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

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Volume 3 Number 6
October 11, 2000

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Contents of this Newsletter

Past Newsletters have discussed the various aspects of the aquatic life toxicity problem in urban area and some agricultural area stormwater runoff. Newsletter Vol. 3 No. 5 of last July, presented a preprint article summarizing issues pertinent to developing TMDLs to control **aquatic life toxicity in urban stormwater runoff** that is due to the OP pesticides diazinon and chlorpyrifos. This paper, **"Development of TMDL Goals for Control of Organophosphate Pesticide-Caused Aquatic Life Toxicity in Urban Stormwater Runoff**," will be presented at the Water Environment Federation national meeting that will be held in Anaheim, CA, from October 16 to 18, 2000. This Newsletter presents many of the text slides that will be used to present this paper at this meeting. These slides summarize many of the key issues that need to be considered in developing a technically valid cost-effective **TMDL for OP pesticide-caused aquatic life toxicity**. The key issue being addressed in the presentation of the paper is the development of an appropriate TMDL goal.

There is considerable controversy about what should be the TMDL goal for OP pesticide-caused aquatic life toxicity. As summarized in the slides presented below, none of the current proposed TMDL goals are appropriate for restricting the use of OP pesticides because of their adverse impacts on the beneficial uses of waterbodies. As currently proposed, they could underregulate as well as greatly overregulate appropriate use of OP pesticides. OP pesticides are useful products to the public. It is important to appropriately regulate the aquatic life toxicity caused by them so as to protect the beneficial uses of receiving waters for urban stormwater runoff without unnecessarily restricting their use. As discussed in the papers and summarized in the slides, several of the current OP pesticide TMDL toxicity goals, such as the California Department of Fish and Game water quality criteria, will effectively ban many of the current uses of diazinon. This ban will result in substitution of other pesticides that could readily cause the same, if not greater, problems.

A basic problem that needs to be addressed is that the US EPA Office of Pesticide Programs (OPP) registration of pesticides does not adequately evaluate the potential for the pesticide to cause aquatic life toxicity in urban and agricultural stormwater runoff. There is a vast arena of pesticides that are already registered that could be used as substitutes for the OP pesticides. Already, there is substantial shift away from the OP pesticides (diazinon and chlorpyrifos) to pyrethroid pesticides by both commercial pest control operators and the public. As summarized in the slides presented below, a number of the pyrethroid pesticides are as toxic to certain zooplankton as the OP pesticides. While there is general agreement that there is need to effectively screen the pesticides that substitute for the OP pesticides prior to substitution, there is no formal mechanism today to require a comprehensive evaluation of the substitute pesticides' potential to cause water quality problems prior to large-scale substitution.

It is important to understand that the recent US EPA action announcing the registrants' withdrawal of registration (see announcement below) eliminating the use of chlorpyrifos in urban areas will mean that the issue of chlorpyrifos-caused aquatic life toxicity in urban stormwater runoff will soon become a non-problem. The author and his colleagues' work in Orange County, California, have shown that in recent years over 100,000 lbs (ai) of chlorpyrifos are used each year on residential properties by commercial applicators and the public. Within a couple of years, as the chlorpyrifos phase-out is implemented, over 100,000 lbs of some other pesticide(s) will be used in place of chlorpyrifos. In recent years, about 25,000 lbs (ai) per year of diazinon have been used in Orange County by commercial applicators. It is estimated that at least an equal amount has been used by the public acquired through over the counter sales. It is of interest to find that about 25,000 lbs of pyrethroid pesticides have been used in Orange County by commercial applicators. There is, however, increasing use of these pesticides by the public as a substitute for the OP pesticides.

It is clear that the current regulatory approach for protecting the beneficial uses of surface waters from pesticide-caused aquatic life toxicity is significantly deficient. There is an urgent need for legislative action that would empower/require regulatory agencies to properly evaluate the water quality impacts of all pesticides that have a potential to be present in urban stormwater runoff as well as agricultural stormwater runoff and discharges. Without this type of evaluation, the public/ agricultural interests will be playing "pesticide roulette," substituting one pesticide that is potentially a problem for another, which may cause even greater environmental problems than the pesticide of concern.

