Chapter 5: Target Pollutant

5-1 INTRODUCTION

The Permittees implement the Target Pollutant program to identify and focus resources on the pollutants most likely to impair local receiving waters. Pollution control strategies and best management practices (BMPs) that address target pollutants complement more general BMPs that are not driven by specific local water quality concerns. The latter, which include control measures such as water quality detention basins and industrial inspections, may also reduce target pollutants, but have a broader focus.

GOAL OF THE TARGET POLLUTANT ELEMENT:

Identify and prioritize Sacramento's most significant urban runoff pollutants and their sources and then develop, implement and evaluated strategies to reduce those pollutants.

A summary of the strategy development and evolution of the Target Pollutant Element is provided in this chapter as well as planned future activities. For a more detailed summary of work completed on the Target Pollutant Element through 1999, refer to the 1998/99 Annual Monitoring Report.[1] For more details of work conducted since 1999, refer to the Annual Monitoring Reports and Annual Reports for the year 2000 and later.

5-2 STRATEGY DEVELOPMENT

The Target Pollutant Element employs a target pollutant identification and control process, which is a stepwise process summarized below and illustrated in Figure 5-1 on page 5-3.

Step 1. Identification and Ranking of Target Pollutants.

The Permittees identify target pollutants by using water quality monitoring data to rank the observed constituents through comparison to various indicators of actual or potential water quality impacts. The data used is primarily from the Permittees monitoring program, and includes water chemistry, toxicity, and bioassessment data. The constituents identified as target pollutants are those receiving the highest rankings, using a weighted scoring scheme based on best available science and professional judgment.

The ranking methodology has become increasingly sophisticated over time. It considers available data regarding measured pollutant levels in local urban runoff, inferred impacts, and the relative contribution of urban runoff to the American and Sacramento Rivers. Another important consideration is whether or not a pollutant is found to impair a water body per section 303(d) of the Clean Water Act. Urban runoff, urban creek, and river constituent levels are compared to levels in the U.S. Environmental Protection Agency (EPA) California Toxics Rule, Regional Board Basin Plan, EPA Safe Drinking Water Maximum Contaminant Levels (MCLs), California Department of Health Services Guidance Levels, California Department of Fish and Game Guidance Levels, and EPA Criteria for the Protection of Aquatic Life.

Step 2. Identification and Prioritization of Sources

Once target pollutants are identified, the Permittees identify and rank likely pollutant sources based on a review of available local, statewide, and national literature. Sources include specific products and activities that contain or are likely to contribute target pollutants to urban runoff. The sources are ranked so that control strategies can be focused on those sources with the greatest potential for reducing local pollutant levels.

Step 3. Development of Target Pollutant Control Strategies

The Permittees work together to develop and periodically update area-wide strategies for controlling the top-ranked sources of each target pollutant. This involves selecting the most technically effective, practical, and cost-effective combination of control measures, and therefore begins with a review of potentially applicable ones. Control measures are identified based on experience and knowledge of program consultants and staff as well as research of regional, statewide, and national programs.

For sources that cannot be effectively controlled at the local level, the Permittees actively seek ways to influence regional policy, participate in State and Federal regulatory processes, or support other agency or stakeholder efforts to effect pollution reduction. For example, Permittee staff lead the effort of the California Association of Stormwater Quality Agencies (CASQA) to submit comments on State and Federal pesticide registration and evaluation activities.

