Toxics on Tap

Pesticides in California Drinking Water Sources

Brad Heavner
California Public Interest Research Group Charitable Trust

One in a series of reports by Californians for Pesticide Reform

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Author

Brad Heavner, California Public Interest Research Group (CALPIRG)

Californians for Pesticide Reform

Californians for Pesticide Reform (CPR) is a coalition of public interest organizations committed to protecting public health and the environment from pesticide proliferation. CPR's mission is to 1) educate Californians about environmental and health risks posed by pesticides; 2) eliminate the use of the most dangerous pesticides in California; and 3) promote sustainable pest control solutions for our farms, communities, forests, homes and yards; and 4) hold government agencies accountable for protecting public health and Californians' right to know about pesticide use and exposure.

For more information on pesticides and how you can work to reduce pesticide use and protect your health and environment, contact CPR.

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Delays in identifying and acting upon threats to groundwater supplies place the health of California citizens at risk.

—Kurt Sjoberg, California State Auditor, 1998

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Executive Summary

Pesticides are in the water supply of many California communities. The drinking water in some areas is unquestionably hazardous to the health of the residents who drink it. In other areas, evidence is strong that the risks are high, although the state has not adopted guidelines to protect public health based on the latest research. In many places, testing is so inadequate that nobody knows what is in the public water supply.

Pesticides have been detected in the sources of water suppliers serving 16.5 million people in 46 of California's 58 counties over the past ten years.

State agencies have blindfolded themselves by establishing regulations and procedures which prevent them from getting a clear picture of the extent of pesticide contamination. In some ways, they have clearly lacked the political will to take action. In other respects, these agencies simply lack the resources to protect public health effectively.

Pesticides are regularly detected in drinking water sources throughout California

Analysis of the databases maintained by the agencies studying California water quality shows that pesticide detections are common. One hundred one pesticides and related compounds have been detected in the state's drinking water sources over the past ten years. Thirty-one have been detected in more than ten sources, and seven in more than 100 sources.

Pesticide contamination is worst in the Central Valley, but occurs throughout the state. Pesticides have been detected in the sources of water suppliers serving 16.5 million people in 46 of California's 58 counties over the past ten years. Only 40 of the 600 water suppliers that have detected pesticides in their water sources use the expensive treatment facilities that effectively reduce the concentration of pesticides in water.

Many Californians are exposed to pesticides in drinking water at levels that threaten their health

Two pesticides—DBCP and EDB—have repeatedly been detected throughout the state at concentrations higher than state-established Maximum Contaminant Levels (MCLs). Both of these are soil fumigants that have long been banned, but both continue to persist in the water in many areas.

Other pesticides are detected above the level believed to cause a significant health risk, but below the maximum level allowed by law. The Public Health Goals (PHGs) of ten of the 19 pesticides for which the Office of Environmental Health Hazard Assessment has revised its risk assessment in the past two years are lower than the MCLs. Seven of these ten pesticides have been detected above the PHG but below the MCL. Most notable among these are atrazine, an herbicide still in use, and DBCP.

New evidence demonstrates that much of California's public water supply is at higher risk than existing standards indicate

New studies show that Californians are also at risk from the many pesticides for which state agencies have not performed an official risk assessment or for which assessments are many years old. Data published by the U.S. Environmental Protection Agency (EPA) on carcinogens shows that simazine, diuron, and molinate are hazardous at concentrations lower than the levels at which these herbicides are detected in California. Other pesticides which are detected with some frequency warrant strict health standards, based on their cancer-causing effects as determined by EPA.

Regulators evaluate the health effects of exposure to pesticides one pesticide at a time. In reality, we are exposed to a multitude of pesticides. While numerous studies have given qualitative proof that negative effects are compounded by multiple contaminants working together, few studies have resulted in hard numbers to quantify those compounded effects. Rather than building an extra margin of safety into their assessments for this uncertainty, California regulators continue to ignore it altogether.