As part of the work that Dr. G. Fred Lee has been doing for the Sacramento River Watershed Program, he has advocated that this program adopt a different approach for detecting/managing the water quality impacts of the large number of pesticides used in the Central Valley of California. He and Dr. Jones-Lee have developed a proactive approach for evaluating pesticide impacts to the beneficial uses of waterbodies. Presented below is the current version of this proactive pesticide water quality impact management approach. Drs. Lee and Jones-Lee's proactive approach is similar to that recently recommended by Kuivila (2000), where she recommends, "*Future monitoring studies should include a careful evaluation of which pesticides are, or are not, being analyzed.*"

Proactive Approach for Managing Pesticide-Caused Aquatic Life Toxicity

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Over the past half a dozen years, several groups in California have been studying the aquatic life toxicity that is present in stormwater runoff from urban and some agricultural areas that is attributable to the use of the organophosphate (OP) pesticides diazinon and chlorpyrifos. These pesticides are sufficiently mobile from their point of application so that they cause aquatic life toxicity to certain forms of zooplankton (*Ceriodaphnia dubia* and *Mysidopsis bahia*) in the receiving waters for the runoff from the area of application. This toxicity was originally discovered in urban stormwater runoff associated with monitoring runoff from urban areas in the San Francisco Bay region for

assessing the impacts of constituents such as heavy metals that are present in the runoff waters above water quality criteria/standards. It was also discovered in the early 1990s, through the work of Dr. Chris Foe of the Central Valley Regional Water Quality Control Board in investigating aquatic life toxicity in the San Joaquin River and its watershed. It was found through the use of TIEs that the heavy metals present in urban stormwater runoff were not in toxic forms; however, there was appreciable toxicity due to the OP pesticides diazinon and chlorpyrifos. In agricultural areas, the toxicity is associated with the use of these pesticides on agricultural crops in the Central Valley. The Sacramento River, Feather River, San Joaquin River, Delta, and Upper San Francisco Bay are toxic each winter/spring due to the use of diazinon as a dormant spray in orchards.

In recent years, in both urban and residential areas, increasing use of pyrethroid-type pesticides is being made as a substitute for the OP pesticides. According to Kuivila (2000), there are over 150 pesticides used in the Central Valley of California. Very few of these are being monitored for their potential impacts to aquatic organisms. Further, a critical review of how the US EPA Office of Pesticide Programs, as well as the California Department of Pesticide Regulation, reviews pesticides in connection with registering their use shows that this review falls far short of providing the information necessary to reliably evaluate whether the replacements for the OP pesticides (such as pyrethroids and other types of pesticides) will cause adverse impacts to the environment.

Basically, the situation today is one of where pesticides are registered for use without adequate evaluation for potential environmental impacts. Under the current passive approach, a somewhat superficial and certainly inadequate registration of pesticides occurs. It is only when substantial problems are found that there is restriction on the use of the pesticides. It is clear that there is need to significantly change from a passive to a proactive approach, in which pesticides that are in use today are evaluated by water quality management agencies for their impacts. It has been clear for some time that this evaluation cannot be done as part of pesticide registration, because of the tremendous pressure on registration agencies at the federal and state level, which effectively precludes requiring that pesticide registrants conduct an adequate evaluation of the potential for pesticides in urban area and, for that matter, agricultural stormwater runoff and agricultural field discharges to cause aquatic life toxicity in the receiving waters for the runoff.

In light of the current deficient regulatory approaches toward controlling aquatic life toxicity associated with pesticide use, there is need to conduct the necessary studies associated with use to determine whether there is aquatic life toxicity in runoff from areas where the pesticide is applied. The proactive approach toward evaluating whether pesticide use in a particular region is adverse to the beneficial uses of the receiving waters for stormwater runoff/drainage/discharges from areas where it is applied involves determining what, when and where pesticides are applied in the region. Associated with each application area should be a monitoring program of the receiving waters for the runoff from the application area. A combination of chemical and biological monitoring should be conducted immediately following, and then for some time after the application(s) occurs. This monitoring should use an event-based approach, in which the monitoring specifically targets stormwater runoff/discharge events when the pesticide is most likely to be present in the discharge. A combination of aquatic toxicity and aquatic organism assemblage information should be collected to assess potential biological impacts. The toxicity information should be not only at fixed locations

downstream of the runoff location, but also sampling should be done in the runoff plume matching the transport of the water receiving the pesticides from the point of application.

