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

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Editor: Anne Jones-Lee, PhD
Contributor to this Issue:
G. Fred Lee, PhD, PE, DEE

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This issue of the Stormwater Runoff Water Quality Science/Engineering Newsletter is devoted to a review of the current situation with respect to **pesticide-caused aquatic life toxicity in urban stormwater runoff now that the sale of diazinon and chlorpyrifos for urban residential use is no longer allowed**. As discussed in past Newsletters, stormwater runoff from urban and some agricultural areas in California, and in some other areas of the US, is toxic to *Ceriodaphnia dubia*, a US EPA standard test zooplankton for assessing aquatic life toxicity in freshwater (US EPA 2002a,b) and for marine organisms (US EPA, 2002c) (See Newsletters 1-1, 2-1, 3-5, 3-6, 6-3, 6-4, 7-6/7 available at www.gfredlee.com with the link on the bottom of the first page, and Lee, 2001a). Toxicity to this organism is an indication of potential adverse impacts on larval fish food. This toxicity is a violation of the Clean Water Act and in California, the Regional Water Quality Control Board Basin Plan objective for controlling aquatic life toxicity. Toxicity investigation evaluations (TIEs) showed that the urban stormwater runoff associated toxicity was primarily due to the organophosphorus (OP) pesticides diazinon and chlorpyrifos used on residential properties.

Several years ago the US EPA Office of Pesticide Programs (OPP) reached an agreement with the diazinon and chlorpyrifos registrants to terminate the sale of these pesticides for residential use where chlorpyrifos was no longer sold for this use after December 2001 and diazinon after December 2004. The restriction on sale for residential use was not based on aquatic life toxicity but on the potential cumulative impact to children under the Food Quality Protection Act.

OP Pesticide TMDLs. In the mid 1990s several of the California Regional Water Quality Control Boards placed urban streams on the Clean Water Act 303(d) list of impaired waterbodies because of the OP pesticide caused aquatic life toxicity. At this time, several of the Regional Boards are adopting TMDLs to control aquatic life toxicity in urban streams due to diazinon and chlorpyrifos even though the sale for the use of these pesticides on residential properties and for most urban uses has been terminated. There are, however, still some urban uses allowed and there is the potential for the allowed uses of these pesticides on agricultural lands to cause aquatic life toxicity in urban areas. The San Francisco Regional Water Quality Control Board TMDL for OP pesticide caused aquatic life toxicity is at, http://www.swrcb.ca.gov/rwqcb2/urbancrksdiazinontmdl.htm. The Central Valley Regional Water Quality Control Board TMDL for controlling OP pesticide caused aquatic life toxicity in the greater Sacramento, CA area is at,
http://www.swrcb.ca.gov/~rwqcb5/programs/tmdl/urbancreeks/urbancrksreport.pdf.

The Santa Ana and the San Diego Regional Water Quality Control Boards have also developed TMDLs for diazinon and chlorpyrifos which are available from their respective websites.

Lee and Jones-Lee (2002a) have prepared a report for developing a TMDL for diazinon and chlorpyrifos caused aquatic life toxicity in several of the city of Stockton, CA sloughs. As discussed in this and other urban TMDLs reports, the TMDL target for control of OP pesticide caused aquatic life toxicity is typically set at the water quality criterion for diazinon and chlorpyrifos. The stormwater discharges to public waters cannot exceed the TMDL goal. Previous Newsletters mentioned that the CA Department of Fish and Game (CDFG) water quality criteria were being used as the TMDL target for diazinon and chlorpyrifos (Siepman and Finlayson 2000). Recently, it has been found that some of the data used by CDFG in developing the CDFG water quality criteria for diazinon and chlorpyrifos is questionable with the result that CDFG has withdrawn these criteria (Finlayson 2004). Originally, the CDFG diazinon acute life criterion for freshwater 1 hour maximum was 80 ng/L. The recalculated CDFG acute criterion which does not include the questionable data is 160 ng/L. The diazinon chronic criterion 4 day average has been changed from 50 ng/L to 100 ng/L. Beaulaurier (2005) of the CVRWQCB presented a review of a proposed Basin Plan amendment for control of the discharge of diazinon and chlorpyrifos into the San Joaquin River. She indicated that the CVRWQCB has selected 100 ng/L as the TMDL target for diazinon based on the studies of Scholtz et al. (2000) who reported that diazinon at concentrations above this level disrupts antipredator and homing behaviors in Chinook salmon. The Beaulaurier (2005) presentation includes information on the US EPA draft acute criterion for chlorpyrifos as 83 ng/L and the chronic criterion of 41 ng/L. The Beaulaurier (2005) presentation discusses the current regulatory approach for controlling diazinon and chlorpyrifos caused aquatic life toxicity derived from agricultural use in the San Joaquin River watershed

Urban Stormwater Runoff Toxicity is a National Problem. Lee (2000) in NL 3-5 based on Jones-Lee and Lee (2000a) reported that based on the USGS (Larson, *et al*., 1999) report covering the USGS national pesticide monitoring program shows that there are sufficient concentrations of diazinon and chlorpyrifos in urban streams located in several areas of the US to be toxic to *Ceriodaphnia*. Jones-Lee and Lee state that, "*it is now clear that the aquatic life toxicity problem associated with the use of OP pesticides on residential properties is a largely unrecognized national problem that needs attention.*" TDC (2003) has provided a more recent discussion of recent USGS data on pesticide concentration in US waters. Many US waters in urban and agricultural areas contained sufficient OP pesticides to cause aquatic life toxicity.

US EPA OPP Pesticide Regulatory Process. The termination of the sale of diazinon and chlorpyrifos for essentially all urban uses has caused the substitution of other pesticides for use on residential properties. It might be thought, that the substitution of a pesticide for residential use would be regulated to insure that the replacement pesticide does not cause aquatic life toxicity in stormwater and fugitive water runoff. However, as discussed in NL 3-5, the registration of pesticides for urban and agriculture use does not prevent the use of pesticides in accord with the registration label that can be present in urban and agricultural stormwater runoff and discharges that are highly toxic to aquatic life in the receiving waters for the runoff.

