolism in certain animals consumed by humans (i.e., fish and chicken). These lower brominated PBDE congeners can undergo further debromination. In addition, during combustion of plastics containing decaBDE and other PBDEs (e.g., incineration), brominated dioxins and related compounds may form. After June 1, 2006, exposures in California to pentaBDEs and octaBDEs that result from new products should decrease. Nevertheless, exposures due to building materials, furnishings, and consumer products produced before June 1, 2006, containing pentaBDE and octaBDE flame retardants will continue for years to come. These releases will result in ongoing exposure to and increased bioaccumulation of the prohibited PBDEs by humans and wildlife. The workgroup has made numerous recommendations to reduce the continuing exposures to PBDEs, including pentaBDEs, octaBDEs, and decaBDEs. The main recommendations are given in the table below.

Outreach and Education

- *Educate key governmental officials and the public about the PBDE prohibition and hazards to encourage compliance with the prohibition and exposure reduction behavior. This would include development of educational materials such as fact sheets.*

Pollution Prevention

- *Encourage the purchase of PBDE-free products.*

Measurement and Monitoring*2*

- *Conduct human biomonitoring to evaluate the effectiveness of the pentaBDE and octaBDE prohibition and other PBDE reduction efforts.*
- *Conduct environmental monitoring to identify sources, pathways and trends in PBDE levels, and to characterize the environmental fate of decaBDE.*

Regulatory Initiatives

- *Develop health guidance levels (e.g., reference exposure levels) for PBDEs to aid in establishing acceptable environmental levels.*
- *Assess the need for further regulation, such as the development of hazardous waste criteria and management and disposal requirements and practices for PBDE contaminated waste, an Airborne Toxic Control Measure, the addition of PBDEs to the Air Toxics "Hot Spots" list, and the need to limit the use of decaBDE.*

Recommendations include near-term actions intended to reduce PBDE exposures through outreach and education, and voluntary pollution prevention. Longer-term recommendations include further environmental monitoring of PBDE levels to increase the scientific base for decision-making, and consideration of specific regulatory actions. All of the Workgroup's recommendations for Cal/EPA action are summarized on page 32. For each recommended action the estimated timeframe for implementation and the responsible BDOs are indicated. In recommending these specific steps for Cal/EPA to reduce PBDE exposures and health risks, the Workgroup explicitly did not address the availability of state resources for their implementation. The majority of these recommendations cannot be acted upon without the provision of additional resources. This requirement for additional resources needs to be addressed as Cal/EPA evaluates and chooses recommendations to implement.

1. Subject to available funding.

2. DTSC will provide guidance to other Cal/EPA BDOs for the sampling and chemical analyses of PBDEs in environmental matrices."

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From the information available on use of PBDEs and the widespread contamination of aquatic life with PBDEs, it is possible that stormwater runoff from some areas will contain PBDEs that contribute to the body burden of these chemicals in aquatic life and humans. There is need to add PBDEs to the list of potential pollutants that are monitored in domestic wastewaters and stormwater runoff from industrial/urban areas in order to determine if those sources are contributing PBDEs to area waterbodies.

2005 National Forum on Contaminants in Fish

One of the most significant impairments of the beneficial uses of waterbodies is the bioaccumulation of chemicals that are a threat to the health of those who use the aquatic life as a source of food. The US EPA has held a series of meetings that reviewed the current information on this issue. The US EPA held the 2005 National Forum on Contaminants in Fish in mid-September 2005. The presentations made at that meeting have been posted at, http://www.epa.gov/ostwater/fish/forum/2005/ and are listed below.