Studies of this type should be conducted for several years associated with the use of a particular pesticide on a particular crop at a particular location. Eventually, provided that the formulation of the pesticide and its application remain the same, the monitoring program for that particular pesticide use at the test application can be significantly curtailed. Further, as experience is gained with this proactive approach, it should be possible to greatly reduce the amount of monitoring/evaluation needed for pesticides for which there is an adequate information base to determine that their use does not pose a threat to the environment.

The funding of these types of studies should be provided by the pesticide manufacturers, where the costs are passed on to the users of the pesticides. Adoption of this proactive approach would significantly change the current after-the-fact definition of problems associated with pesticide use to detecting them when they first begin to be used. This approach should be considered part of the registration/re-registration process, where any registration would be provisional, subject to immediate revocation if it is found that the pesticides are adverse to non-target organisms associated with the stormwater runoff/discharges.

Best Professional Judgment/Weight of Evidence Triad for Evaluation of Significant Pesticide Impacts on the Beneficial Uses of Waterbodies

It is becoming increasingly clear and accepted among the professional community that a best professional judgment/weight of evidence triad approach is the appropriate approach to evaluate potentially significant water quality impacts associated with chemical constituents in the environment. The weight of evidence triad consists of:

- appropriately developed information on the toxicity/bioaccumulation of the constituents of concern to aquatic life or within aquatic organism tissue;
- information on the alteration of aquatic organism assemblages within the area of potential impact, relative to appropriate reference situations which are not impacted by the chemical(s) of concern; and
- appropriate chemical information on the concentrations and, in particular, chemical species present in the waters of concern associated with a stormwater runoff event discharge situation.

The toxicity and chemical concentration information should define the magnitude of toxicity and concentration as a function of time of exposure for organisms potentially impacted by the pesticide. A key component of the chemical information is toxicity identification evaluation studies to specifically determine the constituent(s) responsible for the toxicity. It should not be assumed that, because a constituent exists at elevated concentrations, it is in fact responsible for the toxicity. Incorporation of aqueous environmental chemistry information coupled with toxicity assessment can provide reliable assessments of the chemical species responsible for the toxicity.

Studies of pesticides focusing only on measuring chemical concentrations can provide highly misleading information on aquatic life toxicity and the impacts of the pesticides found on the beneficial uses of waterbodies. All pesticide water quality impact studies should include assessing total toxicity to a suite of types of organisms. Further, and most importantly, where toxicity is found a dilution

series should be conducted to determine the magnitude of the toxicity and whether, through TIEs, all of the toxicity can be accounted for based on known toxicants in the samples.

The weight of evidence triad information should be presented to a panel of experts who would first critically review the information provided for its adequacy and reliability, and then define what, if any, additional studies are needed to make a proper adverse impact evaluation. This panel should conduct its review in a full public interactive peer review arena, where the panel's deliberations would be open to the public for review and comment.

The typical peer review that occurs today of regulatory processes is often significantly deficient in providing a comprehensive, reliable assessment of issues that should be considered in evaluating the impact of a particular constituent(s) on the beneficial uses of waterbodies. The public interactive peer review process (Lee, 1999) that is recommended could, if properly implemented, significantly improve the quality and reliability of peer reviews of environmental issues.

The panel would present a preliminary assessment of its findings, with appropriate supporting information. Those who feel that the panel has not properly considered the information available would be provided the opportunity to comment on the panel's initial deliberations, providing any additional information that they feel is important. The panel then would issue a final determination, which would present their conclusions on the issue. Based on this information, the regulatory authorities would then determine whether the pesticide(s) or other constituents are significantly adverse to the beneficial uses of a waterbody.

The adoption of this best professional judgment/weight of evidence triad, interactively peer-reviewed approach would lead to far more technically valid assessments of adverse impacts of pesticides and other constituents on the beneficial uses of waterbodies. The funding for this type of review should be provided by the pesticide manufacturers, who would, in turn, pass this cost on to those who wish to use the pesticides.