Another complicating factor in regulating the pesticide-caused aquatic life toxicity is the different regulatory approaches that are used for controlling pesticide impacts on non-target organisms versus the control of toxicity to aquatic life. The Clean Water Act as being implemented by the US EPA requires the control of toxics discharged in toxic amounts. Pesticides are regulated by the US EPA Office of Pesticide Programs. The US EPA OPP Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) regulations allow toxicity to non-target organisms provided that this toxicity is not significantly adverse to the beneficial uses of the waterbody. FIFRA definitions include:
“x) Protect health and the environment.--The terms ‘protect health and the environment’ and ‘protection of health and the environment’ mean protection against any unreasonable adverse effects on the environment.”
3 *“(bb) Unreasonable Adverse Effects on the Environment.--The term ‘unreasonable adverse effects on the environment’ means (1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide, or (2) ....”*

The US EPA OPP FIFRA regulations allow other factors (such as economics and social) than impairment of beneficial uses of a waterbody to determine whether a pesticide’s registration or re-registration should be limited by adverse impacts to non-target organisms. The US EPA OPP FIFRA regulations point to the need to have a much better understanding of the role of specific types of zooplankton that are impacted by OP pesticide toxicity in influencing beneficial uses of waterbodies. Basically, from an US EPA OPP prospective, the question becomes one of whether the numbers, types, and characteristics of aquatic life present in receiving waters for urban stormwater runoff containing OP pesticide-caused aquatic life toxicity are being significantly adversely impacted by this toxicity while, the Clean Water Act prevents all aquatic life toxicity.

There is no regulatory proactive process whereby a new or substitute pesticide is critically reviewed for stormwater runoff water quality impacts before widespread use can take place. It was based on this situation that Jones-Lee and Lee (2000b) and Lee (2001b) recommended that the water quality regulatory agencies adopt a proactive approach of requiring that stormwater runoff water quality impact studies be conducted with the initial use of a new or expanded use pesticide. The results of these studies could be used to screen for aquatic life toxicity problems in stormwater runoff from areas where the pesticides are initially applied before widespread application occurs.

Development of an Approach for Evaluating Potential Pesticide Caused Toxicity. The TMDLs that are being adopted by the CA Regional Water Quality Control Boards do not require that an evaluation be made of potential aquatic life toxicity of replacement pesticides for diazinon and chlorpyrifos be conducted. However, the Regional Boards are incorporating toxicity monitoring requirements into the NPDES permits for urban stormwater management agencies. The previously required monitoring of the stormwater runoff has been expanded to include receiving water water column monitoring.

Presented below are excerpts from the greater Sacramento, CA stormwater NPDES permit that presents the current approach used by the CVRWQCB to try to control aquatic life toxicity in stormwater runoff that is due to any continuing uses of diazinon and chlorpyrifos and the alternative pesticides that are being used as replacements. The complete NPDES permit is available at,
http://www.swrcb.ca.gov/~rwqcb5/adopted_orders/Sacramento/R5-2002-0206.pdf.

"WASTE DISCHARGE REQUIREMENTS ORDER NO. R5-2002-0206 41 COUNTY OF SACRAMENTO AND SACRAMENTO AREA CITIES MUNICIPAL SEPARATE STORM SEWER DISCHARGES SACRAMENTO COUNTY

Water Quality Based Programs

14. The Permittees have completed a Target Pollutant Reduction Strategy process, which has identified target pollutants for the Sacramento area. The Permittees shall continue or initiate implementation of control programs for pollutants that have been identified to cause or contribute to exceedances of water quality standards and potential impairment of beneficial uses. These control programs shall be incorporated into each Permittee's SQIP and revised in accordance with the directives of the Executive Officer. At a minimum, these control programs shall include the following:

b. Pesticides: To address pesticide impairment of urban streams, the Permittees shall continue implementation of a pesticide toxicity control plan (Pesticide Plan) that addresses their own use of pesticides including diazinon, chlorpyrifos, and other lower priority pesticides, and the use of such pesticides by other sources within their jurisdictions. The Permittees may address this requirement by building upon their prior submissions to the Regional Board. They may also coordinate with the Sacramento River Watershed Program (SRWP), and other interested agencies and organizations.

The Pesticide Plan shall include a program to quantitatively identify each Permittee's pesticide use by preparing a periodically updated inventory of pesticides used by all internal departments, divisions, and other operational units as applicable to each Permittee. The Pesticide Plan shall also include (1) goals and implementing actions to replace the use of banned pesticides with less toxic alternatives, and minimize the use of pesticides whenever possible; and (2) a schedule for implementation and a mechanism for reviewing and amending the plan, as necessary, in subsequent years.

ii. Periodic surveys of the local or regional sales and use of residential and commercial pest control products potentially found in storm water runoff. The first survey shall be conducted by 1 December 2004. A second survey shall be conducted by 1 December 2006. The surveys may be conducted in conjunction with other municipalities in the Central Valley or Bay Area as long as residences and retailers from the Sacramento County area are included. The proposed survey design and protocols shall be submitted for approval with the Annual Work Plan for the year in which the survey is to be conducted.

Based on the evaluation required in II.E.4 of the Monitoring and Reporting Program, the Permittees may be required to revise the Pesticide Plan to include a Diazinon and Chlorpyrifos Mitigation Program. The purpose of this revision would be to address any remaining urban sources of diazinon and/or chlorpyrifos that could cause or contribute to the maintenance of a toxic hot spot or to the non-attainment of water quality standards in CWA 303(d) listed water bodies. The Regional Board will make its determination as to the necessity and schedule for a Diazinon and Chlorpyrifos Mitigation Program no later than 30 June 2006.

The Permittees shall coordinate with the pesticide control stakeholders and other municipal storm water management agencies to assess which pesticide products and uses pose the greatest risks to surface water quality. The Permittees shall also monitor USEPA and Department of Pesticide Regulation (DPR) activities related to the registration of pesticide products and uses.

The Permittees shall provide technical assistance to the Regional Board and other agencies in developing TMDLs for pesticide impaired urban creeks and other tributaries to the Sacramento River receiving runoff from the urbanized portions of Sacramento County. The Permittees will participate in stakeholder forums and collaborative technical studies necessary to assist the Regional Board in completing the TMDLs. These studies may include, but shall not be limited to, additional diazinon and chlorpyrifos monitoring and toxicity testing in Arcade Creek, Chicken/Strong Ranch Sloughs, Elder Creek, Elk Grove Creek, Morrison Creek, and Natomas East Main Drain.

15. The Permittees shall comply with Monitoring and Reporting Program No. 5-2002-0206, which is part of this Order, and any revisions thereto approved by the Regional Board. Because the Permittees operate facilities that discharge waste subject to this Order, a Monitoring and Reporting Program is necessary to ensure compliance with waste discharge requirements.

The Sacramento area NPDES stormwater permit contains the following requirements for monitoring of pesticides in stormwater runoff and receiving waters.