State regulatory agencies have failed to protect Californians adequately from pesticides in drinking water

The Department of Pesticide Regulation (DPR) is the state agency charged with overseeing pesticide use to prevent contamination of drinking water sources. Under previous administrations, DPR's commitment to this mission has been weak at best—the regulations DPR put in place to implement pollution prevention laws have been ineffective, and work has proceeded very slowly. Decisions by upper management at DPR have prevented the rest of the department from doing their jobs effectively.

In 1986, California legislators passed the Pesticide Contamination Prevention Act. Its stated purpose was "to prevent further pesticide pollution of the groundwater aquifers of this state which may be used for drinking water supplies." The law gave DPR the responsibility of identifying potential contaminants, checking for them in groundwater, and limiting their use when they are found.

DPR has come up short in each of the four main requirements of the Act:

- *The restrictions placed on the pesticides known to pollute groundwater have been ineffective at preventing further contamination.* DPR placed restrictions on seven pesticides from 1986–90 due to their detection in groundwater, yet each of those pesticides has continued to be detected since then. No other pesticides were restricted due to groundwater contamination until 1997, when use of norflurazon was restricted slightly.
- *DPR has delayed identifying and evaluating pesticides likely to contaminate groundwater.* Thirteen years after creating a priority list for groundwater monitoring, DPR has satisfied the testing requirements for only 19 of the 63 pesticides on the list.
- *DPR does not follow up on all detections reported by other agencies.* According to DPR's database, DPR never attempted to follow up on thousands of detections reported by other agencies. The detections that were followed up on were not resampled until an average of 25 months after the initial detection.
- *DPR does not collect all available data on groundwater testing for pesticides.* Over 9,000 records of pesticide detections by the Department of Health Services and the U.S. EPA are not in the DPR database. This includes detections of over 100 pesticides, some of which were detected above health standards.

The California Department of Health Services (DHS) is the state agency charged with overseeing water suppliers to protect public health from exposure to unsafe levels of pesticides in drinking water. Their efforts fall short in three main areas:

- *The maximum level of contamination allowed in drinking water for some pesticides is* *higher than the level believed to cause a significant health risk.* For some pesticides, this is due to provisions in the law which allow DHS, after a cost-benefit analysis, to adopt standards much weaker than an analysis of health effects alone would dictate. For other pesticides, this is due to the slow pace at which DHS accepts new scientific understanding. For 15 of the 27 pesticides which currently have enforceable standards, those standards allow for significant risk to public health. In addition, according to studies approved by U.S. EPA, standards should be set for other pesticides which are not currently regulated, including 29 pesticides believed to have carcinogenic effects.

- *DHS ignores valuable data in their assessments of the extent of pesticide contamination of drinking water sources.* DHS sets weak statewide reporting limits based on the minimum technological standards for laboratories, and instructs labs not to report detections at concentrations below those limits. Detections below those levels by more sensitive instrumentation are treated as non-detections. Some reporting limits are higher than levels believed to cause a significant health risk. Only six of the 27 regulated pesticides have reporting limits low enough to identify contamination problems that are approaching dangerous levels.

- *DHS does not force many small water suppliers to comply with minimum testing requirements.* Over 1,700 water suppliers, serving nearly two million people, have never tested for pesticides, according to the DHS water quality database. Most of these are small rural water suppliers, which are often the most vulnerable to pesticide contamination.

Legal protections are not as strong for surface water as they are for groundwater. Although pesticide contamination of surface water sources has been widespread throughout the past 20 years, no formal mechanism for addressing this problem was in place until two years ago. In 1997, DPR, together with the State Water Resources Control Board, devised regulations to control polluted run-off. These new regulations are now about to be used for the first time for just one pesticide.

Recommendations

Recommendations for the Department of Pesticide Regulation

- *Phase out the use of all pesticides that are continually contaminating drinking water sources.* Atrazine, bromacil, diuron, molinate, and simazine have been plaguing California drinking water sources for years. Use restrictions have not been effective at ending contamination. All are suspected or known human carcinogens for which there is no safe use.

