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WATERWISE

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TMDLs - A New Approach to Water Quality Regulation

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The Total Maximum Daily Load (TMDL) term refers to a regulatory program, numeric water-quality standards, the process to set those standards, and a new approach to regulating water-quality. The TMDL approach is different from past water-quality regulation because it focuses on improving the quality of a water body rather than limiting the concentration of pollutants coming out of the end of a pipe. Furthermore, the TMDL approach is designed to limit pollution from both point and non-point pollution sources. Finally, the TMDL program's goal of improving the quality of water bodies necessitates a watershed-wide pollution-reduction strategy.

History

The TMDL program has its roots in the Clean Water Act (1972); which directs states to identify polluted water bodies and take action to eliminate pollution. However, for the first two decades following passage of the legislation, Federal and State Governments used the National Pollutant Discharge Elimination System (NPDES) permit system to reduce pollution from large point sources such as public wastewater plants. This approach has largely succeeded in identifying low-cost pollution reduction technologies and mandating that point sources install these technologies. However, despite this success, in California many water bodies remain polluted; 80-85% of river miles and 63% of lake acreage suffer significant impairment (EPA 2002). The key unaddressed problems are non-point agricultural and urban runoffs. The EPA began to address non-point water pollution and contaminated water bodies in the early 90s through the TMDL program.

Process

Current NPDES permits regulate the contaminants emerging from the end of a pipe. However, the TMDL process begins instead by setting a water quality goal - the desired beneficial uses (i.e., drinking water, recreation, or sport fishing) for a waterbody. In California, the regional water quality control boards (RWQCBs), together with local stakeholders, decide these beneficial uses. The designation of beneficial uses is frequently controversial. For example, there is ongoing discussion over whether certain reaches of the Los Angeles River could ever be used for recreation. The next step is to determine which water bodies are too polluted to achieve their beneficial uses. For these water bodies, the RWQCBs set numeric pollutant standards whose attainment will allow the water body to fulfill its designated beneficial use. Each separate numeric standard is called a TMDL. TMDLs also need to be approved at the state and national levels.

Regulation Implementation

The RWQCBs next step is to implement the numeric standards through regulation of polluters. Nationally, there is a great deal of controversy over whether the states are required to implement the

Introduction

This is the debut edition of the Department of Environmental Sciences new quarterly newsletter focusing on water issues. Each issue will address a current topic in water policy. The first two issues will look at the TMDL program from natural science, policy, and economic viewpoints. The TMDL program is a new approach to water regulation that is likely to significantly affect industry, agriculture and government. In this issue we discuss the TMDL approach and regulation, some recent legislative updates to the TMDL program, pesticide TMDLs, and the relationship between solid-waste application and water quality. We welcome suggestions for future topics and any follow-up questions on the subjects discussed in this newsletter.

The list for this issue was compiled from the following mailing lists: Soil Water Newsletter, PesticideWise Newsletter and Waste Management Workgroup membership list. Please contact bowman.cutter@ucr.edu if you wish to be removed from this list.

numeric standards. However, in California, the Porter-Cologne act requires implementation. The RWQCBs first implementation step is to determine who has to reduce pollution in order to satisfy the numeric standards. One avenue to achieve the TMDLs is further reduction of pollution limits in current NPDES permits for point sources. However, this path is likely to be very expensive, since the available low-cost pollution-reduction technologies have already been implemented in point sources. Another avenue to pollution reduction is to require that non-point sources undertake best management practices (BMPs) such as construction of wetlands to treat urban runoff. The consensus economics view is that non-point-source BMPs are likely to have greater bang-for-the-buck than further tightening of NPDES permits (Boyd 2000). In most cases, it is likely that TMDL compliance will necessitate further regulation of point sources as well as BMPs for non-point sources. The California TMDL process affords many opportunities for affected parties such as industry and local governments to comment on how pollution reduction requirements will be assigned (SWRCB).