MONITORING AND REPORTING PROGRAM ORDER NO. R5-2002-0206 -4- COUNTY OF SACRAMENTO AND SACRAMENTO AREA CITIES MUNICIPAL SEPARATE STORM SEWER DISCHARGES SACRAMENTO COUNTY

*II. **MONITORING PROGRAM***

The primary objectives of the Monitoring Program include:

- *Provide data necessary to assess compliance with this Order;*
- *Measuring and improving the effectiveness of the SQIP and implemented BMPs;*
- *Assessing the physical, chemical, and biological impacts of urban runoff on receiving waters;*
- *Characterizing urban runoff discharges;*
- *Identifying sources of pollutants; and*
- *Assessing the overall health and evaluating long-term trends in receiving water quality.*

The Permittees shall implement the Monitoring Program as follows:

*A. **Sampling Protocol***

1. Samples collected from the receiving water and urban discharge monitoring stations described below shall be analyzed for constituents listed in Table 1 for all sampling events unless otherwise noted.

2. Samples collected from the monitoring stations described below shall be analyzed for constituents listed in Table 2 during the first storm event of the 2nd and 5th years of this Order.

1. American and Sacramento River Monitoring

*Each year, samples shall be collected **during two wet season storm events**, targeting the first storm of the wet season, and **two dry season events**.*

2. Urban Tributary Monitoring at Arcade, Morrison and Willow Creeks

*a. Samples shall be collected during **three wet season storm events**, targeting the first storm of the wet season, and **one dry weather event** per year shall also be monitored at each station.*

2. Urban Tributary Monitoring at Arcade, Morrison and Willow Creeks

*a. Samples shall be collected during **three wet season storm events**, targeting the first storm of the wet season, and **one dry weather event** per year shall also be monitored at each station. If a given tributary is dry or has only standing water during a scheduled sampling event, then sampling is not required; however, Permittees shall attempt to sample tributaries at times when water flows are more likely, such as the early part of the dry season.*

D. ***Water Column Toxicity Monitoring*** *The Permittees shall analyze samples to evaluate the extent and causes of toxicity in receiving waters, and to provide information to support identification of practices that eliminate sources of toxicity or remove them to the MEP.*

The Permittees shall conduct short-term chronic toxicity testing at each downstream receiving water monitoring station during the second of the five fiscal years (July 1 of the current year to June 30 of the following year) of this Order. Toxicity testing shall include (1) analysis of samples from ***two wet season storm events****, targeting the first storm of the wet season,* ***and two dry season events*** *from each receiving water monitoring station; and (2) analysis of at least the following two freshwater test species for each storm event: Fathead minnow (Pimephales promelas) and water flea (Ceriodaphnia dubia). If new toxicants are discovered in the first toxicity testing, the Permittees will perform additional toxicity tests as directed by the Executive Officer.*

If toxicity is detected in a sample, a dilution series shall be initiated (0.5x steps) ranging from the undiluted sample (or the highest concentration that can be tested within the limitations of the test methods or sample type) to less than or equal to six percent of the sample. Further, if toxicity is detected at a given monitoring station, the Permittees will continue conducting toxicity testing and TIEs until the nature and cause(s) of the toxicity are defined.

1. Toxicity Identification Evaluations (TIE)

The Permittees shall begin a Phase I TIE immediately on all samples that are substantially toxic to either test species. Alternatively, the Permittees may employ directed TIE methods in parallel to the toxicity testing (e.g., PBO addition) instead of a Phase I TIE when there are strong indications as to the cause(s) of toxicity.

2. Toxicity Reduction Evaluations (TRE)

a. When the same pollutant or class of pollutants is identified through the TIE process as causing at least 50 percent of the toxic responses in at least three samples at a sampling location, a TRE shall be performed for that identified toxic pollutant. The TRE shall include all reasonable steps to identify the source(s) of toxicity and discuss appropriate BMPs to eliminate the causes of toxicity. Once the source of toxicity and appropriate BMPs are identified, the Permittees shall submit the TRE to the Executive Officer for approval.

At a minimum, the TRE shall include a discussion of the following items:

i. The potential sources of pollutant(s) causing toxicity;

ii. A list of Permittees having jurisdiction over sources of pollutant(s) causing toxicity;

iii. Recommended BMPs to reduce the pollutant(s) causing toxicity;

iv. Proposed changes to the SQIP to reduce the pollutant(s) causing toxicity; and

v. Suggested follow-up monitoring to demonstrate that toxicity has been removed.

c. If TRE implementation for a specific pollutant coincides with Total Maximum Daily Load (TMDL) implementation for that pollutant, the efforts may be coordinated.

d. Upon approval by the Executive Officer, the Permittees(s) having jurisdiction over sources causing or contributing to toxicity shall implement the recommended BMPs and take all reasonable steps necessary to eliminate toxicity.

e. The Permittees shall develop a maximum of two TREs per year. If applicable, the Permittees may use the same TRE for the same toxic pollutant or pollutant class in different watersheds or basins. The TRE process shall be coordinated with TMDL development and implementation to avoid overlap.

f. The Permittees shall report on the development, implementation, and results for each TRE in the Annual Reports, beginning the year following the identification of each pollutant or pollutant class causing toxicity.

4. Monitor diazinon and chlorpyrifos in rainwater at one site within and one site outside of the Sacramento urban area, beginning in the second year of this Order. This monitoring shall be done during five wet season storm events (if possible) per year and shall only be required if it can be performed in conjunction with other rainwater monitoring to be performed by others outside of Sacramento County (e.g., Regional Board or U.S. Geological Survey). The Permittees may request that rainwater monitoring be discontinued or reduced after the third year of this Order.

The Permittees shall submit an evaluation and formal request to Regional Board staff for the reduction or discontinuation of rainwater monitoring. Discontinuation of monitoring may be granted if diazinon and chlorpyrifos are not found in rainwater or if diazinon and chlorpyrifos in urban streams are below receiving water limitations.