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Development of TMDLs for Control of Organophosphate Pesticide-Caused Aquatic Life Toxicity in Urban Stormwater Runoff

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Anaheim, California - October 2000

Overview of Aquatic Life Toxicity in Urban Stormwater Runoff
- Lack of Heavy Metal Toxicity
- Organophosphate Pesticide-Caused Toxicity

Recommended Approach for Developing a TMDL to Control OP Pesticide-Caused Aquatic Life Toxicity

Urban-Area Stormwater Runoff Is Toxic to Certain Forms of Aquatic Life Due to OP Pesticides

Diazinon and Chlorpyrifos
- Used for Termite, Ant, Lawn & Garden Pest Control in Residential Areas

Typically 1 to 2 TUa of *Ceriodaphnia* Toxicity in Urban Stormwater Runoff

In Orange County, California, 10 to 20 TUa of *Ceriodaphnia* Toxicity
- Causes of Half of Toxicity in Orange County Stormwater Unknown

Toxicity Is Violation of the Narrative Water Quality Standard
- "No Toxics in Toxic Amounts"
- Results in 303(d) Listing and Requires TMDL Development to Control Toxicity

CA Department of Fish and Game (DFG) Diazinon and Chlorpyrifos Water Quality Criteria (2000)

	Acute (1-hr) CMC (ng/L)	Chronic (4-day) CCC (ng/L)	*Ceriodaphnia* LC_{50}
Diazinon	80	50	450
Chlorpyrifos	20	14	80

Toxicities Are Additive = $\sum \frac{DiazConc}{LC_{50}} + \frac{ChlopyrConc}{LC_{50}}$

Toxicities Decreased or Delayed by PBO (Piperonyl Butoxide)

More Than 100,000 lbs (ai) of OP Pesticides Used in Orange County by Commercial Applicators in 1998

At Least an Equivalent Amount Used by the Public

OP Pesticides Being Replaced by Pyrethroid Pesticides

- LC50s Are Less Than Those of OP Pesticides
- Less Mobile? Data?

Issues in Developing TMDLs for OP Pesticides

Water Quality Significance of OP Pesticide-Caused Aquatic Life Toxicity

- Short-Term Toxic Pulses Associated with Runoff Event
- Potentially Impact Limited Number of Types of Zooplankton
- Importance of "*Ceriodaphnia*-Like" Zooplankton to Beneficial Uses of Waterbody
- Are "*Ceriodaphnia*-Like" Organisms Essential-Key Components of Larval Fish Food?

What Will Be Substituted for OP Pesticides if Use Is Restricted?

Toxicity of Selected Pyrethroid Pesticides to *Daphnia magna* and *Mysidopsis bahia*

Pesticide	LC_{50} (ng/L)	
	Daphnia magna	*Mysidopsis bahia*
Permethrin	320	46
Cypermethrin	1,000	5
Fenvalerate	50	8
Bifenthrin	1,600	4
Tau Fluvalinate	400	18
Esfenvalerate	150	?

More Than 25,000 lbs (ai) of Pyrethroid Pesticides Used by Commercial Applicators in Orange County in 1998

- Does Not Include Public Use
- About 1,800 lbs of PBO Used in Orange County in 1998

Possible TMDL Goals

No Toxicity in Standard Toxicity Test

Numeric Water Quality Objectives
Department of Fish and Game Criteria

Ecological Risk Assessment Approach

Mesocosms – Large-Scale Field Studies

No Adverse Impact on Beneficial Uses of Receiving Waters

U.S. EPA Region 9, A. Strauss Letter

- CA Department of Fish and Game Criteria Acceptable as TMDL Goal
- Ecological Risk Assessment Approach Not Acceptable
  Could Be Tested in the Courts Based on US EPA OPP Pesticide Impact Regulations

Development of a TMDL for OP Pesticides

Initially Limit the Use of OP Pesticides for Lawn and Garden Purposes
Use Still Possible for Termite and Ant Control

Chlorpyrifos Is Being Banned from Residential Use by US EPA Based on Potential Threat to Children's Health

