Water Woes

An Analysis of Pesticide Concentrations in California Surface Water

California Public Interest Research Group
Charitable Trust

Pesticide Action Network

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California Public Interest Research Group Charitable Trust

California Public Interest Research Group (CALPIRG) Charitable Trust is the 501(c)(3) sister corporation of CALPIRG, a non-profit, non-partisan, research and advocacy organization working on behalf of consumers and the environment. With over 60,000 members and 14 offices statewide, CALPIRG is the largest environmental, consumer and good government advocacy group in California.

For more information, contact CALPIRG Charitable Trust:
3486 Mission Street
San Francisco, CA 94110
tel 415-206-9338
fax 415-206-1859
email calpirg@pirg.org
website www.calpirg.org

Pesticide Action Network

Founded in 1982, Pesticide Action Network is an international coalition of over 400 citizens groups in more than 60 countries working to oppose the misuse of pesticides and to promote sustainable agriculture and ecologically sound pest management.

For more information, contact Pesticide Action Network:
49 Powell Street, Suite 500
San Francisco, CA 94102
tel 415-981-1771
fax 415-981-1991
email panna@panna.org
website www.panna.org

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Front cover: Map of testing sites in Department of Pesticide Regulation (DPR) Surface Water Database, released July 15, 2000.

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Principal authors:
Teresa M. Olle, Toxics Policy Advocate and Staff Attorney
CALPIRG Charitable Trust
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Brad Heavner, Policy Analyst
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Executive Summary

Analysis of recently released surface water sampling data compiled by the Department of Pesticide Regulation (DPR) reveals that many California surface water bodies suffer from toxic pesticide contamination that poses health threats to humans and aquatic life.

The database contains records of over 92,000 sampling tests from 133 locations on California creeks, rivers, drainage basins and sloughs—most of which are in the Central Valley.[1] The data result from 32 studies conducted over the last ten years, principally by the California Department of Pesticide Regulation.[2]

Pesticide contamination is widespread in California's waterways

The data reveal a pattern of pesticide pollution in California's waterways.

- Of the 151 different pesticide active ingredients that were sampled for, eighty-six compounds (57%) were detected at least once.
- Pesticides were detected in nearly 8,500 samples (9% of all samples).
- Pesticides were detected in almost every waterway tested. Pesticides were detected in 128 of the 133 (96%) locations tested.

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[1] Surface Water Database, compiled and released by California Department of Pesticide Regulation, as of July 15, 2000. For a full bibliography, see http://www.cdpr.ca.gov/docs/surfwatr/surfdata.htm.

[2] In addition to DPR, studies also conducted by U.S. Geological Survey via its National Water Quality Assessment Program (NWQA), Central Valley Regional Water Quality Control Board, State Water Resources Control Board, DeltaKeeper, Dow Agro Sciences, City of Modesto, City of Stockton, City and County of Sacramento, Sacramento River Watershed Program, and Sutter County Dept. of Agriculture.

- Many water bodies produced widespread detections. Pesticides were detected in over 50% of tests in 13 locations where more than 10 tests were conducted.

Particularly hazardous pesticides were widely detected

- The five most frequently detected pesticide active ingredients were diuron, diazinon, simazine, chlorpyrifos and molinate. (See Table A below.)

- All five of these are particularly hazardous pesticides that have been linked to cancer, nervous system damage, endocrine (hormone) system disruption, and/or groundwater contamination.

Table A: Health Effects of Top Five Most Frequently Detected Pesticides

Pesticide	Percent Positive Detections	Health Effects
Diuron	58%	Carcinogen, groundwater contaminant
Diazinon	48%	Nerve toxin, potential groundwater contaminant
Simazine	44%	Endocrine disruptor, groundwater contaminant
Chlorpyrifos	27%	Endocrine disruptor, nerve toxin
Molinate	23%	Nerve toxin, potential groundwater contaminant

Toxic pesticides are present at levels that threaten aquatic life and drinking water sources

- Of the nearly 8,500 positive detections in the DPR database, 4,349 (51%) exceeded safe levels for aquatic toxicity or drinking water consumption, according to criteria set by state or federal agencies.

- Certain pesticides frequently exceeded criteria. For example, diazinon exceeded criteria 98% of the time it was detected, chlorpyrifos 92%, molinate 33%, and simazine 12% of the time it was detected.

- Four pesticides, atrazine, molinate, simazine and carbofuran, were detected at levels that exceed California drinking water standards.[3]

- One hundred and forty-six detections exceeded California drinking water standards or health goals.

[3] Atrazine, molinate and simazine exceeded the enforceable Maximum Contaminant Levels (MCLs) established by California's Department of Health Services (DHS). Atrazine, carbofuran and simazine exceeded the Public Health Goals (PHGs) adopted or proposed by California's Office of Environmental Health Hazard Assessment (OEHHA).

Pesticides in surface water may pose a health threat to people who use that water for a drinking source or recreational activities. For example, approximately 20 million people in Southern California depend on the Delta for drinking water. Contaminated surface waters may also recharge underground aquifers that are widely used for drinking water in the Central Valley. Actual health risk will depend on the degree to which individuals are exposed to pesticides -- an analysis that is not attempted here.

While we know less about the health threat to humans from pesticide concentrations in surface water, we do know that widespread pesticide toxicity in waterways poses a clear threat to aquatic life, including important fisheries.

Recommendations

Although DPR's database is not a comprehensive set of all studies of surface water quality in California, its significant volume of data demonstrates the widespread contamination of the tested locations, corroborating the findings of many other studies.[4] This persistent pesticide contamination in California's waters reflects the continued failure of the responsible agencies to take strong action for the protection of our aquatic resources.

Policymakers and regulating agencies should:

- Begin immediate phase out of pesticides that continually contaminate our waters at levels harmful to aquatic ecosystems and human health.

- Phase out the use of all pesticides linked to cancer, reproductive and developmental harm, acute toxicity, nervous system damage, or groundwater contamination. Pesticides that are suspected of disrupting the proper function of the endocrine (hormone) system should also be phased out. All of these pesticides threaten both humans and aquatic animals, and should be phased out as a class.

- Close loopholes for agricultural runoff of pesticides. Irrigation return flows and rinse waters are currently considered non-point sources of pollution, effectively exempting conventional agriculture from complying with the state clean water act. Agricultural entities that apply pesticides should be required to monitor their discharges into nearby waterways and apply for permits to discharge pesticides into our creeks, rivers, lakes and estuaries.

- Establish enforceable drinking water standards for all pesticides, and revise existing standards to make them fully protective of public health.

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[4] *See* J. Phyllis Fox and Elaine Archibald, *Aquatic Toxicity and Pesticides in Surface Waters of the Central Valley*, California Urban Water Agencies (California, 1998).

Chapter1

Pesticides are Present in Surface Water Data at Levels Harmful to Humans and Aquatic Life

Toxic pesticides are common in California waterways

California's Department of Pesticide Regulation (DPR) recently released its Surface Water Database. The database consists of over 92,000 water-sampling tests from 133 locations on California creeks, rivers, drainage basins and sloughs, located primarily in the Central Valley. (See Figure, Appendix H).[5] Compiled by DPR, the data result from 32 studies conducted over the last ten years, principally by the California Department of Pesticide Regulation.[6]

Pesticides were detected in nearly 8,500 (9%) of all samples. Of the 151 different pesticide active ingredients sampled for, eighty-six compounds were detected. Eighteen pesticides were detected frequently, showing up in more than 10% of the samples in which those pesticides were tested for.

Table 1-1: Top Five Most Frequently Detected Pesticides

Pesticide	# of Positive Detections/ # of Tests	Percent Positive Detections	Health Effects
Diuron	343 / 591	58%	Carcinogen, groundwater contaminant
Diazinon	2,353 / 4,912	48%	Nerve toxin, potential groundwater contaminant
Simazine	927 / 2,110	44%	Endocrine disruptor, groundwater contaminant
Chlorpyrifos	1,189 / 4,364	27%	Endocrine disruptor, nerve toxin
Molinate	427 / 1,883	23%	Nerve toxin, potential groundwater contaminant

The five most frequently detected pesticide active ingredients—diuron, diazinon, simazine, chlorpyrifos and molinate— are some of the most hazardous pesticides used in California. These pesticides have been linked to severe human health and environmental health problems. (See Table 1-1 above).

Diazinon, chlorpyrifos and molinate are cholinesterase-inhibitors—chemicals that interfere with the proper functioning of the nervous system. In addition, chlorpyrifos and simazine are suspected to cause disruption of the endocrine

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[5] Surface Water Database, compiled and released by California Department of Pesticide Regulation, as of July 15, 2000. For a full bibliography, see http://www.cdpr.ca.gov/docs/surfwatr/surfdata.htm..

[6] Studies also conducted by United States Geological Survey, Central Valley Regional Water Control Board, State Water Resources Control Board, DeltaKeeper, Dow Agro Sciences, City of Modesto, City of Stockton, City and County of Sacramento, Sacramento River Watershed Program, and Sutter County Department of Agriculture.

(hormone) system. Diuron, the most frequently detected pesticide in tests for that pesticide, has been classified by the U.S. EPA as a known or probable carcinogen. Four of the five are either known (diuron and simazine) or potential (diazinon and molinate) groundwater contaminants.