5. *Should the Regional Board determine that a Diazinon and Chlorpyrifos Mitigation Program is required per the Order, the Permittees shall prepare a diazinon and chlorpyrifos monitoring and surveillance plan as part of that mitigation strategy to identify and quantify the remaining urban sources of diazinon and chlorpyrifos. This monitoring and surveillance may be based on known remaining uses of diazinon and chlorpyrifos in the Sacramento urban area; and*
6. *The Permittees shall provide an assessment of the relative contribution of urban storm water runoff to diazinon and chlorpyrifos levels in waters within its jurisdiction that are identified as a toxic hot spot (per Section 13394 of California Water Code) or are on the Federal Clean Water Act (CWA) 303(d) list. This assessment should take into account the contribution of the sources outside of the urban area (including contributions via atmospheric transport). This assessment should include a determination as to whether urban storm water runoff continues to contribute to the maintenance of a toxic hot spot or to the non-attainment of water quality standards in CWA 303(d) listed water bodies. The results of this assessment shall be reported in the 1 October 2005 Annual Report. Updates to the initial assessment results shall be conducted as needed as part of subsequent Annual Reports unless the Regional Board determines that diazinon and chlorpyrifos in urban storm water runoff no longer causes or contributes to the maintenance of a toxic hot spot or non-attainment of water quality standards in CWA 303(d) listed water bodies.*

Bioassessment

The Permittees shall participate and coordinate with the Surface Water Ambient Monitoring Program (SWAMP) being developed by the State Water Resources Control Board (State Board). The SWAMP has begun work on a statewide effort to determine how to identify reference sites with the goal of Index of Biological Integrity (IBI) development. The purpose of this requirement is to detect biological trends in receiving waters and to collect data for the development of an IBI. The ultimate goals of bioassessment are to assess the biological integrity of receiving waters, to detect biological responses to pollution, and to identify probable causes of impairment not detected by chemical and physical water quality analysis.

1. *The Permittees shall participate in and coordinate with the SWAMP to identify the most appropriate locations for bioassessment stations within Sacramento County's urbanized areas.*
2. *The Permittees shall submit a bioassessment monitoring plan by 1 September 2003. Monitoring shall begin as soon as practicable after approval of the monitoring plan and stations by the Executive Officer. A minimum of three replicate samples shall be collected at each station during each sampling event.*

The CVRWQCB (2003) adopted an Agriculture Waiver program that requires that agriculture in the Central Valley of CA conduct a monitoring program that includes monitoring of aquatic life toxicity. Ag waiver monitoring by several agriculture coalitions have reported finding toxicity at a monitoring station that was traced to upstream urban areas as a source of the toxicants apparently due to diazinon used in the urban area. It will be of interest to see if the urban area toxicity that impacts downstream agriculture waters decreases as current urban residential stocks of diazinon are used.

Also the reverse is likely in that the agricultural use of OP pesticides can cause aquatic life toxicity in urban streams where the upstream agriculture stormwater runoff/discharges to streams that enter urban areas can cause urban waterbody toxicity.

There is also concern that airborne OP pesticides used on agricultural lands can lead to sufficient urban stormwater runoff concentrations to cause toxicity and/or violation the TMDL targets for diazinon and chlorpyrifos. As discussed by Lee and Jones-Lee (2002a) there are two aspects of airborne pesticide transport; 1) spray drift that falls near the area of application and the longer range transport of airborne pesticides. Majewskie et al. (2004) and Zamora et al. (2003) have conducted on studies on long range transport of pesticide in the Central Valley, where it has been found that there can be long range airborne transport of pesticides. The CVRWQCB stormwater permits such for the greater Sacramento area require that the urban stormwater runoff water quality management agencies monitor rainfall to determine the concentrations of OP pesticides in the rainfall.

The US EPA standard freshwater aquatic life toxicity test organisms include using the alga *Selenestrum capricornutum* to test for aquatic plant toxicity (US EPA 2002a). It is G. F. Lee's experience that most urban area stormwater runoff shows stimulation of algal growth is in the Selenestrum toxicity test. This is the result of the elevated nitrogen and phosphorus compounds in urban stormwater runoff compared to their concentrations in the test media. However, occasionally some samples show toxicity to the test algae. The cause of this algal toxicity in urban stormwater runoff has not been identified. However, Miller et al. (2005) has found that diuron, a widely used herbicide on highway right of way and for other agricultural purposes is present at sufficient concentrations to cause toxicity to the test algae.

Under current regulatory requirements, algal toxicity needs to be controlled where algal toxicity is found in the standard toxicity test. There is controversy on the water quality significance of algal toxicity to the beneficial uses of a waterbody. It is well established that increased algal biomass is related to increased fish production. Lee and Jones-Lee (1991) have presented information on the relationship between algal biomass and fish production. It is unclear that short term diminished algal populations in a waterbody related to toxic pulses of herbicides is significantly adverse to the overall fish production of the waterbody. Many waterbodies receiving urban stormwater runoff have excessive algal growth that is adverse to the water quality of a waterbody.

Measurement of Chlorinated Pesticides. Table 1 and 2 in the CVRWQCB stormwater NPDES permit for the greater Sacramento area contains a list of constituents required for monitoring of stormwater runoff and receiving waters. This list includes pH, DO, and temperature, nutrients, BOD, TOC TSS, TDS, metals, Priority Pollutants, chlorinated pesticides, PCBs, carbamates, herbicides, triazines and diazinon, chlorpyrifos and malathion. In general, based on the authors experience the monitoring parameters listed in the Sacramento area stormwater NPDES permit are appropriate with the exception of the chlorinated pesticides. Lee and Jones-Lee (2002b) has reviewed the issues concerning the monitoring of the chlorinated "legacy" pesticides such as DDT and its transformation products DDD and DDE, chlordane etc. and PCBs. While the use of these chemicals has been banned for many years, these chemicals are highly persistence in soil and sediments and can contribute to current water quality problems. It is appropriate to require monitoring for these compounds in urban stormwater runoff since they were used in urban areas as well as agricultural areas that have been converted to urban areas. These chemicals are of concern because of their bioaccumulation to sufficient concentrations in fish to be a hazard to cause cancer in those who use substantial amounts of fish containing these chemicals as food.

As Lee and Jones-Lee (2002b) discuss, trying to monitor these legacy pesticides and PCBs by measuring their concentrations in water or sediments is of limited reliability for identifying water quality problems caused by these chemicals for several reasons. The analytical methods available do not have sufficient sensitivity to measure these chemicals in water at concentrations that can bioaccumulate to excessive levels in edible fish and some other edible aquatic life. As a result, failure to detect any of the legacy pesticides and PCBs in water does not mean that excessive bioaccumulation of these chemicals will not occur in fish. Another problem with water and sediment chemical concentration is that the interpretation of this data is dependent on a variety of site specific factors that affect the biouptake of chemical from water and sediments.

A much more cost effective and reliable approach for regulating the legacy pesticides and PCBs is to focus the monitoring programs is to first determine if the fish in a waterbody contain excessive concentrations relative to existing public health guidelines. This approach is based on the Evaluation Monitoring approach that was developed by Jones-Lee and Lee (1998). If excessive concentrations of a pesticide are found then a water quality problem has been found that needs attention. Through the used of forensic approaches it is possible to define the source of the pesticide/PCBs. Lee and Jones-Lee (2002b) provide guidance on to how to conduct these studies.