TMDL Costs

The TMDL program does not mandate that pollution-load reduction necessarily achieve the TMDL standards in one fell swoop. Instead, it envisions a gradual ratcheting up of standards. If TMDLs are not achieved by initial steps, the RWQCBs will require further BMPs and/or reduce pollution allowances in NPDES permits. The EPA hopes that this will minimize the costs of reaching the ambient water quality standards.

TMDL requirements are likely to cause significant new pollution-control costs for local governments as well as private industry. The EPA has estimated that TMDL development for a single waterbody (up to and including pollution-load reduction allocations) costs about $50,000 (EPA 2001). Implementation costs are likely to be significantly higher. Local governments will, at a minimum, be required to undertake some BMPs such as increased street sweeping. At a maximum, the regional boards may require some treatment of wastewater. Though these implementation costs may be significant, they can be reduced substantially by research into cost-effective pollution control methods. In the next newsletter, I will discuss how economists think regulatory agencies should assign pollution reduction responsibilities to minimize costs.

1. 2000 National Water Quality Inventory. Environmental Protection Agency, EPA-841-R-02-001 August 2002.

2. Boyd, James. (2000) "The New Face of the Clean Water Act: A Critical Review of the EPA's Proposed TMDL Rules." Washington, D.C.: Resources for the Future, Discussion Paper 00-12.

3. State Water Resources Board. "Background." TMDL Information. 2003. http://www.swrcb.ca.gov/tmdl/background.html#background