Toxic pesticides frequently threaten California's aquatic ecosystems

Sampling data show that pesticide concentrations in many of California's surface water bodies often exceed safe levels for aquatic health or drinking water safety.

Water quality and aquatic life

Rivers and streams are unique and critical ecosystems supporting enormous biodiversity. The health of California's aquatic ecosystems has declined significantly over time, as human activities encroach on land and water once primarily the realm of fish and wildlife. While many destructive causes play a role, it has become increasingly clear that in recent history, the application of massive quantities of pesticides is a significant contributor to the decline of aquatic ecosystems.

Criteria for protection of aquatic life

One tool for protecting aquatic organisms from the adverse effects of pesticides is setting maximum allowable concentrations of pesticides in water. These numeric objectives are often called "criteria for protection of aquatic life." Both acute and chronic criteria exist. Acute criteria provide limits for a high level, one-time exposure. Chronic criteria provide the maximum allowable concentration assuming repeated long-term exposure.

Several organizations have developed aquatic life criteria for pesticides, including the U.S. Environmental Protection Agency (U.S. EPA), the U.S. Geological Survey via its National Water Quality Assessment program (NAWQA), the Canadian Council of Ministers of the Environment, and the California Department of Fish and Game. As used below, "aquatic life criteria" are derived from those agencies' criteria. While these criteria are not enforceable standards, comparing pesticide concentrations detected in California surface waters to these recognized criteria produces a striking overall picture of the health of California's aquatic ecosystems.

AQUIRE-based criteria for aquatic animals and plants

The U.S. EPA maintains a database of studies that the agency has reviewed and accepted on the toxicity of pesticides to aquatic animals and plants. The database, known as AQUIRE,[7] provides information on both acute toxicity (one-time high dose effects) and chronic toxicity (long-term effects of exposure). The studies in this database have been reviewed and accepted by the EPA, but have not been used in the process of setting official water quality standards. As used below to evaluate harm to aquatic animals and plants, "AQUIRE-based criteria" is the lowest concentration level at which a negative effect, acute or chronic, has been observed in a species of aquatic animal or plant from these approved studies. The observed effect may be death, or it may be an observable chronic

[7] AQUIRE stands for Aquatic Toxicity Information Retrieval Database.

effect such as reproductive effects, developmental damage, or lowered population levels.

Pesticides in California surface waters often exceed aquatic life criteria and AQUIRE-based criteria

Overall, 34% of positive detections (2,916) exceeded aquatic life criteria. Forty-eight percent (4,068) of positive detections exceeded AQUIRE-based criteria. In total, 4,315 detections (51% of detections) exceeded either aquatic life or AQUIRE-based criteria.

All of the most frequently detected pesticides exceeded either aquatic life criteria or AQUIRE-based criteria, some with alarming frequency. (See Table 1-2 below).

Table 1-2 Pesticides Detected at Levels Harmful to Aquatic Ecosystems

Pesticide	Positive Detections	Positive Detections Exceeding AQUIRE-based Criteria	Positive Detections Exceeding Aquatic Life Criteria	Pounds Applied in 1998 in CA
Diazinon	48%	98%	56%	874,663
Chlorpyrifos	27%	92%	92%	2,374,727
Molinate	23%	33%	18%	1,001,156
Simazine	44%	6%	9%	793,436
Diuron	58%	2%	0%	1,504,655

Diazinon

An insecticide used often on prunes and almonds, diazinon is one of a widely used class of pesticides—organophosphates. Organophosphates inhibit cholinesterase, an enzyme critical to the proper functioning of the nervous system of animals, including humans. In humans, diazinon and other organophosphates can cause headaches, dizziness, blurred vision, vomiting, diarrhea and seizures.[8] In addition, based on its solubility and half-life, diazinon qualifies as a potential groundwater contaminant.[9] Although diazinon use has decreased slightly between 1995 and 1998, it still ranks among the top 15 most frequently used highly toxic pesticides in California.[10]

The most frequently monitored pesticide, diazinon is routinely found in California's surface waters. Over the ten year period, diazinon was detected 48% of the time it was tested for. Almost every time diazinon was detected (98%), it exceeded the AQUIRE-based criteria. In other words, almost any time diazinon was detected in surface waters, it was found at a concentration harmful to at least one species of aquatic life. Over half of the time it was detected (56%), diazinon

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[8] U.S. Environmental Protection Agency, *Recognition and Management of Pesticide Poisonings*, 5[th] ed., EPA 735-R-98-003, 1999, p. 34.

[9] S. Kegley, S. Orme, L. Neumeister, *Hooked on Poison: Pesticide Use in California 1991-1998*, Pesticide Action Network (San Francisco, CA) and Californians for Pesticide Reform (San Francisco, CA 2000), p. 76.

[10] Ibid., reference 9, p. 19.

exceeded aquatic life criteria. Given the frequency with which diazinon was detected, diazinon poses a major threat to the aquatic ecosystem. Diazinon has not been regulated as a drinking water contaminant in California.

Chlorpyrifos

Used in agriculture on cotton and orange groves, and in structural pest control, chlorpyrifos is among the most widely used organophosphate insecticides on the market. Organophosphates, as noted above, interfere with the nervous system of animals, including humans.

Chlorpyrifos is also a suspected endocrine (hormone system) disruptor.[11] In recent years, many chemicals have been linked to disruption of the hormone function in humans and or wildlife.[12] Interference with the endocrine system particularly affects developing organisms, and can result in abnormalities in growth, reproduction and development, as well as cancer and immune system disorders.[13] In 1998, chlorpyrifos was the most widely used endocrine-disrupting insecticide.[14]

Citing concerns about harmful health effects on children, the U.S. EPA recently announced its decision to restrict the use of chlorpyrifos on certain crops frequently consumed by children, such as grapes, apples and tomatoes.[15] The U.S. EPA also banned use of the chemical in homes, schools and day care centers because they determined it to be too toxic to use around children.

Chlorpyrifos was the second most frequently tested-for pesticide. While chlorpyrifos appeared less frequently than diazinon (27% of the time), it was found at harmful levels with great regularity. Chlorpyrifos exceeded AQUIRE-based criteria 92% of the time it was detected, and exceeded aquatic life criteria 92% of the time it was detected. Chlorpyrifos has not been regulated as a drinking water contaminant in California.

Diuron

Diuron, the most frequently detected pesticide in DPR's data set, is an herbicide used primarily on rights-of-way and in agriculture on orange groves and alfalfa fields. Diuron is among the 15 most hazardous pesticides with the highest reported use. Between 1995-1998, reported diuron use increased by 40%.[16]

The U.S. EPA has classified diuron as a known or probable carcinogen. It is also a known groundwater contaminant in the state of California.

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[11] Ibid., reference 9, p. 51, n. 10.
[12] Ibid., reference 9, p. 50.
[13] Ibid., reference 9, p. 50.
[14] Ibid., reference 9, p. 24.
[15] U.S. Environmental Protection Agency, Office of Pesticide Programs, "Administrator's Announcement on Chlorpyrifos," http://www.epa.gov/pesticides/.
[16] Ibid., reference 9, p. 19.

Diuron was detected in 58% of all samples, making it the most frequently detected pesticide in the data set. Diuron levels exceeded AQUIRE-based criteria 2% of the time it was detected, and did not exceed aquatic life criteria.

Toxic pesticides threaten drinking water sources

Many different factors contribute to pesticide contamination of drinking water sources, including the chemical properties of pesticides, amounts used, application methods, type of soil, amount of rainfall and proximity to rivers. Contamination is worst where pesticides are used most heavily—California's Central Valley has the worst contamination problem in the state.[17] But the problem is not limited to the Central Valley. Pesticides are used throughout the state, and the combination of factors that allow pesticides to move into drinking water sources exists in many areas.

Protecting drinking water sources

Surface water is typically stored in reservoirs during the rainy winter months and spring thaw, and slowly released into rivers and aqueducts throughout the year. With over 1,400 dams in California, virtually the entire hydrologic system of the state is engineered to meet human water needs.[18]

Pesticides enter into surface water through a variety of avenues. (See Figure 1-1 below). Rain and irrigation water wash pesticides away from farms and urban areas into surface waters. This pollution can be washed down rivers or cling to sediment lining waterways and be released slowly. Groundwater also interacts with rivers and streams, and pesticides that have leached through the soil into groundwater aquifers can be drawn into surface water bodies through this interaction. Even aerial pesticide drift can be picked up by moisture in the air and fall to the ground as precipitation, then drain into surface water bodies.

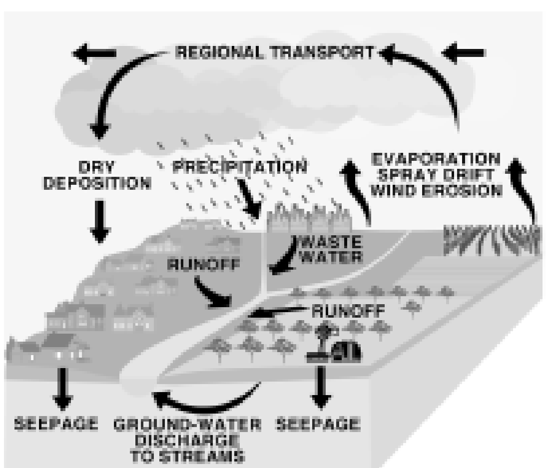

Figure 1-1: Routes of Pesticide Contamination of Surface Waters
Credit: U.S Geological Survey

[17] B. Heavner, *Toxics on Tap: Pesticides in California Drinking Water Sources*, CALPIRG Charitable Trust (San Francisco, CA) and Californians for Pesticide Reform (San Francisco, CA 1999), p. 12.
[18] California Department of Water Resources, Division of Safety of Dams, *Bulletin 17-93*, 1993.