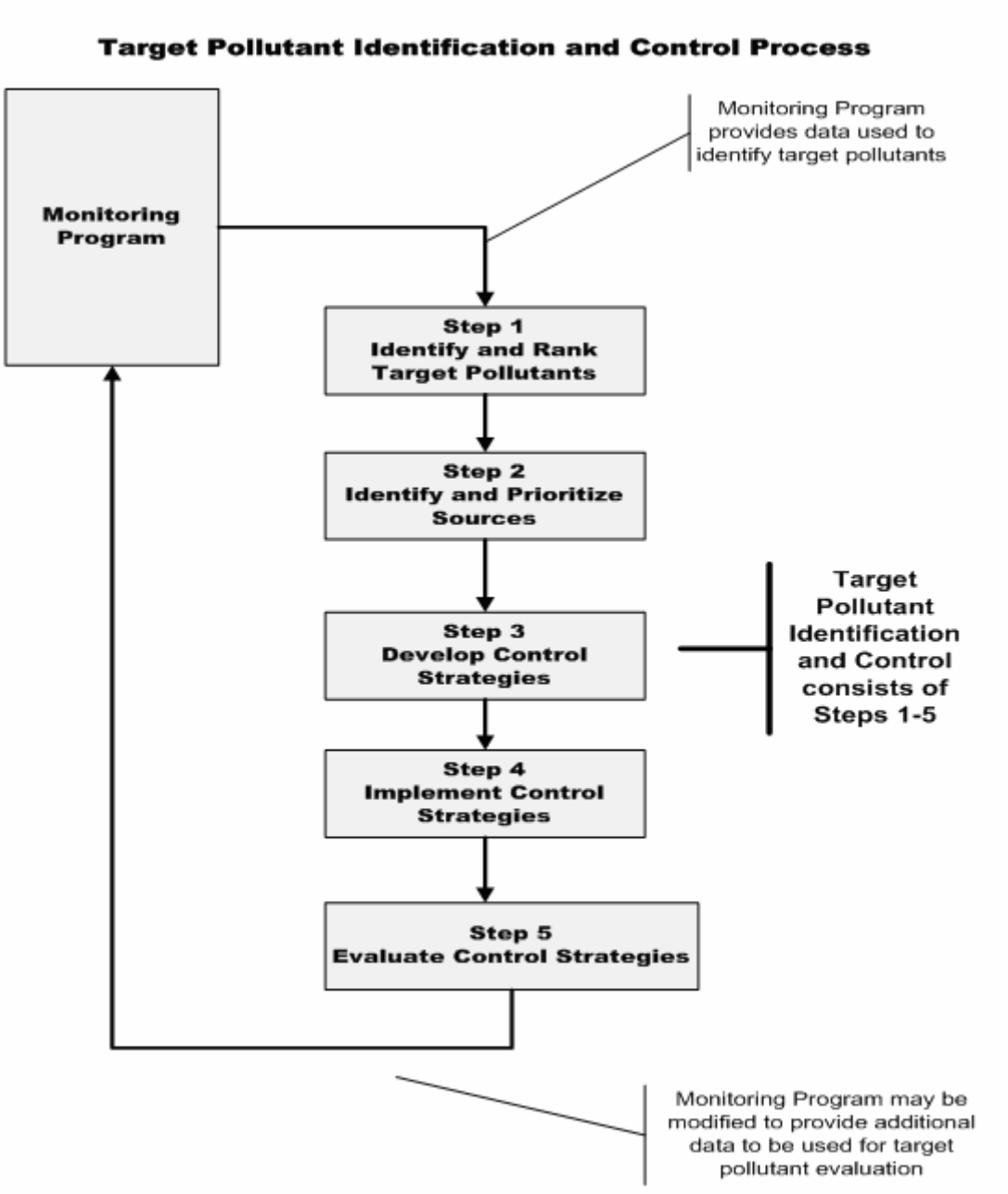
Step 4. Implementation of Target Pollutant Control Strategies

Identified control strategies are implemented as part of other program elements, when appropriate; otherwise, they are implemented under the Target Pollutant program. Selected best management practices (BMPs) and activities may be implemented under one program element or several program elements, and may be done jointly by all Permittees or individually.

Step 5. Effectiveness Evaluation for Target Pollutant Control Strategies

As described in Chapter 3, the Permittees are adopting the CASQA methodology for evaluating the effectiveness of their program, including control strategies for target pollutants.