Other Pesticides Will Be Used

- Current US EPA Office of Pesticide Programs Does Not Require Adequate Screening of Pesticides for Stormwater Runoff Impacts
- No Fate Information Is Required

Evaluation of the Water Quality/Beneficial-Use Significance of Toxicity to *Ceriodaphnia* Caused by OP Pesticides in Stormwater Runoff

Use Best Professional Judgment Triad Weight-of-Evidence Approach

- **Toxicity**
  Areal Extent, Duration, and Magnitude
  What Types of Organisms Are Potentially Impacted?
  Additivity, Synergism, Antagonism
  At Location, and Downstream in the Pulse

- **Chemical Concentrations, Chemical Species Present**
  Fate/Persistence, Reactions, Dilution, TIEs
- **Organism Assemblages**
  Are the Numbers and Types of Desirable Organisms Adversely Impacted by Toxic Pulses of OP Pesticides?
  Consider Both Water Column and Sediments

Interactive Public Peer Review of Information by Expert Panel

Inadequacies of Current OP Pesticide TMDL Goals

DFG Criteria Overly Protective Unless Impacted Zooplankton and Benthic Organisms are Key Components of Higher Trophic Level Organisms' Food
Under-Protective — Do Not Consider Additivity of OP Pesticide-Caused Toxicity

Ecological Risk Assessment Under-Protective If There Are Organisms Impacted by OP Pesticide Toxicity That Are Important, Essential Components of the Food Web
Under-Protective — Do Not Consider Additivity of OP Pesticide-Caused Toxicity

Mesocosms Can Be Under-Protective Depending on the Physical, Chemical and Biological Characteristics of the Mesocosm

The Reliable OP Pesticide TMDL Goal Requires Site-Specific Evaluation of the Impacts on the Receiving Water Beneficial Uses

Conclusions and Recommendations

Use of Diazinon and Chlorpyrifos for Residential Pest Control Leads to Stormwater Runoff Toxicity to *Ceriodaphnia* and *Mysidopsis*

- Toxicity Violates *"No Toxics in Toxic Amounts"* Narrative Standard
- Leads to 303(d) Listing and TMDL Development

First Step in TMDL Development Should Be an Evaluation of the Water Quality Significance of the OP Pesticide-Caused Toxicity

- Requires Evaluation of the Magnitude and Duration of Toxicity in Receiving Waters
- Assessment of Whether Zooplankton Harmed by OP Pesticide Toxicity Are Essential Components of Higher-Trophic-Level Organisms' Food

Without this Information, Use DFG Criteria as TMDL Goal
Will Effectively Ban the Use of OP Pesticides for Non-Structural, above- Soil-Surface Applications

Must Develop Effective Method for Screening Substitute Pesticides for Adverse Impacts on Beneficial Uses of Stormwater Runoff Receiving Waters

Chlorpyrifos Registration Voluntary Cancellations Announced

In June 2000, the US EPA and the chlorpyrifos registrants announced that they had reached an agreement to voluntarily withdraw the registration of chlorpyrifos which could result in residential exposure of children to this pesticide. The final announcement on this action was recently published by the US EPA. A synopsis of this agreement developed by the US EPA is presented below.

"On September 20, 2000, US EPA announced receipt of requests by registrants to cancel registrations for chlorpyrifos intended for use to manufacture pesticide products. In addition, registrants are requesting US EPA to cancel or amend uses of certain pesticide products containing chlorpyrifos. These registration cancellations result from the memorandum of agreement signed by US EPA and certain registrants of chlorpyrifos products on June 7, 2000, and followup agreements with other registrants. This agreement was designed to reduce risks to children and others from exposure to chlorpyrifos from dietary and non-dietary sources. The Federal Register notice (65 FR 56886) lists the products being canceled and describes uses that are being eliminated or changed. US EPA must receive comments on this notice by October 20, 2000, identified by docket number OPP-34203D. The Federal Register notice is available at www.epa.gov/fedrgstr. In some cases, the manufacturing-use registrations are being replaced by new registrations allowing manufacture of products for chlorpyrifos uses that are not affected by the June 7 agreement. A future Federal Register notice will address revocation or modification of pesticide tolerances (maximum residue limits) brought about by the June 7 agreement."