National Mercury Advisory - Jim Pendergast, US EPA
State/Regional Cooperation Projects
Atlantic Coast Striped Bass & Bluefish PCB Advisory - Eric Frohmberg, Maine Bureau of Health
Great Lakes Mercury Protocol - Pat McCann, Minnesota Department of Health
Upper Mississippi (UMBRA) Mercury Advisories - John Olson, Iowa Department of Natural Resc
Mercury Advisory for King Mackerel in the Gulf of Mexico - Joseph Sekerke, Florida Department Health
Advisories in Shared Waters – Two States Achieve Consistent Advice - Gary Buchanan, New Jers Department of Environmental Protection
Coordination Between State and Tribal Nations
Akwesasne Mohawk Fish Advisory Communication - Tony David, St. Regis Mohawk Tribe, Environment Division
State-Tribal Risk Assessment Methods for Mercury Advisory - Jerry BigEagle, Cheyenne River Si Tribe Environmental Protection Department
EPA Advisory Program Update - Denise Keehner, US EPA
FDA Advisory Program Update - Donald Kraemer, U. S. Food and Drug Administration
Sampling and Analysis Issues
Key Considerations in Fish Tissue Sampling Design - Lyle Cowles, US EPA Region 7 So How Many Fish DO We Need? Protocol for Calculating Sample Size for Developing Fish Consumption Advice - Jim VanDerslice, Washington Department of Health
U. S. Food and Drug Administration Total Diet Study - Katie Egan, U. S. Food and Drug Administration
Analysis of Chemical Contaminant Levels in Store-Bought Fish from Washington State - David McBride, Washington State Department of Health
Commercial Fish Distributor Self-Testing Program for Mercury and PCBs - Henry Lovejoy, Seafood Safe, LLC; John Cosgrove, Axys Analytical Services; Colin Davies, Books Rand
Fish Hatcheries: Contaminant Concentrations in Fish Feed and Fish - George Noguchi, Linda Andreasen, and Dave De Vault, U. S. Fish and Wildlife Service
Variability of Mercury Concentrations in Fish with Season and Fish Body Condition - Paul Cocca, US EPA

Evaluation of Performance of the Wente Model as Used in the Clean Air Mercury Rule - Janet Cakir, US EPA
Mapping Vulnerability of Aquatic Ecosystems to Mercury Inputs Across the Contiguous United States - David Krabbenhoft, U.S. Geological Survey (At the author's request this presentation will not be made available online.)
Projected Mercury Concentrations in Freshwater Fish Tissue and Changes in Exposure Resulting from the Clean Air Mercury Rule - Lisa Conner, US EPA

Toxicology

Fish Consumption and Mercury Exposure Assessment - Lynda Knobeloch, Wisconsin Department of Health and Family Services
Physiological and Environmental Importance of Mercury-Selenium Interactions - Nick Ralston, Energy and Environmental Research Center
Update on Mercury Issues and the NHANES Study (Regional Comparisons) - Kate Mahaffey, US EPA
A Fresh Look at the Uncertainty Factor Adjustment in the Methylmercury RfD – Presentation and Open Discussion - Alan Stern, New Jersey Department of Environmental Protection
Review of Cardiovascular Health Effects of Mercury - Eric Rimm, Harvard School of Public Health
Review of Cardiovascular Health Effects of Mercury – European Data - Eliseo Guallar, Johns Hopkins Bloomberg
Developmental Toxicity of PFOS and PFOA - Christopher Lau, US EPA
Overview of National Toxicology Program Studies of Interactions Between Individual PCB Congeners - Nigel Walker, National Institutes of Health
Establishing PCB Fish Advisories: Consideration of the Evolving Science - John D. Schell, BBL Sciences
Historical Basis of the Mercury Action Level and PCB Tolerance Level - P. Michael Bolger, U. S. Food and Drug Administration
Update on EPA's New Cancer Guidelines - Rita Schoeny, US EPA

Eating Fish: Risks, Benefits and Management

Omega-3 Fatty Acids: The Basics - William Harris, University of Missouri-Kansas City

Health Benefits of Fish Consumption

Adult Health Benefits of Fish Consumption - Eric Rimm, Harvard School of Public Health
DHA and Infant Development - Susan Carlson, University of Kansas
Review of Neurodevelopmental Health Benefits of Fish Consumption - Rita Schoeny, US EPA
Fish Consumption and Reproductive and Developmental Outcomes - Julie Daniels, University of North Carolina at Chapel Hill

Balancing Risks and Benefits

Nutrient Relationships in Seafood: Selections to Balance Benefits and Risks - Ann Yaktine, The National Academies, Institute of Medicine
Maternal Fish Consumption, Hair Mercury, and Infant Cognition in a U. S. Cohort - Emily Oken, Harvard Medical School

Toxicology (continued)

PBDE Exposure and Accumulation in Fish: The Impact of Biotransformation - Heather Stapleton, Duke University
PBDEs: Toxicology - Linda Birnbaum, US EPA