Figure 5-1: Target Pollutant Identification and Control Process



5-3 EVOLUTION

During the first Stormwater Permit term (1990-1996), the Permittees initiated the process to identify target pollutants (formerly referred to as "constituents of concern" or "COCs") and made target pollutant control a distinct and important Program strategy.[2] The 1992/93 Annual Monitoring Report first introduces the concept and includes the first pollutant ranking results (based on a simpler process than the one now used).

The Permittees developed guidance procedures to identify and rank pollutant sources and to identify control strategies addressing the likely sources[3,4,5]. The guidance procedures recommend using available national, state, and/or local literature and data.

The Permittees have developed comprehensive plans to address pesticides (including diazinon and chlorpyrifos), fecal coliform/pathogens, and mercury. In addition, the Permittees identified sources and control measures for copper and lead.

A third round of Target Pollutant Prioritization occurred in early 2007. The most recent prioritization results show a continued high ranking for diazinon, chlorpyrifos, mercury, copper, lead, and bacteria. Notable additions to the higher ranks include aluminum and the PAH compounds chrysene, benzo (a) fluoranthene, and benzo (k) fluoranthene.

Table 5-1 below shows the target pollutant results for both the 2002 and 2007 ranking process.

Table 5-1: Target Pollutant Ranking: 2002 and 2007

Rank	2002 Constituent	2002/2003 Score	2007 Constituent	2006/2007 Score
1	Diazinon	67.9	Diazinon	59.3
2	Chlorpyrifos	59.8	Chlorpyrifos	52.5
3	Mercury, Total	43.1	Mercury, Total	33.5
4	Copper, Dissolved	14.0	Aluminum, Total	16.2
5	Zinc, Dissolved	10.7	Escherichia Coli	13.6
6	Coliform, Fecal	10.3	Coliform, Fecal	13.3
7	Coliform, Total	10.2	Copper, Dissolved	11.5
8	Solids, Total Dissolved	5.8	Zinc, Dissolved	8.2
9	Lead, Dissolved	5.2	Chrysene	7.3
10	Bis2(ethylhexyl)phthalate	5.1	Solids, Total Dissolved/EC	6.6
11	Cadmium, Dissolved	3.1	Benzo(b)fluoranthene	6.2
12	Solids, Total Suspended	3.0	Benzo(k)fluoranthene	5.4
13	Organic Carbon	2.2	Bis2(ethylhexyl)phthalate	3.4
14	Pentachlorophenol	1.4	Solids, Total Suspended	3.0
15	Benzo(b)fluoranthene	1.1	Lead, Dissolved	2.8
16	Chrysene	1.0	Trash	1.0
17	Methyl Tertiary Butyl Ether	1.0	Iron, Dissolved	0.8
18	Trash	1.0	Pentachlorophenol	0.5
19	Malathion	0.8	Hexachlorocyclohexane (Lindane and by-products)	0.1
20	Simazine	0.8	Simazine	0.0
21	Benzo(k)fluoranthene	0.6	Malthion	0.0
22	Iron, Dissolved	0.4	Carbon, Total Organic	0.0
23	2,4-Dinitrotoluene	0.3		
24	Benzo(a)anthracene	0.3		

5.4 Activities

Overview of Planned Activities

This section describes the planned target pollutant control activities for the next five years. Table 5-2 on pages 5-11 and 5-12 summarizes the proposed activities that will be continued during the fourth permit term. Significant alterations of activities are not planned, pending the results of effectiveness evaluations that will be conducted during this permit term. Activities will be modified, as necessary, based on the results of the evaluations.

The Permittees plan to:

- Periodically review new information such as recent monitoring data and revised water quality criteria to determine if there are any changes that would substantially affect the ranking of target pollutants. Such reviews are not intended to be a comprehensive review of the target pollutant rankings.

- Once during the 5-year permit term, conduct a comprehensive review of the target pollutant prioritization process (and revise as necessary).

- Re-prioritize the target pollutants using the revised process and incorporating new pertinent data (including the latest monitoring data).