The health of our drinking water sources depends on the health of our surface water

Detection of pesticides in surface water at levels dangerous to human health does not necessarily mean that those pesticides will be found at equally high levels at the tap. Nonetheless, the ongoing presence of pesticides in our drinking water and our continued inability to treat drinking water thoroughly underscores the need to protect our drinking water at the source. With a growing population and limited sources of drinking water that are already overused, California has no margin of error allowing us to abandon polluted drinking water sources without jeopardizing our ability to meet our basic water needs.

California's drinking water standards

The only legally enforceable drinking water standards in California are the California Maximum Contaminant Levels (MCLs) set by the state Department of Health Services (DHS).[19] Of the over 860 pesticides registered for use in California, only 27 pesticides have established MCLs. MCLs are expressed as concentration levels of "parts per billion" or "ppb."

In 1996, legislation was passed requiring California's Office of Environmental Health Hazard Assessment (OEHHA)[20] and DHS to revise existing drinking water standards. Since then OEHHA has reviewed recent scientific studies and issued Public Health Goals (PHGs) for 22 of the 27 regulated pesticides. A draft PHG for simazine has been proposed, but not yet adopted. PHGs for 14 of those 23 pesticides are lower than the MCL for that pesticide (including the proposed simazine PHG), indicating that these pesticides pose a health threat at concentrations lower than those that have been allowed by law. DHS will now consider whether to revise the MCLs for these pesticides based on the new PHGs.

Agencies have been slow to establish MCLs and PHGs, resulting in regulation of only a limited number of pesticides. Many high-use and / or frequently detected pesticides go unregulated, while these pesticides may pose an equal or even greater threat of contamination to our drinking water.

Toxic pesticides were found at levels exceeding human health standards

Of the 27 pesticides for which MCLs have been set, positive detections were found for nine of them. (See Appendix F). Three pesticides, atrazine, molinate and simazine, were detected at levels exceeding the established MCL. (See Table 1-3 below). In at least one instance, molinate was detected at a concentration more than double the MCL, and simazine was detected at more than three times the MCL.

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[19] California enacted its Safe Drinking Water Act (SDWA) in 1976 to administer the federal SDWA through the California Department of Health Services. The California SDWA requires DHS to establish MCLs for California for all contaminants that are regulated by U.S. EPA, and to establish additional state MCLs for contaminants of particular concern in California.

[20] A division of the California Environmental Protection Agency that performs risk assessments.

Table 1-3 Pesticide Detections Exceeding MCLs

Pesticide	MCL (ppb)	MCL Exceedences (#)	Highest Concentration Detected (ppb)
Atrazine	3	3	5.3
Molinate	20	21	44.09
Simazine	4	4	13

Samples tested positive for eight of the 23 pesticides for which PHGs have been set or proposed. (See Appendix E). Of these, three pesticides were detected at a level exceeding their PHGs. (See Table 1-4 below).

Detected levels of atrazine exceeded its PHG of 0.15 five times; in one instance, the concentration of atrazine exceeded its PHG by 35 times. Carbofuran exceeded its PHG 8 times, with the highest concentration detected at 5.15 ppb, over 3 times the PHG of 1.7**.** (See Table 1-4 below). Simazine was detected 112 times at levels exceeding the draft PHG of 0.4 ppb. The highest concentration of simazine detected was 13 ppb, or 32.5 times the public health goal.

Table 1-4 Pesticides Exceeding PHGs

Pesticide	PHG (ppb)	PHG Exceedences (#)	Highest Concentration Detected (ppb)
Atrazine	0.15	5	5.3
Carbofuran	1.7	8	5.15
Simazine	Draft 0.4	112	13

Atrazine

Atrazine has been a popular weed killer across the U.S. since its introduction in 1958. In 1998, over 58 thousand pounds of atrazine were reported used in California, mostly on fodder crops and feed corn.[21] DHS set the MCL for atrazine at 3 ppb in 1989 based on non-cancer effects. Since then, atrazine has been classified as an endocrine disruptor, and evidence of its cancer-causing potential has continued to mount. In addition, U.S. EPA recently raised atrazine to "likely human carcinogen" status. The State of California has not yet listed atrazine as a human carcinogen either (Prop 65 list), but it is on the state priority list for possible future listing.[22]

OEHHA set its new Public Health Goal for atrazine based on its carcinogenic effects. The new atrazine PHG of 0.15 ppb is 20 times lower than the atrazine MCL, meaning that concentrations of atrazine in water far below legally tolerated levels may cause significant risk of cancer.

Molinate

Since the mid-1970s, California rice farmers have used molinate to control weeds. Molinate use decreased from 1991 to 1998, but reported use still exceeded one

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[21] Ibid., reference 9, p. 74

[22] Cal/EPA Office of Environmental Health Hazard Assessment, *Public Health Goal for Atrazine in Drinking Water*, February, 1999.

million pounds in 1998.[23] Molinate is one of the most frequently detected pesticides in tested surface waters. Molinate is a cholinesterase-inhibiting nerve toxin, as well as a potential groundwater contaminant.[24]

Currently, the MCL for molinate is 20 ppb. Since DHS set that level, studies have shown molinate to cause reproductive damage. The U.S. EPA has also listed it as a possible human carcinogen.

Simazine

Simazine, an herbicide in the triazine class, is closely related to atrazine. In California, over 793,000 pounds of simazine were used in 1998, largely on orchards, vineyards, and nut groves.[25] Simazine, too, is among the pesticides most often detected in California waters.

The Office of Environmental Health Hazard Assessment (OEHHA) was scheduled to review simazine to establish a new public health goal (PHG) by the end of 1999. In October, 1999, OEHHA proposed draft PHGs for four pesticides, carbofuran, diquat, thiobencarb and simazine. In September, 2000, OEHHA announced the adoption of the PHGs for carbofuran, diquat, thiobencarb, but not simazine. The adoption of the proposed PHG of 0.4 for simazine, which is 10 times lower than its current MCL of 4, is still pending.

Carbofuran

An insecticide used primarily on alfalfa, rice and grapes, carbofuran's long half-life and high water solubility qualifies it as a potential groundwater contaminant in California.[26] Carbofuran is a carbamate—a type of pesticide that inhibits the proper functioning of the nervous system. It is also a U.S. EPA Category I acute systemic poison.[27]

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[23] Ibid., reference 9, p. 80.
[24] Ibid., reference 9, pg. 80.
[25] Ibid., reference 9, p. 82.
[26] Ibid, reference 9, p. 75.
[27] The U.S. EPA categorizes pesticide products according to their acute (immediate toxicity). Ranging from I to IV, I is the most toxic. Evaluated according to the same guidelines of lethality, the active ingredient carbofuran qualifies as a Category I acute toxin. See ibid, reference 9, pp. 50, 75.

Chapter 2

Most California Rivers Tested for Pesticides Suffer from Contamination

Over 92,000 sampling tests were conducted at 133 sites on or near California rivers. (See Figure, Appendix H). Pesticides were found in 128 of the 133 sites. The sites were located in 16 counties, and the majority of the test sites located in Stanislaus, San Joaquin and Sacramento counties, with over ten test sites in Sutter, Merced and Imperial counties, as well. (See Appendix G).

Arranged by river below, DPR's data set shows routine contamination of California's rivers by the most frequently detected pesticides.

- **The Sacramento River (Butte, Colusa, Glenn, Sacramento, Sutter, Tehama and Yolo Counties)**

Nearly 19 thousand tests were conducted at 20 sites on the Sacramento River. Roughly four percent of tests resulted in positive detections (680 positive detections). Of the positive detections, 33% of detections (221 detections) exceeded AQUIRE-based, aquatic life or human health criteria for any pesticide.

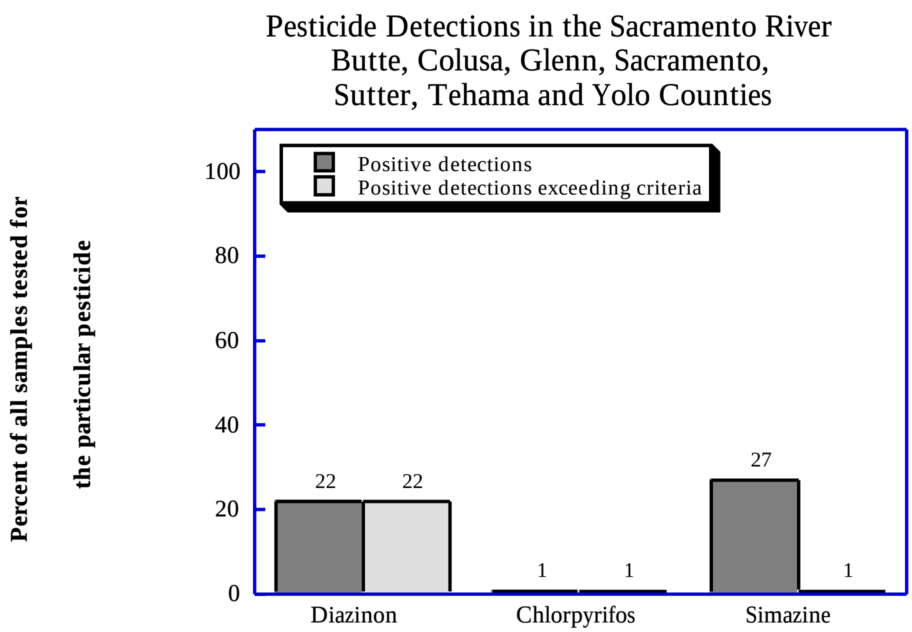

Figure 2-1: Detections and Exceedences in the Sacramento River (Butte, Colusa, Glenn, Sacramento, Sutter, Tehama and Yolo Counties)

Twenty-two percent of tests (203 of 944 tests) for diazinon returned a positive result. All of the positive detections exceeded AQUIRE-based criteria or aquatic life criteria. (See Figure 2-1 above).