Interpretation of Sediment Chemical Data. The interpretation of aquatic sediment chemical concentration data has several problems. The author is continuing to find that regulatory agencies are using or allowing the use of cooccurrence based so-called sediment quality guidelines (SQGs) as regulatory limits for chemicals such as DDT in sediments even though it has been know since these guidelines were first introduced by Long and Morgan (1990) that this approach is not technically valid for evaluating the potential for a chemical in sediment to cause aquatic life toxicity or to be bioaccumulated to excessive levels in edible fish. Lee (2005) has recently provided comments on the inappropriateness of using cooccurrence values for determining whether a chemical in sediments is adverse to aquatic life. Jones-Lee and Lee (2004) have summarized the reasons why even using the cooccurrence based guidelines for screening values are unreliable. While there are some who advocate that the cooccurrence based values can be used for screening purposes, such use can lead to unreliable assessment of the water quality impacts of chemicals in sediments. Some of the reasons include:

- This approach erroneously presumes that there is a cause-and-effect relationship between the concentrations of chemical contaminants in sediment and toxicity caused by the sediment. This presumption ignores the vast knowledge, and limitations in knowledge, of aquatic chemistry and aquatic toxicology. This fallacy of this presumption has long been recognized, yet it is a fundamental presumption of co-occurrence approaches.

• Even if there were a cause-and-effect relationship between concentration and effect, this approach assumes that the only chemicals in a sediment that can be toxic are those for which there are co-occurrence-based SQGs. Thus it can erroneously "clear" or overlook sediments – even in screening – that contain toxicants not included among the SQGs.
• It ignores additive and synergistic toxicity.
• Most important, it allows those want to minimize sediment toxicity problems to assume that there is no need to conduct an evaluation for impacts of unmeasured chemicals.

By far one of the most important problems with this approach is that it gives credibility to a fundamentally flawed approach for assessing sediment quality that ignores aquatic chemistry/toxicology and leads others to believe the co-occurrence-based approach is valid for assessing sediment toxicity.

The introduction provided by Jones-Lee and Lee (2004) discusses the current situation regarding the use of cooccurrence based sediment quality guidelines by regulatory agencies:
"*Many Superfund/hazardous chemical sites include waterbodies whose sediments contain hazardous chemicals. With the need to assess, rank, and remediate contaminated sediments at such sites, as well as in other waterways, regulators seek a simple, quantitative assessment approach that feeds easily into a decision-making scheme. Numeric, co-occurrence-based "sediment quality guidelines" have emerged with the appearance of administrative simplicity. However, the very foundation of the cooccurrence approach, based on the total concentrations of a chemical(s) in sediment, is technically invalid; its application relies on additional technically invalid presumptions. Use of technically invalid evaluation approaches renders any assessment of the significance of sediment contamination, unreliable."*

"In order to determine whether a chemical, or group of chemicals, in a sediment is toxic to aquatic life, it is necessary to measure the toxicity using a suite of sensitive organisms. It is naïve, at best, to attempt to use chemical concentration measurements and SQGs to try to estimate toxicity or bioaccumulation. There are far too many factors that influence the manifestation of toxicity by sediment-associated chemicals to ever be able to reliably assess toxicity based on chemical measurements."

Cooccurrence based sediment quality guidelines should not be used for any purpose including assessing whether DDT and other pesticides that accumulate in aquatic sediments are adverse to aquatic life related beneficial uses of waterbodies. Lee and Jones-Lee (2004a) have recently presented a discussion of a sediment quality triad best professional judgment approach that can/should be used to evaluate whether a chemical, group of chemicals or unidentified chemical in a sediment is having a significant adverse impact on water quality. Their discussion focuses on how to reliable use sediment derived chemical information in a water quality evaluation. These procedures require the use of US EPA standard benthic organism uptake studies of the type used by Lee et al.

(2002) in their studies of PCB bioaccumulation from city of Stockton, CA Smith Canal sediments.

Need to Monitor for Dioxins. A chemical that is receiving increasing attention that is not included in the CVRWQCB list of stormwater NPDES required monitoring parameters are the dioxins. As discussed by Lee and Jones-Lee (2002b, 2004c) it has been found that stormwater runoff from urban area highways contain sufficient dioxins are present to potentially cause excessive bioaccumulation in edible fish. Yee (2004) and Connor et al. (2004) have presented information on dioxins in the San Francisco Bay area. Based on the information available on urban street and highways being a source of dioxins urban stream water quality evaluation should include screening the fish of the area for dioxins.

A problem with the CVRWQCB monitoring program for stormwater runoff is that no monitoring is required for sediment toxicity. This is an especially significant deficiency since the pyrethroid based pesticides will accumulate in the urban stream sediments where there is a potential to cause aquatic life toxicity.

Potential Problems with Pyrethroid Pesticides. Reviews of the pesticides that are marketed for home use as replacements for diazinon and chlorpyrifos have shown that several of the pyrethroid based pesticides are being used for this purpose. Several of these pesticides are as, if not more toxic to zooplankton than diazinon and chlorpyrifos. Further, they are more toxic to fish. The pyrethroid based pesticides tend to have much stronger sorption tendencies and therefore become attached to surfaces to a greater degree than the OP based pesticides. It was claimed by some of those who manufacture pyrethroid based pesticide that this stronger tendencies would eliminate the problems of stormwater runoff caused aquatic life toxicity associated with OP pesticides. However, pyrethroid based pesticides used in agricultural areas are being found by Weston et al. (2004) in receiving water sediments for stormwater runoff/discharges from areas where they are being applied in CA Central Valley waterbodies. This could also be occurring in urban stream sediments as well although there is no know data showing this. The Weston et al. (2004) studies include finding that the sediments where pyrethroid based pesticides are being found are toxic to some benthic organisms. The measuring of these pesticides was based on solvent extraction that recovered all pyrethroid based pesticides in the sediment sample. As of yet however, it has not been shown that this toxicity is due to the presence of the pyrethroid pesticide in the sediments. It is known that the sorption of pesticides and some other chemicals eliminates the toxicity to many types of aquatic life. Ankley et al. (1994) reported that the sorption of chlorpyrifos on TOC resulted in its detoxification. However, apparently there are some filter feeders that can be impacted by sorbed particulate pesticides through ingestion of the particles that contain the sorbed pesticide.

A significant problem exists in trying to work with the pyrethroid based pesticides in that their strong sorption tendencies make conducting TIEs on sediment and water samples difficult at this time. Under these conditions a standard additions approach where small amount of the pyrethroid pesticide that is present in a toxic sediment sample is added to the sample to see if the toxicity is increased proportional to the amount added. If it is not then the toxicity is not likely due to the pyrethroid pesticide, but to some other substance.