The target pollutant prioritization process outlined in the preceding subsection uses comparisons to threshold values (such as water quality objectives) as the primary method for prioritizing target pollutants. Although this method is a very useful screening tool, the Permittees believe that refining the process may provide a better, more holistic way to identify the most important pollutants.

The planned comprehensive review/revision of the target pollutant prioritization process will consider additional information and analyses such as the following:

- New data sources, such as urban creek, bioassessment, and habitat monitoring;
- Trend information;
- Biotic ligand model[6];
- Influence on scoring results by regulatory factors such as the Sacramento River Basin Plan tributary rule[7] and U.S. EPA drinking water secondary maximum contaminant levels; and
- Beneficial use analysis.

Coordination with Notice of Water Quality Exceedance (NWQE) and Report of Water Quality Exceedance (RWQE) Processes

The Permittees plan to coordinate the evaluation of target pollutant control strategies with the NWQE and RWQE processes, described in Chapter 6. As part of that effort, the Permittees will develop and document the decision process used to determine when observed exceedences call for amendments to existing control programs.

Activities Addressing Pesticides

In the mid-1990s, the pesticides diazinon and chlorpyrifos were found in local urban creeks at concentrations where chemical and toxicity data implicated these two pesticides as significant pollutants in Sacramento waterways. These two pesticides were the first and second highest ranked target pollutants in both the 1993 and 2002 target pollutant prioritization.

Permittee efforts to address diazinon and chlorpyrifos evolved into an effort to address urban pesticides in general. The Permittees and other stakeholders (including Regional Water Boards and California Department of Pesticide Regulation or DPR) recognized that solely reducing the use of these pesticides might result in threats to water quality by other pesticides used to replace them.

That concern has subsequently been realized as pyrethroid insecticides have replaced diazinon and chlorpyrifos in urban areas. Studies by Dr. Donald Weston of UC Berkeley showed that pyrethroid insecticides used in urban areas are causing sediment toxicity to test organisms in the sediment in northern California urban creeks.

Urban uses of diazinon and chlorpyrifos were almost completely eliminated by 2004 as a result of actions taken by US EPA and the pesticide manufacturers, primarily based on issues identified under the Federal Food Quality Protection Act. Stocks of these pesticides purchased before they were pulled from the market may still be used legally.

Since 2004, these pesticides are still detected in urban creeks and urban runoff, although generally at levels below water quality objectives[8]. This represents a significant improvement over previous years when diazinon and chlorpyrifos were frequently detected in urban creeks at levels above water quality objectives. It is anticipated that observed concentrations will continue to drop as existing stocks are depleted and relinquished to household hazardous waste programs.

Pyrethroid monitoring has not been included in the Permittees' monitoring program to date, because the dramatic increase in urban pyrethroid uses is very recent, and because pyrethroid analytical methods with adequate detection limits have not been readily available from commercial laboratories. Due to the lack of data, pyrethroids have not yet been included in the Permittees' formal target pollutant prioritization process.

Primarily through taking a leadership role in CASQA's Pesticides Subcommittee (and using Dr. Weston's data), the Permittees helped persuade DPR to place pyrethroids in a regulatory process called re-evaluation. Information generated in this process will be used by DPR, and probably eventually U.S. EPA, to establish mitigation measures as necessary to reduce pyrethroid impacts.

The Permittees will continue to implement their comprehensive Pesticide Plan, which was submitted to the Regional Water Board in 2004 and received final approval in 2006. The plan's pesticide control strategies include:

- Reducing pesticide use associated with Permittee operations, including by adopting in-house policies promoting integrated pest management (IPM).

- Promoting IPM among the public and industry, including by supporting *Water Wise* and *Our Water Our World* IPM outreach programs; developing IPM guidance and training for landscape professionals; and helping to develop EcoWise Certified, an IPM certification for structural pest control operators.
- Monitoring, including water quality monitoring and evaluating pesticide sales and use patterns.
- Influencing State and Federal pesticide policy and regulations to improve water quality protection.
- As pyrethroid analytical methods become more readily available, the Permittees will integrate pyrethroids in the pesticide monitoring program.