Chlorpyrifos was detected infrequently (1% of all tests for the pesticide). However, in all positive tests, chlorpyrifos levels exceeded either the aquatic life or AQUIRE-based criteria. Simazine, detected 27% of the time, was found at concentrations exceeding the draft Public Health Goal of 0.4 ppb in 1% of the total tests. Diuron, the most commonly detected pesticide overall, was found in nearly half (44%) of tests on the Sacramento River and its tributaries, but did not exceed any criteria. Molinate was detected 13% of the time it was tested for, and also did not exceed criteria.

■ The American River (Sacramento County)

Seven sites of the lower portion of the American River in Sacramento County were tested. Of the 4,262 tests conducted, pesticides were detected infrequently, in only 2% of the tests (98 detections). This is largely because many pesticides were tested for, but were not found. Of the positive detections, 57% exceeded AQUIRE-based criteria, aquatic life criteria or human health standards for any pesticide.

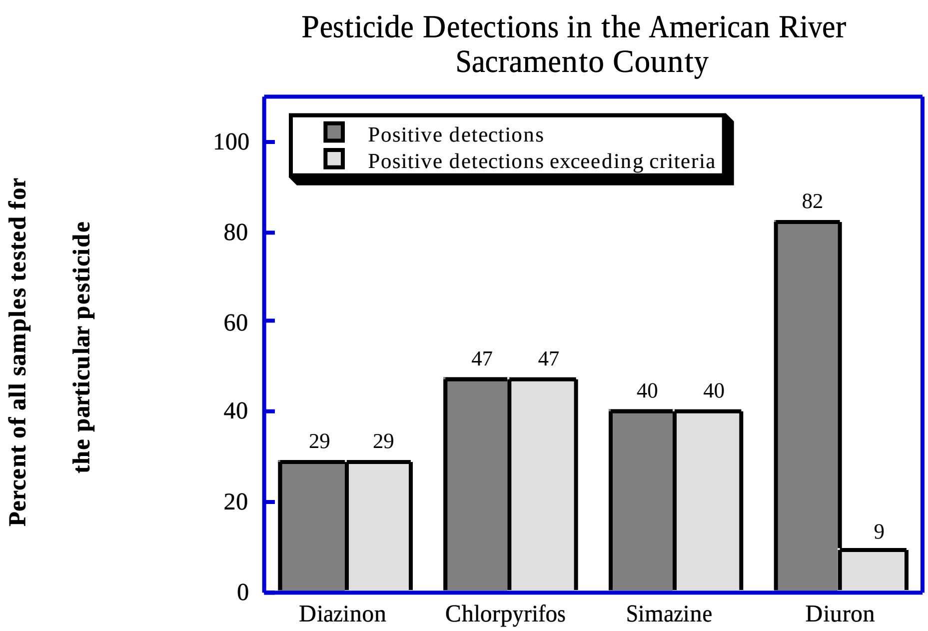

Figure 2-2: Detections and Exceedences in the American River (Sacramento County)

Although many pesticides monitored were not detected, thereby resulting in a low percentage of positive tests overall, tests for certain pesticides routinely returned positive detections. (See Figure 2-2 above). Of the tests for diazinon, positive detections of diazinon were found 29% of the time. Every detection exceeded AQUIRE-based or aquatic life criteria. Chlorpyrifos was present 47% of the time it was tested for, and again, every detections exceeded AQUIRE-based or aquatic life criteria. Simazine, detected in 40% of the samples, also exceeded AQUIRE-based, aquatic life criteria or California drinking water standards every time. In fact, all simazine exceedences were found at levels exceeding California's proposed PHG of 0.4 ppb. Diuron was tested infrequently

(11 times), 9 detections were found, and 2 of the detections exceeded AQUIRE-based criteria.

■ **The San Joaquin River (San Joaquin, Stanislaus, and Merced Counties)**
The San Joaquin River is the main river carrying water through the Central Valley. Nearly 35,000 tests were conducted at 20 test sites on the San Joaquin River and its tributaries in three counties. Pesticides were detected in over nine percent of the tests (3,208 detections). Of the positive detections, 50% exceeded aquatic life criteria, AQUIRE-based criteria or drinking water standards.

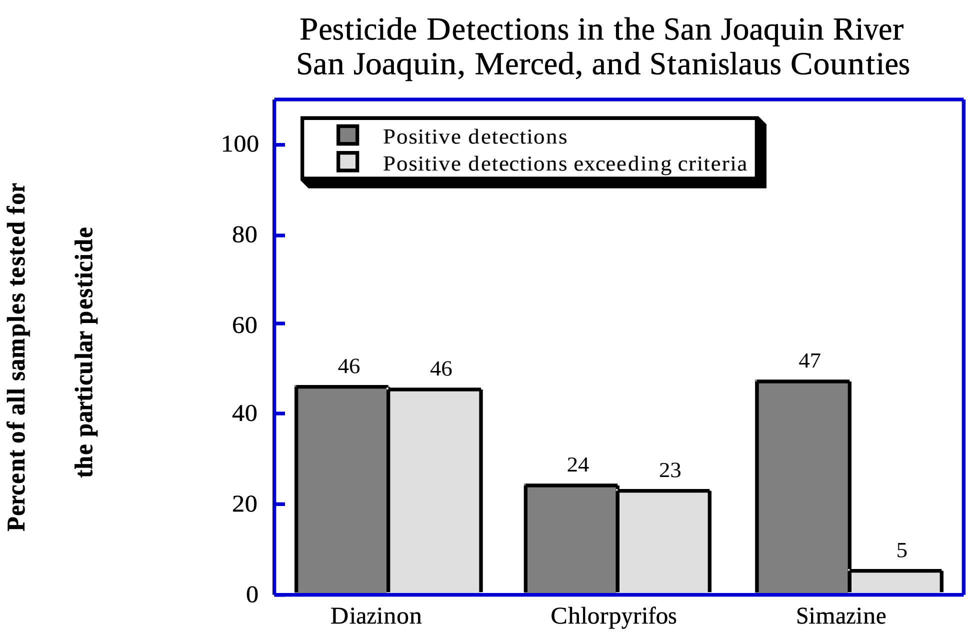

Figure 2-3: Detections and Exceedences in the San Joaquin River and Tributaries (San Joaquin, Stanislaus and Merced Counties)

Diazinon was detected 46% of the time it was tested for in the San Joaquin River and its tributaries (853 of 1,871 tests). Almost all positive detections (842) exceeded either AQUIRE-based criteria or aquatic life criteria. (See Figure 2-3 above).

Chlorpyrifos was detected roughly one quarter of the time (24%, or 468 positive detections of 1,968 tests) in the San Joaquin and its tributaries. Nearly all chlorpyrifos detections exceeded aquatic life criteria or AQUIRE-based criteria.

Simazine appeared frequently (47% or 417 of 889 tests) in the San Joaquin and its tributaries. Five percent of all tests for simazine exceeded AQUIRE-based criteria, aquatic life criteria or the draft Public Health Goal for drinking water in California. In fact, every exceedence of simazine in the San Joaquin and its tributaries exceeded the draft PHG of 0.4 ppb.

Molinate was not detected much in the San Joaquin River. Although it is one of the five most frequently detected pesticides overall, it was only detected in three percent of the total samples on the San Joaquin and its tributaries. Of those positive detections, molinate levels exceeded aquatic life or AQUIRE-based criteria once.

■ The Tuolumne River (Stanislaus County)

Testing was conducted at five sites on the Tuolumne River in Stanislaus County. Seven percent of the 2,601 tests detected any pesticide. Over half of the positive detections exceeded criteria (52%).