The phase-out of the manufacture and sale of chlorpyrifos-containing products will take place over a several-year period. All manufacture of chlorpyrifos for residential use associated with lawn application and similar outdoor uses will be terminated on December 1, 2000. On February 1, 2001, the registrants will terminate sale of chlorpyrifos products that could be used for outdoor residential purposes. The termination of retail sales of these types of products will occur on December 31, 2001. Some allowed residential uses will continue for several years after that date, such as for the control of termites.

Questions have been raised about several aspects of this action, one of the most important of which is the time period allowed for the elimination of future sales of chlorpyrifos that would become restricted under this voluntary reduction in the permitted uses. While there are some who call for an immediate ban/termination of the sales of chlorpyrifos based on stormwater runoff aquatic life toxicity issues, the immediate implementation of this restriction on residential use sales seems to be an inappropriate action based on several factors, the most important of which is that, while causing aquatic life toxicity to a certain group of zooplankton, the significance of this toxicity to the beneficial uses of waters is appropriately questioned.

As discussed in previous Newsletters, while both diazinon and chlorpyrifos are toxic to *Ceriodaphnia* (a freshwater zooplankton), and chlorpyrifos is highly toxic to *Mysidopsis* (a marine zooplankton), the importance of this toxicity to higher trophic level organisms, especially in the marine, but also in the fresh water environment, is questionable. Basically, arguments are made that while *Ceriodaphnia* and *Mysidopsis* could be impacted by these stormwater runoff-associated pulses of chlorpyrifos toxicity associated with its continued residential use, the potential for adverse impacts to higher trophic level organisms appears to be remote, especially in the marine environment. The Upper

Newport Bay, Orange County, studies, conducted by Lee and Taylor (1999) and Lee, *et al.* (2000), show that, in order for the chlorpyrifos to be significantly toxic to marine zooplankton that would be translated into an impairment of beneficial uses of a waterbody, marine zooplankton would have to migrate into the freshwater lens associated with a stormwater runoff event that still contained chlorpyrifos at concentrations that are toxic to the zooplankton, and this toxicity must persist long enough to actually harm the zooplankton that are present in the freshwater/marine water mixed layer near the surface of the waterbody. Further, the zooplankton that are adversely impacted by the chlorpyrifos toxicity must be key and important components of higher trophic level organisms' food, where the higher trophic level organisms are important to the beneficial uses of the waterbody.

The Upper Newport Bay studies on the fate, persistence and toxicity, as well as chlorpyrifos concentrations in the Bay associated with stormwater runoff events indicates that the toxicity present in stormwater runoff entering the Bay is unlikely to be adverse to the beneficial uses of the Bay or its tributaries. In the Upper Newport Bay watershed and in most urban streams, there is a limited time (a few hours) from where the chlorpyrifos associated with stormwater runoff events enters the headwaters of the urban streams before it enters the Bay or is diluted in the receiving waters to nontoxic levels. Within Upper Newport Bay, there is a day or so from the time that the chlorpyrifos enters the Bay in a stormwater runoff event before it is diluted by mixing with marine waters to nontoxic concentrations.

In addition, there is substantial evidence that, because of the sorption tendencies of chlorpyrifos, its toxicity is significantly reduced in the sorbed form. As Lee and Taylor discussed, studies by the US EPA staff (Ankley, *et al.*, 1994) have shown that chlorpyrifos associated with sediments is in a nontoxic form. It may be concluded that, with respect to stormwater runoff impacts, there is considerable question about the water quality beneficial use significance of chlorpyrifos toxicity as a cause of beneficial use impairment of waterbodies.

Another argument has been made that this delayed voluntary restriction of the use of chlorpyrifos in residential areas could lead to additional 303(d) listings and the associated TMDLs, and thereby cause stormwater management agencies to have to initiate control programs. This is not a valid reason to immediately terminate the sale of chlorpyrifos to the public. It is the author's experience that elimination of chlorpyrifos from residential use, while it may reduce, will not solve the aquatic life toxicity problem in urban stormwater runoff. This problem is due to both diazinon and chlorpyrifos, where most of the time the toxicity is due to diazinon. In some instances, chlorpyrifos adds to this toxicity. Any new 303(d) listings that occur during this period of phase-out of residential use of chlorpyrifos will likely occur due to diazinon's presence. It is highly doubtful that the elimination of the use of chlorpyrifos on residential properties will have any impact on the beneficial uses of urban streams that now show toxicity due to or in part to chlorpyrifos.