Activities Addressing Copper

Copper occurs naturally in local soil and water and its release to the urban environment is a by-product of everyday human activities. Copper can cause toxic effects to aquatic life if it is in a bio-available form (i.e., usually a dissolved form) at a sufficiently high concentration and a sufficient length of exposure.

Through the NWQE/RWQE process (discussed in more detail in the Monitoring Program), the Permittees have reported a number of exceedances of copper in urban creeks, in both dissolved and recoverable forms. These exceedances were based on the California Toxics Rule objective, which allows for a hardness adjustment but does not consider other significant water quality parameters that affect copper aquatic toxicity. Through application of the U.S. EPA's recently adopted Biotic Ligand Model, the Permittees have determined that copper toxicity occurs much less frequently than previously believed.[9]

In 1997, the Permittees identified and prioritized sources of copper, as well as potentially effective BMPs.[10,11,12] This effort identified several potential sources of copper: rainfall, potable water used outdoors, naturally occurring copper in soils, brake pad wear, and possibly pesticide use.

In the 1990's, Bay Area stormwater programs estimated that approximately 80% of copper in urban runoff may originate from brake pad wear. Therefore, the likely most effective control measure for copper involves reducing the content of copper in manufactured brake pads. Subsequently, brake pad industry representatives and water quality interests (environmental organizations; and state, federal, and local government agencies) voluntarily formed the Brake Pad Partnership. The Permittees contribute financial support to the partnership, which examines the link between copper in automotive brake pads and copper in surface waters.

The partnership has been developing rigorous methods for studying the release of copper from brake pads, and estimating copper releases from other sources. Its 2006 reports on copper sources in the San Francisco Bay area[13,14] have confirmed the earlier estimate that brake pads are the major source of copper in that watershed. This confirmation helps clear the way toward industry reduction of brake pad copper content.

Although brake pads are the major source of copper in the waterways, the Permittees are also pursuing control measures for other sources. In 1998, the Permittees held a workshop to integrate the identified copper BMPs (for the targeted sources) into the activities of the various program elements.

The Permittees will continue to implement copper control strategies. The Program's control strategy for copper is summarized in Table 5-2, on page 5-11.

The Permittees will:

- Conduct special studies to evaluate street sweeping and detention basin effectiveness, utilizing data from existing studies, to estimate copper load reductions.
- Conduct a special study, utilizing existing documentation, to estimate behavior changes associated with the industrial inspection program.
- Evaluate progress of the Brake Pad Partnership in reducing brake pad copper content.

Activities Addressing Lead

Historically, lead had numerous uses in the urban environment. This resulted in a large reservoir of lead that remains as a legacy, even though the main uses of lead have been abandoned. The largest sources of lead in urbanized areas were gasoline and lead paint. Many buildings painted before 1978 include lead paint which remains on the houses and thus continues to be a source of lead in urban runoff. Lead gasoline was phased out in the 1970s and 1980s, but lead levels in soil in urban areas continue to exceed background levels. Lead contained in soils and subsequently mobilized in urban runoff may contribute to the amount of lead observed in local waterways.

Identified local potential sources of lead included weathering and erosion of lead-painted structures, small aircraft and vehicle exhaust emissions, tire wear, use of leaded pavement marking paints, erosion of soil with past accumulations of lead, shooting ranges, and several types of industries (auto and radiator repair shops; airports; auto dismantlers; machinery, electrical, and transportation equipment manufacturers; landfills and transfer stations; rail yards; and metal recyclers). The BMP identification work led to a list of potentially applicable good housekeeping practices, structural controls, and education and training activities for the identified sources.
In 1998/99, a joint Lead/Copper Workshop was held with Permittee staff to integrate the results of the source and BMP identification work into the activities of the various program elements.[15] The workshop was designed to address both copper and lead target pollutants because there are BMPs which address both constituents.