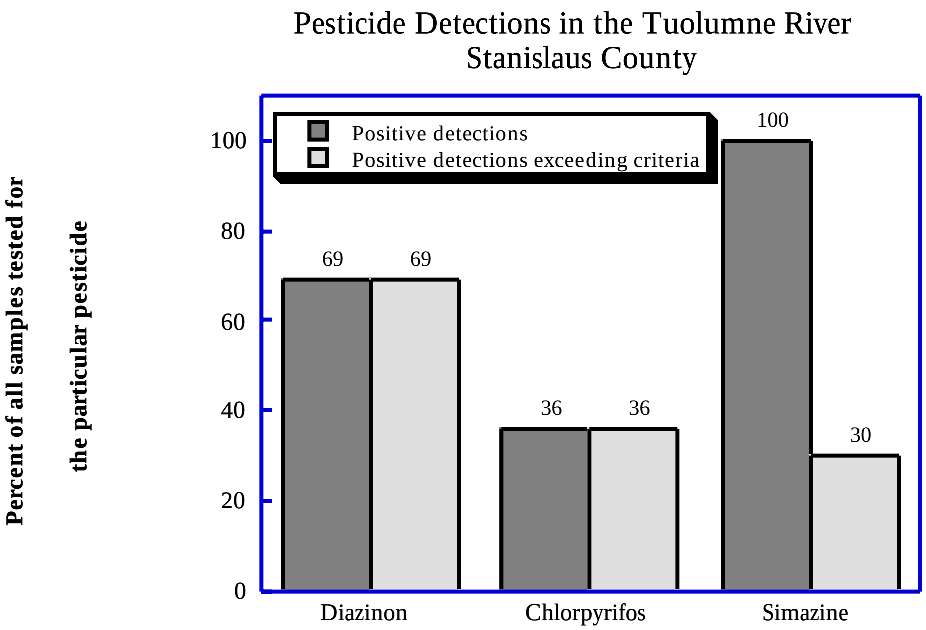

Figure 2-4: Detections and Exceedences in the Tuolumne River (Stanislaus County)

As has been the pattern, for diazinon and chlorpyrifos, all of the positive detections of these pesticides exceeded one or more criteria. Diazinon was found 69% of the time it was tested for; chlorpyrifos 36% of the time. Simazine was detected 100% of the time it was tested for, and 30% of the total simazine tests exceeded criteria, including the draft PHG of 0.4 ppb. (See Figure 2-4 above).

■ The Merced River (Merced County)

The Merced River was tested in three locations, all in Merced County. Four percent of the tests detected pesticides. Of those detections, 45% exceeded criteria for any pesticide.

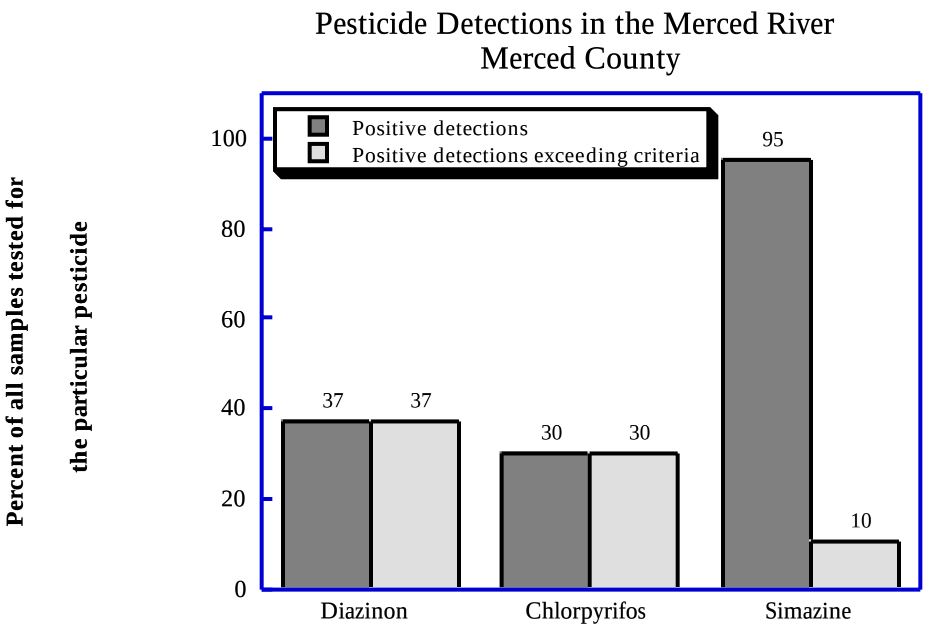

Figure 2-5: Detections and Exceedences in the Merced River (Merced County)

Diazinon detections (37% positive) exceeded AQUIRE-based or aquatic life criteria every time it was tested for. Chlorpyrifos, detected 30% of the time, also exceeded AQUIRE-based or aquatic life criteria every time it was detected. For simazine, 95% of all tests showed the presence of pesticides. Ten percent of all tests for simazine exceeded criteria, including California's draft Public Health Goal of 0.4 ppb. (See Figure 2-5 above).

■ **The Alamo River (Imperial County)**

Nearly 5,000 tests were conducted at eleven locations on the Alamo River in Imperial County. Nine percent (426 detections) of tests detected pesticides. Sixty-three percent (268 detections) of the positive detections exceeded criteria for any pesticide.

Tests for diazinon were positive 49% of the time (55 of 113 tests). All positive tests exceeded at least one AQUIRE-based or aquatic life criteria.

Chlorpyrifos was detected in 28% of the tests (32 of 113 tests). Again, every positive test exceeded AQUIRE-based or aquatic life criteria.

Endosulfan family[28] pesticides are not among the five most frequently detected pesticides statewide, but in Imperial County, use of these pesticides on alfalfa crops is common. Not surprisingly, endosulfan family pesticides were detected 64% of the time (125 detections of 195 tests). Fifty-six percent (110) of all tests for these pesticides exceeded either AQUIRE-based or aquatic life criteria. (See Figure 2-6 below).

[28] Endosulfan, endosulfate and endosulfan II.

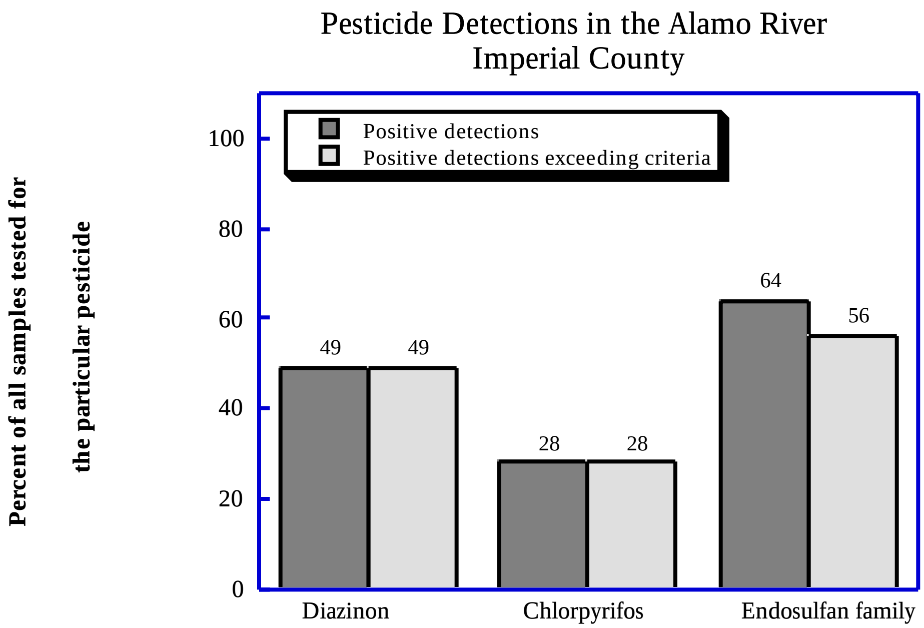

Figure 2-6: Detections and Exceedences in the Alamo River (Imperial County)

Chapter 3
Conclusions and Recommendations

Pesticide use continues unabated in conventional agriculture
More than 1.5 billion pounds of pesticides were released into the environment in California between 1991 and 1998, according to use reporting data.[29] In 1998, nearly 64 million pounds of the most toxic pesticide active ingredients—acute nerve toxins, carcinogens, reproductive or developmental toxins, neurotoxins, or groundwater contaminants—were used.[30] Because many routes exist for transport of pesticides to water, it is no surprise that numerous pesticides are commonly found in the state's waters, sediments, and animal tissues.

Extensive analyses of pesticide contamination and its effects on our aquatic ecosystems and drinking water are available in *Toxics on Tap: Pesticides in California Drinking Water Sources* and *Disrupting the Balance: Ecological Impacts of Pesticides in California.*

Analysis of DPR's data confirms what this previous research has already demonstrated: California's waterways suffer from widespread contamination from pesticides, including the most toxic pesticides. Only with rigorous commitment to curbing the release of pesticides—starting with wholesale reduction of use and including the regulation of unchecked sources of discharge—will we foster the rehabilitation of our aquatic ecosystems and protect the quality of our drinking water sources.

Recommendations for the California Department of Pesticide Regulation

- *Begin immediate phase-out of diazinon and chlorpyrifos immediately to stop the toxic flows in California surface waters.* All available data indicate that diazinon and chlorpyrifos are the worst offenders causing toxicity in California waterways. Neither voluntary efforts nor government regulation is working to protect our waterways from toxic flows of these pesticides. The presence of these pesticides must be eliminated from our water so California's aquatic organisms can recover. With the recent issuance of U.S. EPA's restrictions on chlorpyrifos and the pending reevaluation of diazinon, California EPA should take the opportunity to restrict the use of these highly toxic pesticides even further.