Lee and Taylor (2001) in their late 1990s studies of aquatic life toxicity in the stormwater runoff in Upper Newport Bay Orange County, CA watershed found evidence for pyrethroid toxicity based on piperonyl butoxide (PBO) activation of the toxicity in water samples. At that time, about 25,000 pounds (ai) of pyrethroid based pesticides were being used each year on agriculture in Orange County. The PBO activation is an indication that pyrethroid based pesticides could be present in the sample. However, it was not possible to confirm that part of the toxicity that Lee and Taylor found in the Upper Newport Bay watershed stormwater runoff was due to pyrethroid based pesticides.

Wheelock et al. (2004) have recently published a procedure that can be used in toxicity identification for pyrethroid pesticide detection using esterase activity. The Wheelock et al. study evaluated the use of carboxylesterase activity, a pyrethroid-specific antibody, and PBO to identify pyrethroid toxicity in aquatic toxicity testing with C*eriodaphnia dubia*. Results showed that esterase was the most promising treatment for removal of pyrethroid toxicity and did not compromise OP toxicity. According to Miller (personal communication 2005) this TIE approach is suitable for water column and sediment pore water samples. Its application to sediment solid phase toxicity is under review.

At this time it is still unclear whether the use of pyrethroid based pesticides in urban and agricultural area is causing aquatic life toxicity especially to benthic organisms. There is need to determine whether the current use of pyrethroid based pesticides are causing water quality problems in aquatic systems with particular reference to sediment toxicity.

Sediment Toxicity due to OP Pesticides. The issue of sediment toxicity of the OP pesticides has not been an area of general concern. It is expected, that toxic pulses of OP pesticides would be toxic to some benthic organisms. Menconi and Cox (1994) and Novartis (1997) have reported that the amphipod *Gammarus fasciatus* is about twice as sensitive to diazinon as *Ceriodaphnia*. Giesy et al. (1999) reported that Gammarus is about twice as sensitive to chlorpyrifos as *Ceriodaphnia*. The focus of the OP toxicity has been on water column impacts. However, R, Katznelson, (URSGWC 1999) has reported elevated concentrations of diazinon associated with aquatic sediments in urban streams in Alameda County San Francisco Bay area. It is not clear at this time whether diazinon found associated with the sediments was attached to sediment particles (sorbed) or found in the interstitial water associated with the sediments. McCutchan (2000) has found that organophosphate pesticide pulses are apparently causing adverse impacts on benthic arthropods in the Sacramento-San Joaquin Delta. It is likely that the OP pesticide pulses associated with stormwater runoff have been adverse to benthic organisms for many years.

Hall has been using benthic organism population assessments to investigate the impact of pesticide use in the Orestimba Creek and several westside San Joaquin River tributary streams over the past five years. These streams watersheds are agricultural area of the San Joaquin River watershed. Hall and Killen (2005) stated, "*A qualitative comparison of OP-sensitives species in the three agricultural streams based on single species toxicity data was limited due to the lack of data. Species most sensitive to chlorpyrifos (Chironomus sp. and Gammarus lacustris) were generally found in all three streams except G. lacustris was absent for Del Puerto Creek. Species most sensitive to diazinon were the amphipod Hyalella sp. and the mayfly Baetis sp. Hyalella was more abundant in both Del Puerto Creek and Salt Slough than Orestimba Creek. Baetis sp. was only collected at one upstream site in Del Puerto Creek.*

The presence of 69 taxa in Del Puerto Creek, 97 taxa in Orestimba Creek and 74 taxa in Salt Slough implies that the benthic communities in these streams are fairly diverse, considering their ephemeral environments, but without a clear definition of benthic community expectations it is unknown if these water bodies are actually impaired. Potential reference sites should be identified in agricultural streams in California's Central Valley in order to identify the range of benthic community taxa expected in non or minimally stressed environments. Extensive spatial and temporal assessments of benthic communities in concert with physical habitat assessments will be needed to accomplish this task."

The results of Hall and Killen are examples of the difficulty of using traditional bioassessment study approaches to examine the impact of pesticides and other toxicants benthic organism assemblages. As recommended by Lee and Jones-Lee (2002c) studies associated with evaluating toxic pulses where monitoring is conducted just before and just after passage of the toxic pulse are needed to determine the immediate impact of the stormwater associated toxicant on benthic organism populations.

While the toxicity of stormwater runoff associated pulses of toxicity is a violation of regulatory requirements, it water quality significance to the beneficial uses of a waterbody is poorly understood. In general it can be expected that the benthic organism populations rapidly recover once the toxicant is dissipated. Further, high stream flows can have similar short term impacts on aquatic organism populations. At this time, any sediment toxicity is in the direction of being adverse to beneficial uses of a waterbody. In order to justify that short term toxicity pulses are of limited water quality significance and therefore should be allowed, detailed studies need to be conducted to relate the impact of diminished benthic organism assemblages on higher trophic level organism populations.

An issue of concern is the water quality significance of sediment toxicity as it impacts the waterbody beneficial uses. While sediment toxicity represents violation of regulatory requirements, there are several issues that need to be understood in interpreting sediment toxicity test results. Lee and Jones-Lee (1996) have discussed issued that need to be considered in regulating sediment toxicity. As they discuss many aquatic sediments are "naturally" toxic to some forms of aquatic life. This toxicity is due to ammonia, hydrogen sulfide and low dissolved oxygen. In order to conduct toxicity tests it is necessary to remove the ammonia and aerate the sample to add DO and remove H_2S. Lee and Jones-Lee (1996) report that sediments of eutrophic lakes are highly toxic to some forms of aquatic life yet have high quality fisheries. It is possible that the fisheries of these waterbodies could be even more productive if the sediments were not toxic.

The ammonia, low DO, H_2S arise from the accumulation of algal remains in the sediments where the algal remains exert an oxygen demand that leads to reduction of sulfate to sulfide and organic nitrogen to ammonia. The algal nutrients that develop into algae in waterbodies are derived from natural sources as well and from anthropogenic sources related to the activities of man in the waterbodies watershed. While regulatory agencies focus on toxicants such as heavy metals and organics and ignore the toxicity of low DO, ammonia and H_2S. There is need to better understand the water quality significance of various types of toxicants in sediments to the beneficial uses of waterbodies.