4. The National Costs to Develop TMDLs (Draft Report). Environmental Protection Agency, EPA-841-D-01-004, July 31, 2001.

A Brief Review of TMDL Legislations

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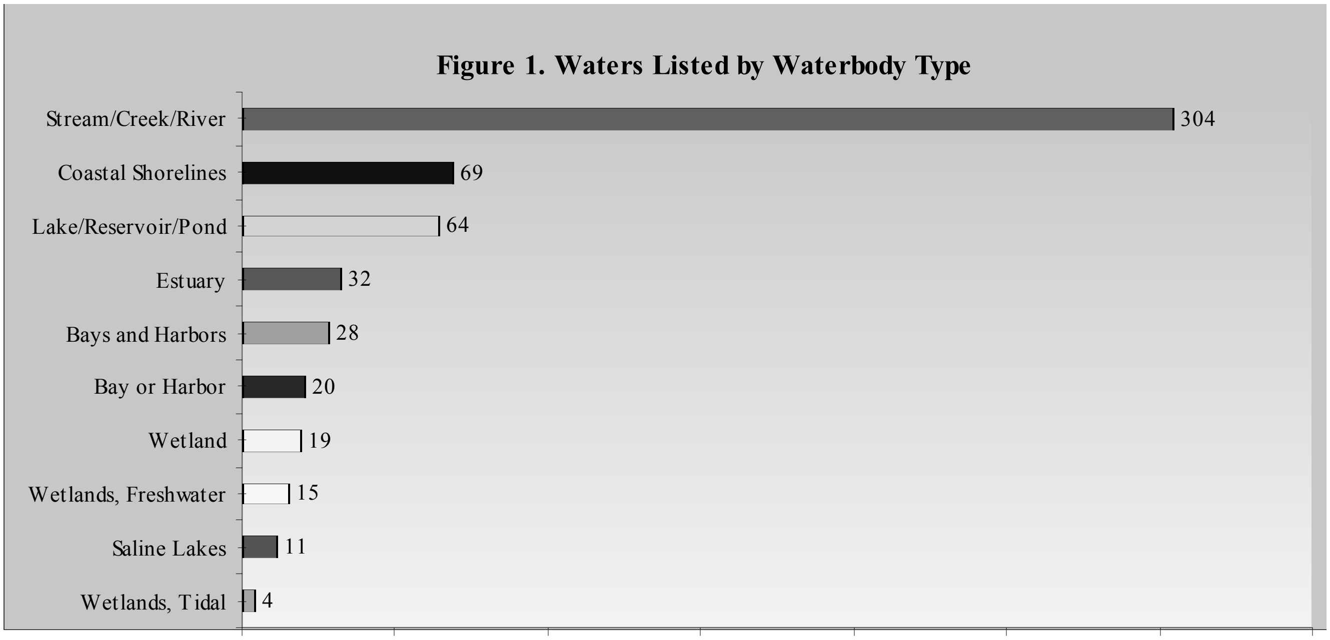
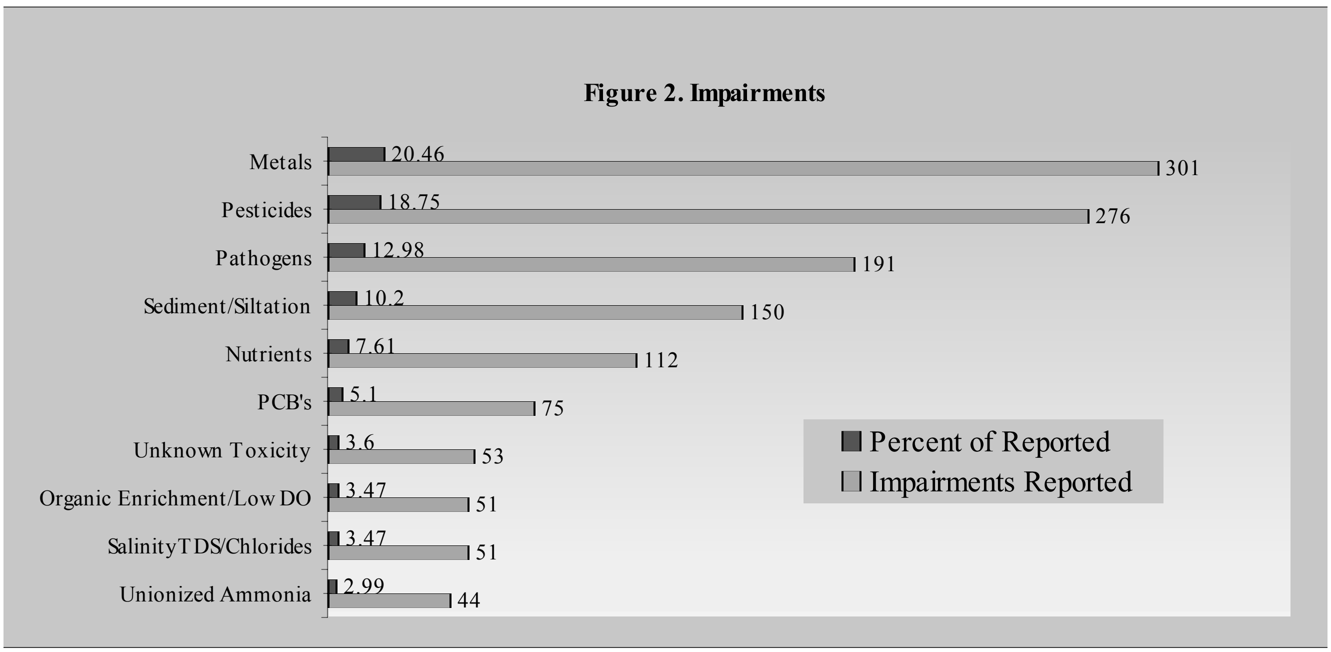
Water Management Specialist

Section 303(d) of the Clean Water Act, passed in 1972, requires states to identify all of their water bodies that fail to meet applicable water quality standards and to establish "total maximum daily loads" -(TMDLs) for these impaired, polluted water bodies so that they can be sufficiently cleaned to comply with applicable water quality standards. TMDLs define how much of a pollutant a water body can tolerate (absorb) daily and still comply with applicable water quality standards. All pollutant sources in the watershed combined, including nonpoint sources, are limited to discharging no more than the TMDL. The Water Act of 1987, Section 304(l), provided a new set of technology standards and called for development of numerical water quality criteria. It also provided a blueprint with a tight, five-year timetable for the accelerated cleanup of toxic hot spots. As much progress was being made in abating point source pollution, nonpoint-source pollution became a major and growing cause of water pollution. In responding to this concern, Congress added Section 309 to the Act to fund and stimulate state nonpoint-source programs.