- *Protect groundwater effectively by beginning to honor the spirit of the Pesticide Contamination Prevention Act.* The intent of this act was to prevent all future pesticide contamination of groundwater, yet DPR in the Wilson Administration hid behind a regulatory system which allowed contamination to continue. In its current revision of these regulations, DPR should implement a system which is effective at prevention.

- *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 system for surface water for the purpose of preventing all future contamination.

- *Increase emphasis on the encouragement of least-toxic pest control methods.* Alternatives to synthetic pesticides have been proven successful, and should be encouraged to spread as rapidly as possible. If all of the environmental and social costs associated with heavy use of synthetic pesticides were taken into account, and if least-toxic pest control methods were given the amount of support now given to the use of chemical pesticides, use of least-toxic methods by California growers would increase exponentially.

Recommendations for the Department of Health Services

- *Revise Maximum Contaminant Levels to make them fully protective of public health.*

As the new Public Health Goals show that MCLs allow levels of contamination that may harm 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 skews DHS's understanding of the extent of the problem and affects their choice of solutions.
- *Do not allow small water suppliers to slip through the regulatory cracks.* Since small, rural water suppliers are generally more vulnerable to pesticide contamination, it is a severe health risk to allow them to pump out untested drinking water.

Recommendations for individuals

- Call or write Governor Davis to express your concern about pesticide contamination of drinking water sources.
- Get information from your local water utility to determine if pesticide contamination of drinking water is a problem in your community.
- Call on your local school system and local government to stop using toxic pesticides.
- Convince local authorities to maintain the roadsides in your community without the use of pesticides.
- Buy organic foods.
- Use least-toxic pest control methods at home.

Preface

The growing use of pesticides since the middle of this century has resulted in increased pesticide contamination of our natural resources. By relying on the intensive use of toxic pesticides, farms have been able to become massive and profitable production facilities with rows of a single crop stretching as far as the eye can see. But counting this agricultural model as a success ignores the damage these pesticides are doing to our health and to the health of our environment.

With over 600 pesticides currently in use in California, and with over 14,000 water suppliers throughout the state, determining which pesticides have contaminated which water supplies and what the health risks may be is a monumental task. From the testing that has been done, we know that pesticide contamination is a major problem. As more studies are done, researchers understand the problem to be worse than anticipated. According to the U.S. Geological Survey, "the primary criterion for whether pesticides had been detected in the groundwater in a state appears to be whether or not [researchers] have looked."[1]

Each year since regular testing began 14 years ago, new pesticides have been detected in drinking water sources.

Communities like Dinuba, California, have learned their lesson the hard way. The economy of this small town southeast of Fresno relies heavily on agriculture. From the 1950s through the 1970s, farmers in Dinuba injected the soil fumigant DBCP into the soil to kill the tiny worms that had become a problem in their crops. Farmers were thrilled with this chemical's effectiveness in killing the pests without harming the plants. Agriculture thrived and the town boomed.

Then scientists revealed that DBCP is a potent carcinogen and reproductive toxicant, and the chemical was found in the groundwater below Dinuba. The town soon discovered that nearly all of its water supply was contaminated, and was forced to close 11 of its 15 wells. Water has since been in such short supply there that the local water utility has sometimes been forced to draw from the polluted wells. They warn residents to boil the water before drinking it, even though this does not treat pesticide contamination.[2]

DBCP has been banned statewide, but we are no less dependent on toxic chemicals for pest control. California's annual pesticide use has grown to over 200 million pounds. Each year since regular testing began 14 years ago, new pesticides have been detected in drinking water sources.

California law concerning pesticide contamination of water is based on the premise that "evidence of relatively localized levels of pesticide pollution should be treated as a warning of more widespread, future contamination."[3] Yet state agencies are still treating pesticide detection as a local problem concerning only the particular pesticide in each specific detection. By continuing to use massive amounts of the pesticides that are known to have contaminated water supplies, California pesticide users are making the contamination worse, threatening public health and destroying valuable natural resources.