Biomarker Responses. As reported by Lee and Jones-Lee (2004b), Anderson (2003) has been examining fish biomarker responses in the San Joaquin River and one of its tributaries. She reported that caged fish in Orestimba Creek (one of the westside tributaries to the San Joaquin River, which has considerable runoff/discharges from irrigated agriculture) showed no cholinesterase inhibition during a February 2000-2001 stormwater runoff event when the concentrations of the OP pesticides diazinon and chlorpyrifos would be expected to be at their greatest. The measured concentrations of OP pesticides during this runoff event were in the low tens of nanograms per liter. The concentrations were below those that are known to be toxic to *Ceriodaphnia* and well below those that are known to be toxic to fish. Anderson (Whitehead et al., 2003) also made measurements of DNA strand breakage and Ames test mutations in the caged fish. There was evidence for positive responses in both tests, indicating that there may have been chemicals in the water that have the potential to be adverse to aquatic life. This type of testing is typically considered measurements of biomarkers – i.e., less than whole organism response to exposure to chemicals. It has been known since the 1960s that fish, under various exposure conditions, show biomarker responses to a variety of chemicals. It is likely that biomarker studies of urban stormwater runoff will show biomarker responses similar to those reported by Anderson. These responses could be related to the use of certain pesticides in urban areas.

In 1996, the American Society for Testing and Materials held a biomarker symposium, at which experts in the field presented the information they had on biomarkers in fish and other aquatic life in response to various types of chemicals or environmental settings. Bengston and Henshel (1996) edited the symposium proceedings. The overall conclusion from the experts at the symposium was that a properly conducted test of a biomarker response does indicate an organism exposure to a chemical or group of chemicals. However, the significance of this response to the ecosystem is unknown. This assessment of the mid 1990s is still appropriate today. Little progress has been made to translate biomarker responses in fish to impact on fish populations

New or Expanded Use Pesticides in Urban Areas. In an effort to learn more about the types of pesticides being used as replacements for diazinon and chlorpyrifos in urban areas, the San Francisco Regional Water Quality Control Board funded the TDC

Environmental report: Insecticide Market Trends and Potential Water Quality Implications (TDC 2003).
http://www.swrcb.ca.gov/rwqcb2/TMDL/urbcrksdiazinon/Final_Report.pdf.
This report contains information on urban pesticide use in the San Francisco Bay area as of 2002 and in California based on DPR 2000 pesticide use reporting.

Neonicotinoid Pesticides. Zalom et al. (2005) have recently published an article that discusses some of the issues associated with the replacement of OP pesticides diazinon and chlorpyrifos with pyrethroid and neonicotinoid type pesticides. The neonicotinoid pesticides are synthetic chemicals based on the structure of nicotine. They mention that several of the neonicotinoid type pesticides are being used in substantial amounts in California agriculture. For example in 2002, 6,632 pounds (ai) of acetacioprid, 224,730 pounds (ai) of imidacloprid and 11,091 pounds (ai) of thiamethoxam were used. According to Zalom et al. the primary use is on fruits and vegetables. "*The neonicotinoids are a new class of pesticides that are now being realized.*"

A review of the US EPA website shows that a web page "Alternatives to Chlorpyrifos" that lists imadacloprid for "Home and Ornamental Products" and for "Pet Products,"
http://www.epa.gov/pesticides/op/chlorpyrifos/alternatives.htm. DPR (2005) has reported that 148,553 pounds (ai) imidacloprid were used in California in 2003. Most of this use was on vegetables, and fruits with 16,765 pounds (ai) used on Landscape Maintenance and 46,528 pounds (ai) used for "Structural Pesticide Control." The DPR pesticide use data base only includes application by agriculture and in urban areas by commercial pest control applicators. It does not include the amounts purchased by the public in garden supply stores. For the OP pesticides, it was estimated that as much diazinon and chlorpyrifos was used by the public on residential properties as by commercial applicators.

A visit to a Davis, CA (population about 50,000) home and garden supply store shows that Bayer Environmental Services is selling several products for home outdoor use that contain imidacloprid including a granular product that is to be applied to lawns by a spreader for grubs. Another Bayer product is being sold in hand spray bottle that contains imidacloprid for use on "rose and flower." This product also contained the pyrethroid cyfluthrin.

The use of imidacloprid on residential properties raises questions about whether this pesticide could cause aquatic life toxicity in stormwater and fugitive water runoff. Zalom et al. (2005) has indicated that the "*neonicotinoids are more similar to the OPs than pyrethroids in their potential to move through soil and runoff in surface waters*." They also state that "imidacloprid is soluble in water (5.14 g/L), has moderate binding capacity to organic materials in soils (K_{oc} = 262 and a relatively long half-life in soils (365 days)."

A review of the US EPA OPP Ecotoxicity Database,
http://www.governmentguide.com/officials_and_agencies/agencies/u.s./independent/govsite.adp?bread=*Main*officials_and_agencies.adp?id=16101798*Officials%20and%20A

gencies*agencies.adp?id=16101799*Agencies*u.s..adp?id=16101800*U.S.*&url=http%3A//www.epa.gov/&CID=16101830
shows imidacloprid has LC 50 for several types of freshwater and marine fish and Daphnia magna in the order of 100 mg/L. The most sensitive aquatic organism tested in registration of the pesticides with US EPA OPP was mysid with a LC50 of about 4,000 ng/L. In comparison the diazinon LC 50 for *Ceriodaphnia dubia* is about 400 ng/L and for *Daphnia magna* is about 1,000 ng/L. Based on the studies of Lee and Taylor (2001) in the Upper Newport Bay watershed where several OP and carbamate pesticides were found in stormwater runoff, that pesticides with LC50 values of above about 3,000 ng/L that are applied in a manner similar to diazinon, and with similar mobility, would rarely cause receiving waters toxicity to larval fish, zooplankton like Ceriodaphnia and green algae. Marshall Lee of the CA Department Pesticide Regulation and Jeff Miller of AquaScience Davis, CA have indicated in personal communications that they agree with this assessment. According to the US EPA OPP website information on the neonicotinoids the rates of application tend to be less than for many other pesticides.

M. Lee (personal communication) 2005) has pointed out that there are exceptions to this guideline where some pesticides are toxic to some fish at very low concentrations well below the LC50. He cited as an example the toxicity of molinate to carp. The LC50 for molinate to carp is about 100 µg/L, however, much lower concentrations affect carp through inhibiting blood clotting. This type of pesticide and fish species specific toxicity should be considered when evaluating the potential impact of a pesticide to aquatic life.