In 1985, EPA issued regulations governing identification of impaired waters and establishment of TMDLs, and the regulations were revised in 1992. The current regulations require that State, Territorial, and authorized Tribal lists must be submitted to EPA every two years, and the priority





ranking for listed waters must include list of the pollutant or pollutants causing or expected to cause the impairment and list of the water bodies targeted for TMDL development in the next two years.

The EPA's July 13, 2000 Final rule: The reasons for the July 2000 rule were the following: (1) EPA was concerned with the slow progress despite the regulations issued in 1985 and 1992; (2) stakeholders had raised concerns with the lack of clarity and consistency in the program, and (3) environmental and public organizations had started filing lawsuits alleging that EPA should be held accountable, under the CWA, for its failure to oversee and supplement inadequate State 303(d) listing and TMDL establishment efforts. The July 2000 rule amended and clarified existing regulations implementing a section of the CWA, which requires States to identify waters that are not meeting applicable water quality standards and to establish pollutant budgets (TMDLs) to restore the quality of those waters. It also amended EPA's National Pollutant Discharge Elimination System (NPDES) regulations to include provisions addressing implementation of TMDLs through NPDES permits. Due to considerable controversy, EPA proposed to postpone the effective date of the July 2000 rule for 18 months, until April 30, 2003.

Withdrawal of the July 2000 rule: Due to the controversy, pending litigation and lack of stakeholder consensus on key aspects of the July 2000 rule, EPA feels that the July 2000 rule cannot function as the blueprint for an efficient and effective TMDL program without significant revision, and such a revision cannot be done before its effective date of April 30, 2003. Therefore, EPA decided to withdraw its July 2000 final rule. However, EPA believes that the withdrawal of the July 2000 rule will not adversely affect the increasing momentum of State TMDL programs across the country. Should EPA ultimately decide to withdraw the July 2000 rule, the TMDL programs would continue to operate under rules promulgated in 1985, as amended in 1992. As a result, there would be no gap in regulatory coverage.

California's Current 303(d) List

California's current 303(d) list includes 509 water bodies identified as failing to meet applicable water quality standards. For these impaired water bodies, TMDLs must be established, calculated by the state or the EPA, and implemented. Figure 1 shows the number of waterbody types identified as impaired. The most frequently found pollutants are metals pesticides, pathogens, sediment, and nutrients (Figure 2).

Reference

Figures were adapted from the U.S. Environmental Protection Agency.Web site:
http://oaspub.epa.gov/pls/tmdl/waters_list.control?state=CA&wbtype=STREAM%2FCREEK%2FRIVER

A Look at Pesticide TMDLs in California

Jay Gan
Water Quality Specialist

What TMDLs?

In California, TMDL pollutants include many different types. According to the 303(d) list, there are about 800 TMDLs in California. However, since many TMDLs address multiple pollutants, on single pollutant basis, the total number of TMDLs is 2125, of which 695 are classified with "high priority." Figure 1 is a breakdown of the pollutants from the high-priority TMDLs.

Pesticides represent a significant 18% of all pollutants! Among the pesticide TMDLs, the majority are associated with legacy pesticides such as DDT and chlordane, but some are associated with currently registered pesticides such as diazinon and chlorpyrifos (Dusban) (Figure 2).