- *Phase out the worst pesticides and reduce the use of the rest.* California needs a comprehensive program to eliminate use of *all* pesticides known to have adverse effects on human health and the environment. Without such a plan, banning individual pesticides will simply result in shifting to equally toxic substitute pesticides. This "risk shifting" would create new and (at present) unknown adverse effects on wildlife and humans. Under current federal risk assessment requirements, it could take another ten years of study to establish

[29] Ibid., reference 9, p. 6.
[30] Ibid., reference 9, p. 7.

without a shadow of a doubt that a new pesticide is indeed harmful in the environment. Meanwhile, the ecosystem will have sustained yet another ten years of damage. Rather than regulating pesticides one at a time—which leads to a tremendous regulatory burden and to serial substitution of one toxic material for another—we should adopt a system of ecologically based pest management that reduces the need for toxic pesticides, including those that are produced by genetically engineered plants.

- *Take decisive action for the protection of surface water.* Pesticide contamination of surface water is not controlled as strictly as groundwater. DPR should create a regulatory system for surface water with a clear legal requirement of preventing all future contamination.

- *Work with the State and Regional Water Quality Control Boards to reduce toxic pesticide runoff into surface waters and groundwater.*

Recommendations for the Central Valley Regional Water Quality Control Board and the State Water Quality Control Board

- *Close regulatory loopholes and enforce the Porter-Cologne Water Quality Act.* For too long, agriculture has avoided regulation of its point and non-point discharges into waterways. Irrigation return flows and rinse waters are currently considered non-point sources of pollution, effectively exempting conventional agriculture from complying with the state clean water act. To prevent the further degradation of California's waterways, both for the restoration of a healthy ecosystem and the maintenance of safe drinking water sources, agricultural entities that apply pesticides should be required to monitor their discharges into nearby waterways and apply for permits to discharge pesticides into our creeks, rivers, lakes and estuaries.

Recommendations for the Department of Health Services

- *Revise Maximum Contaminant Levels (MCLs)—the only enforceable drinking water standards—to make them fully protective of public health.* As new Public Health Goals show that MCLs allow levels of contamination that pose a significant risk to human health, DHS should act quickly to correct this shortcoming. DHS should also adopt health standards for pesticides that are not currently regulated but have been shown to be a potential threat to public health.

- *Stop ignoring valuable data in assessing the extent of pesticide contamination*. Discarding pesticide detections below weak reporting limits skew DHS's understanding of the extent of the problem and affects its choice of solutions.

Recommendations for individuals

- Use least-toxic pest control methods around your home and garden.
- Buy organic foods whenever possible.

- Call on your local school district and local government to stop using toxic pesticides.
- Call or write Governor Davis to express your concern about pesticide contamination of drinking water sources.

Appendix A: Methodology

In July 2000, the California Department of Pesticide Regulation (DPR) released its Surface Water Database (SWD). The SWD provided results in database form from 32 studies of California waterways conducted over the past ten years. The included studies, conducted in large part by DPR itself, and also by the U.S. Geological Survey, California Department of Fish and Game, and some others, represent but a small sample of all the tests of California surface waters. Nonetheless, presented as DPR's Surface Water Database, we thought it important to analyze the information DPR has chosen to provide the public under its name.

We analyzed the data in several ways to develop an overall view of surface water quality in the tested water bodies. First, we determined the most frequently detected pesticides by comparing the number of tests for a particular pesticide and the number of positive detections for that pesticide. We identified the most frequently detected pesticides overall as diuron, diazinon, chlorpyrifos, molinate and simazine. With few exceptions, we contained our later analyses to these five pesticides. The exceptions are noted below.

In Chapter One, we analyzed the SWD using water criteria and standards established to protect human health and aquatic life. "Aquatic life criteria" are derived from recognized aquatic life and ambient water quality standards (enforceable by law) and criteria (not enforceable) from the U.S. EPA (Freshwater Aquatic Life Criteria for Continuous Exposure), the U.S. Geological Survey via its National Water Quality Assessment program (NAWQA), the California Department of Fish and Game, and the Canadian Council of Ministers of the Environment (Guidelines for water quality for recreational use, freshwater aquatic life, and agricultural uses (irrigation and livestock consumption).. An "exceedence" is any detection that exceeded the lowest standard or criteria for each particular pesticide.

We derived additional criteria based on levels observed to harm aquatic life using data from the U.S. EPA AQUIRE database. AQUIRE is a collection, in database form, of thousands of studies evaluating toxicity to aquatic life. The AQUIRE data provide pesticide concentration levels at which acute or chronic harm has been noted in aquatic animals and plants. From the AQUIRE data, we determined the lowest level at which harm has been observed and compared the detected concentrations from the SWD against the AQUIRE levels. This compilation of criteria provides another baseline against which to gauge harm to the aquatic ecosystem.

Next, we analyzed the SWD data against California's drinking water standards, the enforceable Maximum Contaminant Levels (MCLs) set by the Department of Health Services, and the Public Health Goals (PHGs) established by the Office of Environmental Health Hazard Assessment (OEHHA). We expanded the analysis beyond the top five most frequently detected pesticides, listed above, to include analyses of atrazine and carbofuran detections, as well. This was done in part because only two of the five most frequently detected pesticides (simazine and molinate) are even regulated as drinking water contaminants in California.

In Appendix B, we expanded the human health references to include other guidelines and criteria in addition to California MCLs and PHGs, such as criteria collected by U.S.G.S. NAWQA from a variety of agencies, the U.S. EPA criteria for human consumption of fish and water, as well as the Canadian drinking water standards. These values were not used to calculate "exceedences" in this report, but rather were added to Appendix B to complete a picture about standards and guidelines pertaining to drinking water in North America.

In Chapter Two, we analyzed the data set according to testing sites. We organized the sites by river and then calculated the total number of tests conducted in the river and the total number of positive detections of any pesticide. Next, we analyzed the presence of the top five most frequently detected pesticides overall—diuron, diazinon, chlorpyrifos, simazine and molinate. Because of the predominance of these five in the data set overall, and to keep the analysis consistent, we analyzed these five even if the individual water body may have had a slightly different top five. The one exception is for the Alamo River in Imperial County, where we saw very high levels of endosulfan family pesticides. In that instance, we included analysis of endosulfan family pesticides (endosulfan, endosulfan II and endosulfate). In the river analysis we evaluated positive detections of the top five pesticides against aquatic life criteria, AQUIRE-based criteria, and where applicable, California drinking water standards.

References for criteria:

DPR Surface Water Database:
http://www.cdpr.ca.gov/docs/surfwatr/surfdata.htm.

U.S. EPA AQUIRE database:
http://www.epa.gov/ecotox

U.S. EPA National Recommended Water Quality Criteria:
http://www.epa.gov/ost/pc/revcom.pdf

U.S. Geological Survey National Water Quality Assessment
http://water.wr.usgs.gov/pnsp/anstrat/ (updated 8-20-99)

California Department of Fish and Game:
M. Menconi and C. Cox, *Hazard Assessment Report of the Insecticide Diazinon to Aquatic Organisms in the Sacramento-San Joaquin River System*, California Department of Fish and Game, Environmental Services Division Administrative Report 94-2, 1994.

Canadian Council of Ministers on the Environment
http://www.ec.gc.ca/ceqe/water.htm (ambient water, 1999)
http://www.hc.sc.gc.ca/ehp/bch/water_quality.htm (drinking water, 1999)

California Drinking Water Standards:
MCLs: http://www.dhs.ca.gov/ps/ddwem/chemicals/mcl/primarymcls.htm
PHGs: http://www. oehha.ca.gov/water/phg/index.html

Appendix B: Detected Pesticides and Criteria

For purposes of calculating human health exceedences in the report, concentrations in water were compared only to California MCLs or PHGs, as listed below. Other "Human Criteria" provided below are for reference purposes only. For calculating aquatic life exceedences in the report, concentrations in water were compared to the lowest of either AQUIRE-based or aquatic life criteria listed below, unless specified. "N/A" below indicates that no criteria have been set for the pesticide. See Appendix A (Methodology) for detailed description of criteria and responsible agencies.

Chemical Name	Reference for Lowest Human Criteria	Human Criteria	Reference for Lowest Aquatic Life Criteria	Aquatic Life Criteria	AQUIRE -based Criteria
2,4,5-T	USGS NAWQA Human	70	Chronic AQUIRE data: 20		20
2,4-D	CA MCL: 70, PHG: 70	70	Chronic AQUIRE data: 1	4	1
2,4-DB acid			Acute AQUIRE data: 10825		10825
2,6-Diethylaniline			Chronic AQUIRE data: 59.84		59.84
3-hydroxycarbofuran					
Alachlor	CA MCL: 2 PHG: 4	2	Chronic AQUIRE data: 5		5
Alachlor	U.S. EPA FWCriteria for Human Consumption of Fish+Water	0	Chronic AQUIRE data: 5		5
Aldicarb	USGS NAWQA Human: draft MCL	7	Canada Water Criteria (FW Aquatic Life)	1	9.8167
Aldicarb sulfoxide	USGS NAWQA Human: draft MCL	7	USGS NAWQA Aquatic: Env. Can. (1999)	1	50
Aldoxycarb	USGS NAWQA Human: draft MCL	7	USGS NAWQA Aquatic: Env. Can. (1999)	1	462.5
Atrazine	CA MCL: 3, PHG: 0.15	0.15	Canada Water Criteria (FW Aquatic Life)	1.8	2
Azinphos-methyl	Canada Drinking Water Standard	20	US EPA FW Aquatic Life Criteria for Continuous Exposure	0.01	0.024
Benfluralin			Acute AQUIRE data: 3275		3275
Benomyl			Acute AQUIRE data: 47742		47742
Bentazon, sodium salt	CA MCL: 18, PHG: 200	18			
Bromacil	USGS NAWQA Human	90	Canada Water Criteria (Irrigation Water)	0.2	97
Bromoxynil octanoate			Chronic AQUIRE data: 85.2727		85.2727
Butylate	USGS NAWQA Human	350	Chronic AQUIRE data: 485		485
Carbaryl	Canada Drinking Water Standard	90	Canada Water Criteria (FW Aquatic Life)	0.2	1
Carbofuran	CA MCL: 18, PHG: 1.7	1.7	Canada Water Criteria (FW Aquatic Life)	1.8	2