Stormwater management agencies should be pressing the US EPA and state water pollution control and pesticide regulatory agencies to use this phase-out period to begin to develop and implement an effective proactive screening approach for the replacements for chlorpyrifos to insure to a high degree of reliability that the replacement of chlorpyrifos with another pesticide does not result in water quality problems not now known. As discussed herein, the US EPA Office of Pesticide Programs registration of pesticides does not effectively screen for residential use stormwater runoff-associated

aquatic life toxicity in receiving waters for the runoff. This is a relatively straightforward procedure that could and should be implemented into the registration/re-registration process. In light of this "pesticide roulette" that is occurring now, stormwater management agencies should be actively petitioning the state pesticide regulatory agencies as well as the US EPA OPP to immediately implement an effective evaluation of all pesticides that are proposed to be used as a replacement for chlorpyrifos. The 100,000 lbs per year or more of chlorpyrifos that is going to be phased out of use in the Upper Newport Bay watershed over the next year will mean that there will be 100,000 lbs (ai) or so of pesticides that will be introduced into the Upper Newport Bay watershed in much larger amounts than are currently occurring there now.

There is need to activate an immediate program to determine which of the pesticides that are currently registered for residential use could be likely candidates to replace chlorpyrifos and their fate in stormwater runoff from residential properties. Are they transported in sufficient concentrations in the runoff waters to cause aquatic life toxicity or excessive bioaccumulation in aquatic life in the receiving waters for the runoff? There could readily be situations develop where the questionable beneficial use impairment associated with chlorpyrifos aquatic life toxicity could be translated into a real significant water quality problem associated with the replacements for chlorpyrifos that will occur over the next year.

The most likely candidates for this replacement are the pyrethroid pesticides. There is a dearth of information at this time on the presence, fate and effects of pyrethroid pesticides associated with their use on residential properties as they may impact the beneficial uses of receiving waters for stormwater runoff from these properties. There is an immediate need for US EPA and state pesticide regulatory agencies to require that this information be provided before there is a larger-scale use of pyrethroid pesticides arising from the phasing out of the residential use of chlorpyrifos.

Overall, rather than entering into a crash program to immediately restrict the sale and use of chlorpyrifos in residential areas based on reducing urban area stormwater runoff aquatic life toxicity to *Ceriodaphnia*, this phase-out period of chlorpyrifos use on residential properties provides an opportunity for an immediate implementation of what could become the first step in a major program of properly evaluating pesticides with respect to their use on residential properties as they may impact the beneficial uses of receiving waters through aquatic life toxicity and/or excessive bioaccumulation in receiving water edible organisms.

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Pesticides in Streams of the United States-Initial Results of the USGS NAWQA Program

The USGS (Larson, *et al.*, 1999) has conducted a study of 58 rivers and streams across the United States which were analyzed for pesticides as part of the National Water-Quality Assessment (NAWQA) program. While the primary focus of the USGS NAWQA study is agricultural lands, some of the sampling sites included urban areas. Samples were collected from 1992 to 1995 and reflect over a 1 to 3 year study period at each of the study sites. Eleven urban basins were investigated as part of this study. The study includes the measurement of 46 pesticides and pesticide degradation products.

The urban indicator site studies included the Norwalk River at Winnipauk, CT; Lisha Kill near Niskayuna, NY; Cedar Run at Eberlys Mill, PA; Accotink Creek near Annandale, VA; Lafayette Creek near Talahassee, FL; Sope Creek near Marietta, GA; Little Buck Creek near Indianapolis, IN; Cherry Creek at Denver, CO; Rush Creek at Arlington, TX; Las Vegas Wash near Las Vegas, NV; and Fanno Creek near Portland, OR. From 20 to about a 100 samples were collected at each of these sites. In all but one of the urban study areas (Las Vegas) the dominant land use was urban. A couple of them had small amounts of crop lands, and two of them had considerable forest areas in the watershed above the sampling station.