The Permittees will continue to implement lead control strategies. The Program's control strategy for lead is summarized on Table 5-2 on page 5-11.

Activities Addressing Coliform/Pathogens

Fecal coliform bacteria are frequently found in urban runoff at significant levels. These bacteria are widely accepted as indicators of fecal contamination, and such levels indicate that a significant amount of fecal material is probably discharged in urban runoff. Sources of fecal contamination in the urban environment are widespread, as they include both wild and domestic animals.

The primary impact of fecal contamination on water bodies is the potential presence of pathogens that may be associated with feces. However, due to limitations inherent to the use of indicator organisms, the actual amount of pathogens in urban runoff cannot be determined by extrapolation. In addition, direct analyses for pathogens in a matrix as complex as urban runoff is difficult, expensive, and inaccurate. As a result, despite high levels of fecal coliform bacteria, there is little direct evidence of pathogens in Sacramento urban runoff.

Despite the lack of adequate information on the presence of pathogens, the Permittees are focusing on measures that will reduce the discharge of fecal material to the storm drain and creeks.

The Permittees will continue to implement the Fecal Waste Reduction Strategy, which includes BMPs addressing human and domestic animal sources in four main areas:

- Illicit cross-connections from the sanitary sewer system to the storm drain system;
- Sanitary sewer overflows to local waterways;
- Pet waste; and
- Manure management at livestock facilities in the urbanized area.

Activities Addressing Mercury

The Permittees identified mercury as a top-ranked target pollutant in 2002. Mercury is a problem due to the high level of methyl mercury measured in several species of edible fish in the Delta. Methyl mercury content poses a threat to humans and wildlife that consume the fish, and thus impairs the fisheries beneficial use. This has led to the listing of the Delta as a high priority impaired water body on the State's 303(d) list, and a draft Total Maximum Daily Load (TMDL) for mercury in the Delta has been released for public comment.

The dominant sources of mercury now found in the Delta are historical mercury and gold mining upstream of Sacramento, as well as geologic sources such as soils and springs located throughout the Coast Ranges. Atmospheric deposition from remote sources such as coal fired power plants and volcanoes are also believed to be a significant contributor to mercury levels in the Delta.

It is unlikely that even complete removal of all mercury from urban runoff would have a significant effect on the levels of mercury in the water column and sediment, and or on the levels of methyl mercury in fish tissues of the Delta. This is because of two main factors. The first is that mass loading of mercury discharged from the Permittees' storm drain systems to local waterways is very small, when compared to the amount of mercury being discharged by other sources in the watershed and the amount already present in sediments of the Delta and the rivers. The other factor is that the amount of mercury discharged by the Permittees is greatly overshadowed by biogeochemical processes occurring in the river and the Delta, that generate methyl mercury from mercury already present in water and sediments.

The Permittees have developed a Mercury Plan that describes activities to address key mercury sources identified in the urban environment.

The Permittees will continue to implement their Mercury Plan. Broad categories of control measures include control of mercury sources associated with municipal operations, industrial inspections, public outreach, participation in initiatives to increase mercury recycling, participation in BeMercuryFree (a mercury source control program established by the Sacramento Regional County Sanitation District), and participation in efforts to address mercury on a regional or watershed basis.

Addressing Other Target Pollutants

The Permittees will begin work to address new top-ranked target pollutants identified in the re-evaluation process, as resources allow.