State and Tribal Approaches to Risk Management
"Eating Fish for Good Health": A Brochure Balancing Risks and Benefits - Eric Frohmberg, Maine Bureau of Health
The Use of Human Biomonitoring as a Risk Management Tool for Deriving Fish Consumption Advice - Scott Arnold, Alaska Division of Public Health (At the author's request this presentation will not be made available online.)
A Comprehensive Risk Framework Presented to the Mohawks of Akwesasne - Tony David, St. Regis Mohawk Tribe,
Communicating the Nutritional Benefits and Risks of Fish Consumption - Charles Santerre, Purdue University
Risk Communication Strategies and Impacts
Implementation of the FDA/EPA Joint Advisory - David Acheson, Food and Drug Administration
Risk Communication: Lessons Learned on Message Development and Dissemination - Joanna Burger, Rutgers University
Communicating to Populations: Issues and Answers
Maine's Survey of Moms – Risk Communication Evaluation - Eric Frohmberg, Maine Bureau of Health
Marketing and Labeling Contaminant Tested Fish - Henry Lovejoy, Seafood Safe, LLC; Barbara Knuth, Cornell University, Department of Natural Resources
Risk Communication Efforts Directed at Baltimore Harbor Fishermen - Joseph Beaman, Maryland Department of the Environment
Fish Consumption Patterns and Advisory Awareness Among Baltimore Anglers - Karen Hockett, Virginia Tech, Conservation Management Institute
Choosing Safer Ogaa: Great Lakes Indian Fish and Wildlife Commission Risk Communication Program - Barbara Knuth, Cornell University, Department of Natural Resources (At the author's request this presentation will not be made available online.)
Great Lakes Health Advisory Advice Related to Nutritional Concerns - Judy Sheeshka, University of Guelph, Family Relations and Applied Nutrition
The Presentation of Fish in Everyday Life: Seeing Culture through Signs in the Upper Peninsula of Michigan - Melanie Barbier, Michigan State University
Novel Ways to Communicate
Promoting Fish Advisories on the Web: WebMD Case Study - Susan Robinson, Centers for Disease Control
Marketing and Labeling Contaminant Tested Fish - Henry Lovejoy, Seafood Safe, LLC; Barbara Knuth, Cornell University, Department of Natural Resources

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Designated Uses and Use Attainability Analyses
A key component of the water pollution control program of the US EPA is the designation of the beneficial uses of waterbodies. For most waterbodies, this designation was established in the 1970s. Today, with the implementation of the TMDLs to achieve water quality standards for a particular designated beneficial use, for some waterbodies there are questions about whether the original designation was appropriate. In an effort to clarify this situation, the US Environmental Protection Agency (EPA) held a public meeting to discuss designated uses and use attainability analyses (Feb 8-9, 2006) in Chicago, IL. "*The primary goals of the meeting were to help educate*
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the public on current water quality standards regulations, guidance and practices related to designated uses and use attainability analyses, and to provide a forum for the public to join in discussions, ask questions, and provide feedback."

The Agenda for this meeting is at http://www.tetratech-ffx.com/stakeholders/agenda.htm. The session topics included,

> ***"CSOs, Designated Uses, and UAAs***
> *Addressing the impacts of CSOs to receiving waters is a long-term and costly challenge. In this session, we will discuss some of the CSO-related designated use issues stakeholders are facing, including the ability to meet recreational use designations at all times, the nature of pollutants and ability to treat pollutants associated with CSOs, and frequency and volume of discharges. We will also discuss various alternative solutions that may be available for addressing CSO-related designated use issues.*
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> ***What to Do When Designated Uses Are Not Met***
> *EPA is aware of the confusion surrounding designated uses. In this session, we will discuss some of the challenges stakeholders are currently dealing with, including determining whether the current designated use is the appropriate use for a waterbody, ways to change designated uses, and alternatives to changing designated uses.*
>
> ***CSOs, Designated Uses, and UAAs***
> *Addressing the impacts of CSOs to receiving waters is a long-term and costly challenge. In this session, we will discuss some of the CSO-related designated use issues stakeholders are facing, including the ability to meet recreational use designations at all times, the nature of pollutants and ability to treat pollutants associated with CSOs, and frequency and volume of discharges. We will also discuss various alternative solutions that may be available for addressing CSO-related designated use issues."*

It is anticipated that the presentations and a meeting summary will be posted by the US EPA.

For further information on this meeting contact Ms. Patricia Harrigan, Standards and Health Protection Division, MC 4305T, Environmental Protection Agency, 1200 Pennsylvania Ave., N.W., Washington, DC 20460; Telephone number: (202) 566-1666; Fax number: (202) 566-1054; e-mail address: harrigan.patricia@epa.gov.