Figure 3. High-priority TMDLs in CA

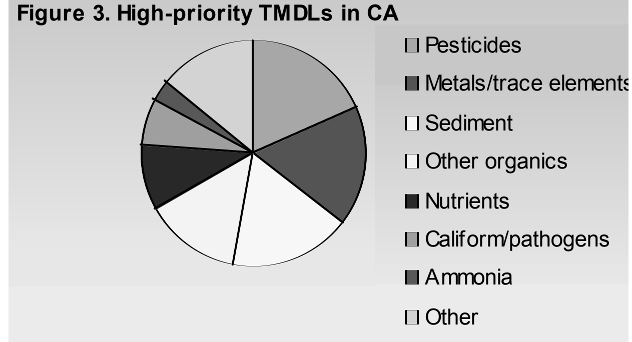
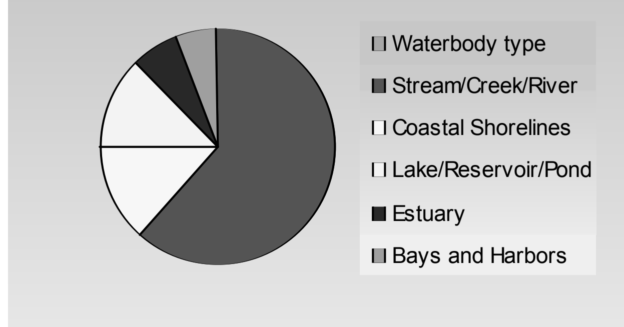


Figure 4. High-priority pesticide TMDLs in CA



Why Pesticide TMDLs?

We need TMDLs for DDT-like pesticides because these pesticides are extremely persistent and they can still be found in sediment even though they were banned over 30 years ago. These pesticides tend to "bioaccumulate" along the food chain. We need TMDLs for diazinon and chlorpyrifos because these two pesticides are acutely toxic to many aquatic organisms.

A Pesticide TMDL Example

In San Diego Creek there are currently a diazinon TMDL and a chlorpyrifos TMDL. These pesticides can cause acute and chronic toxicity to aquatic life in San Diego Creek and its tributaries. Average diazinon concentrations during baseflow (200 ppb) and stormflow (445 ppb) have exceeded the chronic numeric target of 50 ppb, while average chlorpyrifos concentrations in San Diego Creek during baseflow (111 ppb) and stormflow (87 ppb) have exceeded the chronic numeric target of 14 ppb.

Numeric Targets

The numeric targets given in Table 1 will be protective of aquatic life in San Diego Creek and Upper Newport Bay and sufficient to remove impairment caused by OP pesticide toxicity.

Taable 1. Numeric targets for diazinon and chlorpyrifos

Pesticide	Criterion	Concentration (ng/l, or ppt) Fresh Water	Salt Water
Diazinon	Chronic	50	N/A
Diazinon	Acute	80	N/A
Chlorpyrifos	Chronic	14	9
Chlorpyrifos	Acute	20	20

Table 2. Diazinon and chlorpyrifos allocations for San Diego Creek

Category	Diazinon (ng/L)		Chlorpyrifos (ng/L)	
	*A	**C	*A	**C
Wasteload Allocation	72	45	18	12.6
Load Alloc.	72	45	18	12.6
Safety Margin	8	5	2	1.4
TMDL	80	50	20	14

*A = Acute; **C = Chronic

Sources

Runoff derived from urban land uses accounts for 88% of the diazinon baseflow load and 96% of the stormflow load. For chlorpyrifos, runoff derived from urban land uses accounts for 85-88% of the baseflow and stormflow loads, while agriculture accounts for about 12-15% of the load.

TMDL Allocations

From Table 2, we can see that in order to meet the chronic and acute numeric targets, the needed reductions for diazinon will be 95% and 93%, respectively. The needed reductions for chlorpyrifos will be 90% and 97%, respectively.

Biosolids and Water Quality

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Municipal wastewater treatment plants eliminate potential pollutants from the sewage generated by California homes and businesses. Solids are removed with screens or by letting them float or settle. Most liquid or dissolved contaminants are eliminated by beneficial bacteria that either assimilate them or convert them to carbon dioxide, gas, and water. The bacteria can also be collected through settling and flotation. Once collected materials are stabilized, they are referred to as biosolids. Biosolids management is itself a critical water quality concern. Approximately 5.6 million dry tons of biosolids are produced in the United States annually (NRC, 2002). Of this amount, approximately 60% is land applied, a practice currently advocated by the EPA, which regulates the practice in 40CFR Part 503. Biosolids are rich in the nitrogen, phosphorus, and trace elements needed by agricultural crops and landscape plants, and land application is generally less expensive than incineration or landfilling.