From this preliminary assessment it appears that the use of imidacloprid for home use as a replacement for chlorpyrifos and diazinon would not likely be a cause of stormwater runoff aquatic life toxicity. However, as discussed by Zalom et al. (2005) there is concern that imidacolprid has the potential to cause groundwater pollution. They state,

> "*Neonicotinoids are more similar to OPs than pyrethroids in their potential to move through the soil and run off in surface water. The California Pollution Contamination Prevention Act of 1985 established a set of specific numerical values (SNV) for pesticides and required DPR to place active ingredients on a list of candidates as potential leachers if their water solubility value exceeds 3 parts per million (ppm) or if the soil adsorption coefficient is less than 1,900 cm^3/g, and if one of three persistence parameters is exceeded. The three major neonicotinoids currently registered in California all exceed the SNVs and are on the list, suggesting that care is needed when using these products to protect water quality.*"

DPR (2004a, b) in accord with Section 13145(d) of the Food and Agricultural Code has listed imidacloprid as having the potential to move to ground water. However, it currently it does not require a groundwater protection permit. In accord with current DPR regulations, before a pesticide is listed as requiring a groundwater protection permit it must have been found to have caused groundwater pollution. This approach is not protective of groundwater quality since based on the properties of a pesticide and soil aquifer characteristics, it is possible to predict whether a pesticide will likely cause groundwater pollution. The potential to cause groundwater pollution is an issue that will likely be addressed in evaluating the agricultural uses of imidacloprid. If it is found that in some areas, the soil column permeability and other characteristics are such that there is potential for groundwater pollution, then urban stormwater runoff water quality managers may need to evaluate whether the imidacloprid in urban stormwater runoff could lead to groundwater pollution in the urban area. Of particular concern is the potential for detention ponds, vegetated areas that tend to promote groundwater infiltration as well as groundwater infiltration basins could lead to groundwater pollution. Lee et al. (1998) have discussed the importance of monitoring groundwater potentially impacted by stormwater infiltration basins to determine if the infiltrated groundwater contains chemical constituents that can pollute groundwater.

Another issue concerning the use of imidacloprid is that it breaks down into several chemicals that have not been properly evaluated with respect to causing aquatic life toxicity. The evaluation of a pesticide for adverse impacts to non-target organisms should include incubation studies where the toxicity of the pesticide to the standard test organisms is evaluated after about one week, one month and several months of appropriate incubation under aerobic and anaerobic conditions. This approach would screen for highly toxic breakdown products.

Urban Pesticide Committee

Several years ago the San Francisco Regional Water Quality Control Board and the Central Valley Regional Water Quality Control Board staff's organized the Urban Pesticide Committee (UPC). The UPC addresses a broad range of issues related to pesticides and water quality. In addition to being an information clearinghouse, the Urban Pesticide Committee serves as a stakeholder forum for development of the Diazinon and Pesticide-Related Toxicity in Bay Area Urban Creeks Water Quality Attainment Strategy (WQAS) and Total Maximum Daily Load (TMDL) an information clearinghouse, and a mechanism for tracking WQAS implementation. The UPC holds a meeting every two months in Oakland, CA. At these meetings discussions are held on urban pesticide water quality related issues. It is possible to participate in these meeting via conference call. Those interested in getting on the UPC meeting announcements email list should contact Laura Speare UP3 Project Manager Urban Pesticide Pollution Prevention Project San Francisco Estuary Project at UP3@waterboards.ca.gov. The UPC website is http://www.swrcb.ca.gov/rwqcb2/urbancrksdiazinontmdl.htm.

Overall Status of Replacement Pesticides Impact Evaluation

The termination of the sale of diazinon and chlorpyrifos for residential use should in about two years when the existing residential stocks are used, greatly reduce to possibly eliminate urban stormwater caused receiving water column aquatic life toxicity to *Ceriodaphnia* due to diazinon and chlorpyrifos. However, the significant deficiencies in the US EPA OPP regulatory process for registration of pesticides, where highly toxic pesticides to one of more forms of aquatic life receive labels that allow use without evaluating whether stormwater runoff and fugitive water releases for the areas of application, can cause aquatic life toxicity in the receiving waters for the runoff, requires that water quality regulatory agencies and urban stormwater quality managers take a proactive approach to evaluating whether new or expanded use pesticides, such as the pyrethroid based pesticides that are being used in large amounts in urban areas as replacement for diazinon and chlorpyrifos, are causing aquatic life toxicity in the urban receiving waters for stormwater runoff.

The stormwater NPDES permits that are being issued by the CVRWQCB and other Regional Boards are a major step in the right direction to becoming proactive to detecting aquatic life toxicity in the receiving water runoff water column. Those stormwater runoff NPDES permits that do not require receiving water sediment toxicity are deficient in evaluating the potential impacts of the pyrethroid based and other pesticides that tend to strongly attach to surfaces/sediments and thereby be adverse to the benthic organism based food web. Sediment aquatic life toxicity testing using US EPA standard benthic organism toxicity tests should be part of the stormwater NPDES required monitoring.

It will be important that urban stormwater managers periodically at least biannually survey the large local garden and home pesticide retail sale locations to determine what pesticides are being sold to the public for home use. When new or significantly expanded sale of pesticides occurs, a preliminary evaluation of the potential to cause toxicity in urban stormwater runoff based on the use of the US EPA OPP Ecotoxicity Database should be conducted. If the LC50 for the pesticide for Daphnia magna, Mycid, and freshwater and marine larval fish is greater than about 3,000 ng/L and if the pesticide is used at application rates similar to diazinon, it is unlikely that the pesticide will cause water column aquatic life toxicity in receiving waters for urban stormwater runoff. However, studies will need to be conducted to determine if the pesticide transformation products can cause aquatic life toxicity in stormwater runoff. At this time there is insufficient information on the toxicity of pesticides that tend to accumulate in aquatic sediments to establish a screening level LC50.

If the pesticide has an K_{oc} similar to the currently used pyrethroid based pesticides, then there is need to evaluate if it can cause aquatic life toxicity in receiving water sediments through the use of sediment toxicity tests. If sediment toxicity is found in the areas where sediments from stormwater runoff tend to accumulate in the receiving waters for urban stormwater runoff, then benthic organism bioassessment studies need to be conducted relative to reference areas with similar benthic organism habitat which have not received the pesticide to determine if the benthic organism assemblages are impacted by the toxicants in the stormwater runoff.

It is also important to evaluate whether highly mobile pesticides can cause ground water pollution through infiltration into groundwaters. This will require groundwater monitoring near areas where groundwater infiltration occurs especially near groundwater infiltration based BMPs.

In order to screen for current water quality problems caused by organochlorine pesticides such as DDT and its transformation products, chlordane and others, representative samples of fish should be collected from the stream and analyzed of these pesticides in the edible tissue. If only small fish are available then whole fish can be used. The analytical results should be examined relative to current US EPA and any state/local guidelines for protection of human health. If there are individuals that use fish from the stream for food at a rate greater than the guideline assumed value then the guideline should be adjusted for the fish consumption rate applicable to the waterbody.

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