Chemical Name	Reference for Lowest Human Criteria	Human Criteria	Reference for Lowest Aquatic Life Criteria	Aquatic Life Criteria	AQUIRE -based Criteria
Chlorpyrifos	USGS NAWQA Human	20	Chronic AQUIRE data: 0.003	0.0035	0.003
Chlorthal-dimethyl			Chronic AQUIRE data: 250		250
Cyanazine	USGS NAWQA Human	1	Chronic AQUIRE data: 0.1.5	0.5	0.1
DCPA acid metabolites					
DDE	US EPA FW Criteria for Human Consumption of Fish+Water	0.00059	Chronic AQUIRE data: 0.0018		0.0018
DDT	US EPA FW Criteria for Human Consumption of Fish+Water	0.00059	Canada Water Criteria (FW Aquatic Life)	0.001	0.0055
Deethyl-atrazine					
Demeton			US EPA FW Aquatic Life Criteria for Continuous Exposure	0.1	120.6
Diazinon	USGS NAWQA Human	0.6	Chronic AQUIRE data: 0.0018; CDFG Aquatic Life Criteria: 0.04	0.04	0.0018
Diazoxon	USGS NAWQA Human	0.6	Chronic AQUIRE data: 8.9; CDFG Aquatic Life Criteria: 0.04	0.04	8.9
Dicamba	Canada Drinking Water Standard	120	Canada Water Criteria (Irrigation Water)	0.006	41333.33 33
Dichlorprop			Chronic AQUIRE data: 10000		10000
Dieldrin	US EPA FW Criteria for Human Consumption of Fish+Water	0.00014	Chronic AQUIRE data: 0.01; US EPA FW Aquatic Life Criteria for Continuous Exposure: 0.056	0.056	0.01
Dimethoate	Canada Drinking Water Standard	20	Chronic AQUIRE data: 1; Canada Water Criteria (Livestock): 3	3	1
Disulfoton	USGS NAWQA Human	0.3	Chronic AQUIRE data: 5		5
Diuron	USGS NAWQA Human	10	Chronic AQUIRE data: 7.0263		7.0263
Endosulfan		110	Chronic AQUIRE data: 0.0003 Canada Water Criteria (FW Aquatic Life): 0.02	0.02	0.0003
Endosulfan II (beta)	US EPA FW Criteria for Human Consumption of Fish+Water	110	Canada FW Aquatic Life Criteria	0.02	0.1
Endosulfan sulfate	US EPA FW Criteria for Human Consumption of Fish+Water	110	Canada FW Aquatic Life Criteria	0.02	212

Chemical Name	Reference for Lowest Human Criteria	Human Criteria	Reference for Lowest Aquatic Life Criteria	Aquatic Life Criteria	AQUIRE -based Criteria
EPTC			Chronic AQUIRE data: 630		630
Ethalfluralin					
Ethion			Chronic AQUIRE data: 2.5187		2.5187
Ethoprop			Acute AQUIRE data: 3020		3020
Fluometuron	USGS NAWQA Human	90	Chronic AQUIRE data: 540		540
Fonofos	USGS NAWQA Human	10	Chronic AQUIRE data: 0.08		0.08
Hexazinone			Chronic AQUIRE data: 3.6		3.6
Isofenphos			Acute AQUIRE data: 10000		10000
Linuron			Canada Water Criteria (Irrigation Water)	0.071	2.5
Malaoxon		190			
Malathion	Canada Drinking Water Standard	190	Chronic AQUIRE data: 0.001; U.S. EPA FW Aquatic Life Criteria for Continuous Exposure: 0.1	0.1	0.001
MCPA, dimethylamine salt		10	Canada Aquatic Life Criteria	0.025	6
MCPB, sodium salt			Acute AQUIRE data: 25650		25650
Methidathion			Chronic AQUIRE data: 0.3		0.3
Methiocarb			Chronic AQUIRE data: 1.6		1.6
Methiocarb sulfone					
Methomyl	USGS NAWQA Human	200	Chronic AQUIRE data: 33.56		33.56
Methyl isothiocyanate			Acute AQUIRE data: 180		180
Methyl parathion	USGS NAWQA Human	2	Chronic AQUIRE data: 0.0003		0.0003
Metolachlor	Canada Drinking Water Standard	50	Canada FW Aquatic Life Criteria	7.8	23.55
Metribuzin	Canada Drinking Water Standard	80	Canada Water Criteria (Irrigation Water)	0.5	22
Molinate	CA MCL: 20, PHG: none	20	Chronic AQUIRE data: 3 Criteria: 10	10	3
Napropamide					
Naptalam, sodium salt			Chronic AQUIRE data: 5000		5000
Norflurazon			Chronic AQUIRE data: 50		50
Oryzalin			Acute AQUIRE data: 190		190
Oxamyl	CA MCL: 200, PHG: 50	50	Acute AQUIRE data: 220		220

Chemical Name	Reference for Lowest Human Criteria	Human Criteria	Reference for Lowest Aquatic Life Criteria	Aquatic Life Criteria	AQUIRE -based Criteria
Parathion	Canada Drinking Water Standard	50	Chronic AQUIRE data: 0.0006; U.S. EPA FW Criteria for Continuous Exposure: 0.013	0.013	0.0006
Pebulate			Chronic AQUIRE data: 1000		1000
Pendimethalin			Acute AQUIRE data: 50		50
Phorate	Canada Drinking Water Standard	2	Chronic AQUIRE data: 2.55		2.55
Phosmet			Chronic AQUIRE data: 1.1667		1.1667
Prometon	USGS NAWQA Human	100	Chronic AQUIRE data: 1000		1000
Prometryn			Chronic AQUIRE data: 0.75		0.75
Propanil			Chronic AQUIRE data: 0.5		0.5
Propargite			Acute AQUIRE data: 220		220
Propham	USGS NAWQA Human	100	Chronic AQUIRE data: 4600		4600
Propyzamide	USGS NAWQA Human	50	Acute AQUIRE data: 40000		40000
S,S,S-tributyl phosphorotrithioate			Chronic AQUIRE data: 0.34		0.34
Simazine	CA MCL: 4, DRAFT PHG: 0.4	0.4	Canada Water Criteria (Irrigation Water)	0.5	0.614
Sulprofos			Chronic AQUIRE data: 5.8		5.8
Tebuthiuron	USGS NAWQA Human	500	Canada Water Criteria (Irrigation Water)	0.27	90
Terbacil	USGS NAWQA Human	90			
Terbufos	USGS NAWQA Human	0.9	Chronic AQUIRE data: 2.37		2.37
Thiobencarb	CA MCL: 70, PHG: 70	70	Chronic AQUIRE data: 6.2		6.2
Triallate			Canada FW Aquatic Life Criteria	0.24	8.7
Triclopyr, triethylamine salt			Chronic AQUIRE data: 290		290
Trifluralin	USGS NAWQA Human	5	Canada Water Criteria (FW Aquatic Life)	0.2	1.0034

Appendix C: Pesticide Detections Do Not Tell the Whole Story[31]

While a great deal of data have been collected on pesticides in water, sediments and tissues, the process of implementing a pesticide monitoring program is prone to errors that result in consistent underreporting of the true concentrations of pesticide residues and pesticide inert ingredients in the environment. A number of factors contribute to these errors.

- Recovery of pesticide residues from soil, water, or tissues is rarely close to 100% effective. Pesticides are usually analyzed by extracting them from a water, soil, or tissue sample. Common analytical methods typically extract only 30-90% of the residues present.

- Some pesticide active ingredients are difficult or impossible to measure accurately.

- "Inert ingredients" are typically not reported or measured. Pesticide active ingredients are usually combined with "inert" ingredients, chemicals that make application and mixing with other pesticides easier or make the active ingredients more effective. These "inert" ingredients are sometimes more toxic than the active ingredients and frequently constitute a major portion of the formulated product, yet are rarely included in pesticide use reports or monitored in environmental samples.[32]

- Pesticide breakdown products are typically not reported or measured. Most monitoring programs only look for the pesticide itself, and not its breakdown products, some of which are more toxic than the pesticide itself. Similarly, toxicity studies are only beginning to examine the effects of these breakdown products on birds, fish, plants and humans.

- Sample sites and times may not be reflective of use patterns. The concentration of a pesticide in water or sediment can vary dramatically depending on the location and the timing of sampling. The best studies are those that sample frequently (to detect variations due to weather, use patterns and irrigation flows) and in locations that are likely to be representative of both the highest and lowest concentrations.