Table 5-2: Planned Target Pollutant Activities: Fourth Permit Term

General Target Pollutant Assessment	
	Integrate NWQE/RWQE process with Target Pollutant Prioritization
	Establish a decision/evaluation methodology to determine if additional actions are necessary to address exceedances as they are discovered
	Review and revise target pollutant prioritization process
	Update ranked list of target pollutants
	Select ranked pollutant and conduct source identification and control process
Continue Lead Control Activities	
	Continue street cleaning
	Continue operation of detention basins
	Continue maintenance of drainage facilities
	Continue to require erosion and sediment control BMPs for construction projects
	Continue new development requirements for on-site and regional stormwater treatment BMPs
	Continue implementation of industrial inspection program
Continue Copper Control Activities	
	Continue participating in funding and supporting the Brake Pad Partnership
	Continue street cleaning
	Continue operation of detention basins
	Continue maintenance of drainage facilities
	Continue erosion and sediment control BMPs
	Continue new development requirements for on-site and regional stormwater treatment BMPs
	Continue implementation of industrial inspection program
	Review and update swimming pool discharge brochure to ensure that copper is adequately addressed
Continue Coliform/Pathogen Control Activities	
	Continue prohibiting discharges of pet waste into the MS4
	Continue kennel inspection programs for appropriate waste handling procedures
	Continue outreach promoting appropriate disposal of pet waste
	Continue implementation of sewer enforcement, inspection and spill response BMPs described in other elements of the Stormwater Management Program
	Conduct three Coliform/Pathogens Workgroups to review current status of coliform/pathogen control efforts in the state and identify additional actions, if any
Implement Mercury Plan	
	Continue street cleaning
	Continue operation of detention basins
	Continue maintenance of drainage facilities
	Continue erosion and sediment control BMPs
	Continue new development requirements for on-site and regional stormwater treatment BMPs
	Update Mercury Plan for consistency with final TMDL, include methodology for calculating mercury load reductions
	Continue participation with the DTMC on mercury watershed programs
	Continue tracking urban runoff and HHW mercury reduction programs

Implement Mercury Plan (continued)	
	Continue tracking mercury air deposition and emission studies relevant to the Sacramento area
	Continue providing review and input for Delta and Sacramento River TMDL
	Incorporate mercury recycling messages into general materials/events
	Supply fact sheet for distribution to County EMD staff
	Conduct outreach to other commercial/ industrial businesses, as appropriate through BERC
Implement Pesticide Plan	
	Establish authority to implement Pesticide Plan tasks
	Document and evaluate municipal pesticide use
	Require oversight by Certified Pesticide Applicator
	Establish/conduct training program for public agency pesticide applicators
	Establish Permittee-specific IPM policies or ordinances
	Begin/continue establishment of operation/department specific IPM plans and procedures
	Ensure that Permittees have coverage under Aquatic Pesticide Permit if required
	Coordinate structural BMP design and maintenance with Sacramento-Yolo Mosquito and Vector Control District as needed
	Continue to support local IPM outreach and education programs, such as Water Wise Program and Our Water Our World
	Continue to support Household Hazardous Waste programs
	Continue to include pesticide information in stormwater media campaign
	Encourage incorporation of IPM in design of new development landscaping and buildings
	Provide training and promote implementation of IPM by Institutional Pesticide Users
	Continue regulation by the County Agricultural Commissioner
	Continue to enforce local prohibitions against illegal discharges
	Promote IPM implementation by PCOs
	Continue conducting water quality monitoring
	Continue tracking relevant monitoring programs by other agencies
	Review findings of residential pesticide sales and use surveys and utilize in outreach efforts
	Evaluate PCO pesticide use data
	Continue tracking and commenting on State and Federal regulatory activities that pertain to pesticides of significance to urban stormwater discharges
	Continue providing input for pesticide product risk assessments for surface water quality
	Continue participating in the development of TMDLs for pesticides in Sacramento urban creeks
	Continue supporting improvements in State and Federal pesticide regulations

Effectiveness Evaluation

Each target pollutant control strategy that is developed includes methods for evaluating the effectiveness of that strategy (Step 5 of the Target Pollutant Identification and Control Process). The results of the evaluations may result in reprioritization of sources, revisions to the reduction strategy, and/or revisions to the implementation of activities and BMPs.

Since some of the activities implemented under the Target Pollutant Element are also implemented under other program elements, the evaluation measures may coincide with evaluation measures in other program elements.

Examples of the outcome levels, goals and evaluation measures that will be used to measure the effectiveness of the Target Pollutant Element are provided below.