The US EPA indicated that it anticipates announcing and holding one additional public meeting on these subjects in 2006. This meeting will likely be held in Seattle in the summer of 2006.

Evaluation of Pesticide Water Quality Impacts

Recently G. F. Lee was asked to evaluate the potential impacts of a pesticide that in a waterbody. In the water quality field, such assessments are made using chemical concentration-based and/or biological response (typically toxicity)-based approaches. A recent example of the importance of assessing aquatic life toxicity in evaluating the potential impacts of pesticides occurred in the report submitted by a consultant to the Sacramento/Yolo Mosquito and Vector Control District. There was concern about the use of a pesticide (natural pyrethrin) that was used in aerial spraying in an attempt to control mosquito populations that could carry the West Nile virus. The consultant focused the assessment of whether or not the pyrethrin that settled into the

waterbodies in the Sacramento/Yolo County area could be causing aquatic life toxicity by measuring the concentrations of pyrethrin in the waterbody. They compared those measured concentrations to LC50 concentrations for toxicity to aquatic life that had been reported in a US EPA database. They concluded that there was little likelihood that the concentrations found, which in some waterbodies exceeded the LC50 for certain forms of aquatic life, were not causing toxicity. However, there are a number of significant technical difficulties that can readily make such chemical concentration-based approaches unreliable.

One of the difficulties with this approach is that the aquatic chemistry of pyrethrin is such is that it tends to sorb (attach) to particulate matter, which can detoxify the pesticide. Since the analytical methods used measure total concentrations of the pesticide, they include nontoxic forms. In addition, it has been found that pyrethroid-type pesticides interact with dissolved organic carbon (DOC), which also detoxifies that portion of the pesticide that has interacted with DOC. These issues were reviewed by Gan et al. (2006). Both of these components of the aquatic chemistry of pyrethrin make the estimates of aquatic life toxicity based on chemical measurements of concentrations unreliably high.

Another component of the aquatic chemistry of pyrethrin is that that pesticide, in attaching to particulate matter, settles to the waterbody sediments, where it can cause toxicity to sediment-associated organisms. The work of D. Weston and his associates at UC Berkeley (Amweg et al. 2006) have demonstrated the importance of this component of pyrethroid-based pesticide toxicity. The toxicity in the sediments is a function of the total organic carbon (TOC) of the sediments. High TOC tends to detoxify the sediment-associated pesticide. The recent article by Raloff (2006) provides additional discussion of these issues.

The aerial spraying of pyrethrin in the Sacramento, CA area to control West Nile virus mosquito vectors included spraying piperonyl butoxide (PBO). PBO is a chemical that enhances the toxicity of pyrethrin and other pyrethroid pesticides. The consultant made a significant error in its approach for assessing the significance of PBO in affecting aquatic life toxicity by focusing on whether the PBO itself caused toxicity. Those knowledgeable in the toxicity of pyrethroids know that the issue is not the toxicity of PBO, but the impact of PBO in enhancing the toxicity of pyrethroid-based pesticides. This enhancement occurs at much lower concentrations than those that are toxic to aquatic life. Again, there is no method to chemically assess the impact of PBO on pyrethrin-based toxicity. It has to be done through measurement of aquatic life toxicity.

Overall, the chemical concentration-based approach can readily lead to inappropriate assessment of the impact of pesticides on aquatic life, since it can lead to an incorrect assessment of aquatic life toxicity. The errors can be positive or negative, depending on the situation. The approach that needs to be followed in regulating pesticides is to base the regulations on aquatic life toxicity assessment in the water column and sediments.

References

Amweg, E.; Weston, D. and Lydy, M., "Recent Studies on Pyrethroid Pesticides in the Sacramento River Watershed," Presentation to the Sacramento River Watershed Program Monitoring Subcommittee, January (2006).

Gan, J.; Yang, W.; Hunter, W.; Bondarenko, S. and Spurlock, F., "Bioavailability of Pyrethroids in Surface Aquatic Systems," Presented at Department of Pesticide Regulation, Sacramento, CA, October 11 (2005). http://www.cdpr.ca.gov/docs/sw/presentations.htm

Raloff, J., "A LITTLE LESS GREEN? Are Pyrethroid Insecticides Dangerous? Studies challenge the benign image of pyrethroid insecticides," *Science News* 169(5):74 (2006), as presented in Rachel's Democracy & Health News #841, February 9 (2006). www.rachel.org