Diazinon and chlorpyrifos were the most detected among the insecticides analyzed. The monthly median concentrations of diazinon found ranged from non-detect of about 1 ng/L to about 2,000 ng/L. Many of the samples had monthly median concentrations of diazinon below the concentration that would be acutely toxic to *Ceriodaphnia*. Several of the study areas had monthly median concentrations of diazinon that would be acutely toxic to *Ceriodaphnia*. This wide range of monthly median concentrations is to be expected for urban streams since during non-stormwater runoff events, the stream waters tend to have low OP pesticide concentrations.

The chlorpyrifos monthly median concentrations ranged from non-detect of about 1 ng/L to about 200 ng/L, with many of the monthly median concentrations ranging from 5 to 80 ng/L. Some of the monthly median concentrations of chlorpyrifos were above the concentrations that would be acutely toxic to *Ceriodaphnia*. Since the LC_{50} normalized concentrations of chlorpyrifos and diazinon are additive in estimating aquatic life toxicity, it is clear that urban streams in many parts of the US would be expected to be toxic to *Ceriodaphnia* during stormwater runoff events.

The USGS NAWQA studies of pesticides in urban streams shows that the urban stormwater runoff aquatic life toxicity problem due to the OP pesticides diazinon and chlorpyrifos is a national problem that has been found in many parts of the US.

References

Larson, S. J., Gilliom, R. J., and Capel, P.D., "Pesticides in Streams of the United States-Initial Results from the National Water-Quality Assessment Program," US Geological Survey, Water Resources Investigations Report 98-4222, Sacramento, California (1999).

Pesticide Action Network Database

The Pesticide Action Network has recently compiled a Pesticide Action Network Database. This database contains over 30,000 entries of information on pesticide characteristics and their toxicity. The database is available through the internet, at www.pesticideinfo.org/documentation/ref_toxicity.html.

US EPA Water Quality Newsletters

The US Environmental Protection Agency, Office of Water, periodically releases the *Water Quality Criteria and Standards Newsletter*. This Newsletter is an important source of information on recent US EPA activities/publications, many of which are relevant to regulating urban area and highway stormwater runoff water quality impacts. If you wish to be added to the US EPA *Water Quality Criteria and Standards Newsletter*, send an email to Frederick Leutner, Chief, Water Quality Standards Branch (4305), EPA, 401 M Street, S. W., Washington, DC 20460, em: leutner.fred@epa.gov.

The US EPA also periodically publishes *EPA Contaminated Sediments News*. This Newsletter provides information on regulatory approaches that the US EPA is developing for managing chemical constituents in aquatic sediments. "To subscribe to SASD-NEWS, please send an email message to listserver@unixmail.rtpnc.epa.gov. Leave the message's subject header blank and provide the following text in the body of the message: Subcribe SASD-NEWS Firstname Lastname."

Stormwater Journal

The first issue of *Stormwater* has recently been published by Forester Communications. This issue contains several papers pertinent to managing the water quality impacts of urban area and highway stormwater runoff. It includes a paper by G. Fred Lee, "The Right BMPs? Another Look at Water Quality." Dr. Lee worked with the editors of *Stormwater* to develop an overview paper that summarizes key information in several of his writings on urban area stormwater runoff water quality management. The paper includes sections of the Newsletter Vol.3 No. 2, developed by Scott Taylor of RBF Consulting of Irvine, California, devoted to the characteristics of conventional BMPs that have been and continue to be used to "treat" urban area stormwater runoff. As discussed by Mr. Taylor and in the *Stormwater* overview review by Dr. Lee, conventional BMPs such as detention basins, grassy swales, etc., will not adequately treat urban area stormwater runoff so that the runoff does not cause violations of water quality standards in the receiving waters for the runoff.

Dr. Lee's *Stormwater* article also provides a review of the recommended approach for developing appropriate BMPs to manage real significant water quality use impairments associated with urban area and highway stormwater runoff. If you are interested in obtaining an electronic version of Dr. Lee's *Stormwater* article, please send an email to gfredlee@aol.com, requesting a copy. If you are not a subscriber to *Stormwater*, you can subscribe electronically at www.stormh20.com.