Outcome Level	Goal	Target Pollutant	Example Evaluation Measures
Level 1 – Documenting Activities	Achieve program development, implementation and basic compliance with NPDES permit requirements.	Coliform /Pathogens	# of people aware of the proper disposal of pet waste
Level 2 – Raising Awareness	Raise a target audience's awareness and understanding of an issue.	Pesticides	% of institutions implementing an IPM approach from previous year
Level 3 – Changing Behavior	Change a target audience's behavior that results in the implementation of recommended BMPs.	Pesticides Copper, Lead & Mercury Coliform /Pathogens	% of change in public awareness on pesticide use based on sales data and telephone surveys % change in violations at re-inspected industries that use metals % change in violations at re-inspected commercial kennels
Level 4 – Reducing Load From Sources	Reduce the load of pollutants from sources to the storm drain system.	Pesticides Copper, Lead & Mercury Copper	Estimates of load reduction associated with in-house IPM programs Estimate of load reduction from street sweeping and detention basins Brake Pad Partnership progress on reducing brake pad copper content

ENDNOTES

[1] Sacramento Stormwater Management Program, December 1999. *1998/99 Annual Monitoring Report and Comprehensive Evaluation, 1990–1999*. Prepared by Larry Walker Associates.
[2] Sacramento Stormwater Management Program, March 1995. *Effectiveness Evaluation Report*
[3] Sacramento Stormwater Management Program, November 1996. *1995/1996 Annual Monitoring Report - Appendix C: Stormwater Pollutant Source Identification, Source Prioritization, and Best Management Practices Identification and Evaluation.* Prepared by Archibald & Wallberg Consultants.
[4] Sacramento Stormwater Management Program, December 1997. *1996/1997 Annual Monitoring Report - Appendix D: Source Prioritization Methodology.* Prepared by Archibald & Wallberg Consultants.
[5] Sacramento Stormwater Management Program, December 1997. *1996/1997 Annual Monitoring Report - Appendix E: Control Measure Identification.* Prepared by Archibald & Wallberg Consultants.
[6] The biotic ligand model is a methodology newly incorporated by U.S. EPA into its water quality criteria process. It considers additional factors that affect the toxicity of metals in water, such as total organic carbon and pH. See USEPA. Office of Water. Office of Science and Technology *Aquatic Life Ambient Freshwater Quality Criteria – Copper*. February 2007 Revision. EPA-822-R-07-001[6]
[7] The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board Central Valley Region, the Sacramento River Basin and the San Joaquin River Basin. Fourth edition, February 2007.
[8] Larry Walker Associates. May 15, 2007.
[9] Laurenson, Brian M. March 2007. *Results of Initial Biotic Ligand Model analysis of Sacramento Urban Tributary Data.* Prepared for the Sacramento Stormwater Quality Partnership (Appendix J).
[10] Sacramento Stormwater Management Program, December 1998. *1997/98 Annual Monitoring Report - Appendix D: Identification of the Sources of Copper in Sacramento Urban Runoff.* Prepared by Larry Walker Associates.
[11] Sacramento Stormwater Management Program, December 1998. *1997/98 Annual Monitoring Report - Appendix E: Copper Source Prioritization.* Prepared by Larry Walker Associates.
[12] Sacramento Stormwater Management Program, December 1998. *1997/98 Annual Monitoring Report - Appendix F: Copper Control Measure Identification.* Prepared by Larry Walker Associates.
[13] Rosselot, Kirsten S. January 2006. *Copper Released from Brake Lining Wear in the San Francisco Bay Area*. Prepared for the Brake Pad Partnership
[14] Rosselot, Kirsten S. January 2006. *Copper Released from Non-Brake Sources in the San Francisco Bay Area*. Prepared for the Brake Pad Partnership
[15] Sacramento Stormwater Management Program, December 1999. *1998/99 Annual Monitoring Report and Comprehensive Evaluation, 1990-1999 - Appendix E: Lead/Copper Workshop Summary.* Prepared by Larry Walker Associates.