- Improved technologies for detecting pesticides in environmental samples make comparison with older data difficult. With the introduction of new technologies, it is possible to detect lower and lower concentrations of pesticides every year. Pesticides listed as "nondetects" in 1981 might easily be detected in 2000. This makes it difficult to compare concentrations of pesticides in samples from different time periods and establish trends in pesticide occurrence in environmental samples.

- Monitoring programs can only detect and quantify the pesticides analysts choose to look for. We have no idea how many of the chemicals not tested for are present in the water and sediments in our rivers and streams. According to Central Valley

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[31] This section is excerpted with permission from S. Kegley, L. Neumeister, and T. Martin, *Disrupting the Balance: Ecological Impacts of Pesticides in California*, Pesticide Action Network (San Francisco, CA) and Californians for Pesticide Reform (San Francisco, CA 1999), and B. Heavner, *Toxics on Tap: Pesticides in California Drinking Water Sources*, CALPIRG Charitable Trust (San Francisco, CA) and Californians for Pesticide Reform (San Francisco, CA 1999).

[32] S. Marquardt, C. Cox and H. Knight, *Toxic Secrets: "Inert" Ingredients in Pesticides 1987-1997*, Northwest Coalition for Alternatives to Pesticides (Eugene, OR) and Californians for Pesticide Reform (San Francisco, CA), 1998.

Water Quality Control Board Environmental Scientist Chris Foe, "Absence of data is usually taken to mean that there isn't a problem when it actually means we don't know."[33]

- The California Department of Pesticide Regulation (DPR) ignores valuable information by discarding all positive detections below method detection limits (MDLs), the levels above which laboratory equipment can be trusted to be 100% accurate. There is clearly a need for these levels, as it is vital to understand the reliability of data used for making policy decisions. However, the main uncertainty in detections below MDLs is not the identification of a contaminant, but its exact concentration. While some detections below MDLs are indeed false positives, the error of counting those records as detections would be small in comparison with the error of reporting actual detections at low concentrations as non-detections. In contrast to DPR, the U.S. Geological Survey (USGS) includes all positive detections below MDLs, but designates concentrations as estimated values. USGS considers it necessary to use all available information for warning and trend detection, enabling protection before the water body becomes significantly contaminated.

[33] J. Mayer, "Scientists say pesticides may endanger river life," *The Sacramento Bee*, June 28, 1993.

Appendix D: Testing Locations in Major Rivers

American River

County Name	Location Code	Description
Sacramento	3408	Chicken / Strong Ranch Slough, stormwater channel, City of Sacramento, drains to American River
Sacramento	3409	American River at Watt Avenue Bridge
Sacramento	3410	American River at Discovery Park
Sacramento	3411	Sump 111 stormwater pumping facility, City of Sacramento, drains to American River
Sacramento	3416	American River at Lake Natomas
Sacramento	3417	American River at Nimbus Fish Hatchery
Sacramento	3419	American River at Folsom Dam outlet

Sacramento River

County Name	Location Code	Description
Butte	402	Sacramento River at Hamilton at Hwy 32 Bridge
Colusa	604	Sacramento River at Colusa, 60 ft. downstream from hwy bridge
Glenn	1101	Sacramento River at Butte City at Hwy 162 bridge
Glenn	1102	Sacramento River at Ord Bend Rd Bridge
Sacramento	3404	Sump 34 urban stormwater pumping facility, discharges to Sacramento River upstream of Freeport
Sacramento	3405	Sacramento River at Freeport where stormwater pumping facility Sump 3 discharges
Sacramento	3406	Sacramento River at Miller Park
Sacramento	3407	Sump 104 stormwater pumping facility, Pocket Area, City of Sacramento, drains to Sacramento River
Sacramento	3412	Sacramento River at Village Marina / Crawdads Cantina
Sacramento	3413	Sacramento River at I Street Bridge
Sacramento	3414	Sacramento River at Tower Bridge
Sacramento	3418	Sacramento River at Alamar Marina Dock, 9 mi below confluence of Feather River
Sutter	5101	Sacramento River at Knights Landing Br. on Hwy. 113
Sutter	5105	Sacramento River 2.5 mi downstream of confluence of Sacramento and Feather rivers
Sutter	5108	Sacramento River approx. 2.8 km downstream frm Wilkens Slough
Tehama	5201	Sacramento River at Vina at Woodson Bridge
Tehama	5203	Sacramento River at Red Bluff above Bend Bridge
Tehama	5204	Sacramento River at Bend Ferry Rd Bridge
Yolo	5701	Sacramento River at Bryte
Yolo	5703	Sacramento River approximately 0.4 km upstream from confluence of Colusa Basin Drain

San Joaquin River and Tributaries

County Name	Location Code	Description
Merced	2409	San Joaquin River at Fremont Ford
Merced	2411	San Joaquin River near Stevinson
San Joaquin	3907	San Joaquin River at Bowman Rd
San Joaquin	3917	San Joaquin River near Vernalis
Stanislaus	5002	San Joaquin River at Maze Blvd.
Stanislaus	5015	San Joaquin River at Laird Park
Stanislaus	5023	San Joaquin River at West Main
Stanislaus	5029	San Joaquin River at Hills Ferry
Merced	2402	Turlock Irrig. Drain #6, 200 yds W of Central Ave (trib to SJR)
Merced	2403	Stevinson Spillway (trib. to SJR)
Merced	2404	Highline Spillway (trib. to SJR)
Merced	2405	Livingston Spillway (trib. to SJR)
Merced	2408	Newman Wasteway (trib. to SJR)
Merced	2410	Los Banos Creek (trib. to SJR)
Merced	2412	Mud Slough (trib. to SJR)
Merced	2413	Salt Slough (trib. to SJR) at Highway 165
Stanislaus	5014	Ingram / Hospital Creek (trib. to SJR)
Stanislaus	5018	Del Puerto Creek (trib. to SJR)
Stanislaus	5025	Spanish Grant Drain (trib. to SJR)
Stanislaus	5028	Orestimba Creek at River Road (trib. to SJR)

Tuolumne River

County Name	Location Code	Description
Stanislaus	5007	Tuolumne River at Modesto
Stanislaus	5013	Tuolumne River at Roberts Ferry Bridge
Stanislaus	5016	Tuolumne River at Shiloh
Stanislaus	5017	Tuolumne River at Carpenter Rd Bridge
Stanislaus	5020	Tuolumne River at Mitchell Rd Bridge

Merced River

County Name	Location Code	Description
Merced	2401	Merced River at Oakdale Road
Merced	2406	Merced River at Hatfield State Park
Merced	2407	Merced River at River Road Bridge near Newman

Appendix D, continued

Alamo River

County Name	Location Code	Description
Imperial	1301	Alamo River at Outlet
Imperial	1302	Alamo River at Albright Road (Nectarine Drain Area)
Imperial	1303	Alamo River at Shank Road (Magnolia Drain Area)
Imperial	1304	Alamo River downstream of Rose Drain
Imperial	1305	Alamo River downstream of Holtville Main Drain
Imperial	1306	Alamo River at Harris Street Bridge
Imperial	1307	Alamo River at Worthington Road
Imperial	1308	Alamo River at Holtville WTP
Imperial	1309	Alamo River at Holtville
Imperial	1320	Alamo River downstream of Verde Drain
Imperial	1321	Alamo River at All American Canal

Appendix E: Twelve Pesticides Most Frequently Tested For

Rank by # of Tests	Pesticide	Number of Tests	Number of Positive Tests	Percent Positive Tests
1	Diazinon	4912	2353	48%
2	Chlorpyrifos	4364	1189	27%
3	Malathion	3404	123	4%
4	Carbofuran	3269	309	9%
5	Methidathion	3146	212	7%
6	Carbaryl	2690	140	5%
7	Fonofos	2548	72	3%
8	Methyl parathion	2142	17	1%
9	Simazine	2110	927	44%
10	Atrazine	1934	84	4%
11	Molinate	1883	427	23%
12	Thiobencarb	1849	211	11%

Appendix F: California Drinking Water Standards and Goals

Pesticide	MCL (ppb)	PHG (ppb)	Detected?
1,2-Dichloropropane	5	0.5	
1,3-Dichloropropene	0.5	0.2	
2,4,5-TP (Silvex)	50	-	
2,4-D	70	70	Yes
Alachlor	2	4	Yes
Atrazine	3	0.15	Yes
Bentazon	18	200	Yes
Carbofuran	18	1.7	Yes
Chlordane	0.1	0.03	
Dalapon	200	790	
DBCP	0.2	0.0017	
Dinoseb	7	14	
Diquat dibromide	20	15	
Endothall	100	580	
Endrin	2	1.8	
EDB	0.05	-	
Glyphosate	700	1000	
Heptachlor	0.01	0.008	
Heptachlor epoxide	0.01	0.006	
Lindane	0.2	0.032	
Methoxychlor	40	30	
Molinate	20	-	Yes
Oxamyl	200	50	Yes
Picloram	500	500	
Simazine	4	draft 0.4	Yes
Thiobencarb	70	70	Yes
Toxaphene	3	-	

Appendix G: Testing Sites Per County

County	Number of Sites		County	Number of Sites
Stanislaus	29		Monterey	3
San Joaquin	22		Tehama	3
Sacramento	17		Yolo	3
Sutter	15		Butte	2
Merced	13		Glenn	2
Imperial	11		Solano	2
Yuba	5		Sonoma	2
Colusa	3		Contra Costa	1

Appendix H: Map of Testing Sites