At the time it was promulgated on February 19, 1993, Part 503 was state-of-the-art in the way it managed the risk of long-term heavy metal toxicity. It also regulated pathogens in biosolids, permitting restricted use for biosolids with low concentrations (Class B biosolids) and unrestricted use for biosolids with very low concentrations (Class A). Prompted by public and scientific discussion about some of the assumptions used to develop Part 503, as well as about the possibility of regulating biosolids contaminants beyond metals and pathogens, the National Research Council (NRC) convened two scientific review committees. The first reported in 1996, while the second published its findings in 2002.

Neither NRC report found documented scientific evidence that land application under the Part 503 rule has harmed public health, despite anecdotes to that effect. The 1996 report focused on land application to food crops and considered subsequent impacts on soils, crops, and groundwater quality. The 2002 document considered all land-application practices, including forest applications and land reclamation, but focused on human health risks and risk assessment issues rather than the environment. The most important ground and surface water findings were:

Groundwater

The 1996 report concluded that metals as well as dioxins and other toxic organic compounds (TOCs) are bound in soils and would not be expected to affect groundwater. The 2002 report concurred with the previous findings, but suggested in addition that percolation of pollutants be modeled more thoroughly, including preferential flow, which is the tendency for water to move quickly through localized pathways rather than uniformly across fields. Preferential flow would, for example, permit smaller pathogens to leach quickly to groundwater where they might survive much longer than they would in a soil environment. The most significant finding of the reports with respect to groundwater was that the rate of nitrogen release from biosolids needs further study to avoid nitrate pollution due to overapplication. Nitrate is the most common groundwater pollutant.

Surface Water

Metals, pathogens, and TOCs can be carried to surface waters through erosion. Fish were considered by Part 503 to the extent that they accumulate metals and are eaten by humans. In June 2002 the EPA proposed land application limits on dioxins and similar compounds in biosolids associated with cancer in humans. The risk assessment for this proposed rule included erosion and leaching processes, air deposition, as well as an aquatic food-chain concentration model. However, because the EPA lacks data about the health effects of these compounds on fish and other aquatic organisms, the risk assessment considered only birds, terrestrial animals, and humans as fish and aquatic insect consumers. Fish health itself was not evaluated. A final dioxin limit is expected by October 2003. The 2002 NRC report questioned some of the assumptions about erosion to surface water made by the EPA to develop Part 503 as part of its call for an overall improved risk assessment.

As we improve our capacity to predict and monitor pollutants in the environment, we can expect increasing demands on regulators to justify their decisions scientifically. We can also expect discussion of pollutants of emerging interest, such as excreted pharmaceuticals and those that behave as hormones (endocrine disruptors). Debate will continue. In the meantime municipalities are working hard to clean wastewater and to use the resulting biosolids responsibly.

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WaterWise is published quarterly by Drs. Bowman Cutter, David Crohn, Jay Gan, Laosheng Wu, and Marylynn V. Yates, Cooperative Extension Specialists in the Department of Environmental Sciences at the University of California, Riverside. The intent of the publication is to disseminate summaries of research results and topics of interest to UC farm advisors, CE specialists, and UC faculty working in areas related to water management and environmental sciences. Additional copies are available upon request. Please address comments and correspondence to Dr. Bo Cutter, current editor. Contact Dr. Cutter via e-mail (bowman.cutter@ucr.edu), by telephone (909-787-2088), by fax (909-787-3993), or by mail addressed to him in the Department of Environmental Sciences, University of California, Riverside, Riverside, CA 92521. WaterWise is issued in furtherance of Cooperative Extension work, Acts of May 8, 1914 and June 30, 1914, in cooperation with the United States Department of Agriculture, W. R. Gomes, Director, University of California Cooperative Extension.

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