Knowing what we know now, we have ample reason to change the way we grow our food. We can and should phase out the pesticides known to be contaminating our water supply. We can and should embrace the many non-toxic pest control methods which have been proven successful, and which would flourish if given proper encouragement. The alternative is to continue business as usual until the diminishing supplies of clean water cause California's world-famous water wars to escalate even further, with victims of cancer, reproductive problems, and other health effects wondering why we didn't act sooner.

1 Pesticide Contamination of California Drinking Water Sources Is Widespread

Most California farmers are highly dependent on the use of pesticides, and the side effects are becoming clearer all the time. The more we look for pesticides in the water, the more we find them. Pesticides persist longer and are more mobile than was previously expected. Now that drinking water sources are becoming contaminated, we find that pesticides are difficult to remove. Our health is at risk, and we are losing precious resources.

Many pesticides have been detected

An analysis of the databases maintained by the agencies overseeing California drinking water quality has revealed some very troubling signs.[4]

- One hundred one pesticides and degradates[5] have been found in California drinking water sources over the past ten years.
- Seven pesticides and degradates have been found in more than 100 sources.
- Thirty-five pesticides and degradates have been found in more than 10 sources. Fifteen of these pesticides are used in amounts of more than 100,000 pounds per year.
- In 1997, California pesticide applicators used 49 million pounds of the pesticides that have been found in drinking water sources. This accounts for 24% of total pesticide use that year.[6]

Table 1-1. Pesticides Detected in More Than Ten Sites in California Since 1990

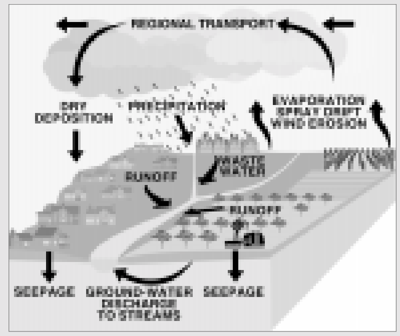
Pesticide	Pounds Used in CA in 1997	Groundwater Wells with Detections	Surface Water Sites with Detections	Total Sites with Detections
DBCP	banned	918	19	937
Simazine	764,586	580	34	614
Diuron	1,228,114	343	8	351
ACET	degradate	202	–	202
Atrazine	46,568	178	11	189
Bromacil	82,424	179	–	179
EDB	banned	129	10	139
Deethyl atrazine	degradate	68	1	69
1,2–Dichloropropane	banned	63	–	63
TPA	degradate	62	–	62
DACT	degradate	47	–	47
Prometon	20	28	4	32
Bentazon	1,907	16	7	23
Methyl bromide	15,663,832	16	4	20
Diazinon	955,108	4	14	18
2,4–D	609,039	5	13	18
Chlorthal	342,000	8	7	15
Aldicarb sulfoxide	degradate	12	2	14
Dalapon	2	7	6	13
Metolachlor	212,714	5	7	12
Carbaryl	753,801	5	7	12
Aldicarb sulfone	degradate	10	2	12
Heptachlor	banned	9	2	11
Norflurazon	212,621	10	1	11
Carbon disulfide	–	10	1	11
EPTC	579,245	2	9	11
Thiobencarb	894,287	1	10	11
Chlorpyrifos	3,152,564	1	9	10
Trifluralin	1,433,999	2	8	10
Cyanazine	470,838	4	6	10
Molinate	1,170,699	2	8	10

Routes of Contamination

Groundwater has been found under approximately 40% of California's surface area. The California Department of Water Resources has identified 450 different groundwater basins, with the largest aquifers lying below the cropland of the Central Valley. Ninety percent of the state's water suppliers, serving 9 million people, use groundwater for at least part of their total supply. In rural areas, 90% of the population rely exclusively on groundwater for their drinking water supply.[1]

Surface water is 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 currently in operation in California, virtually the entire hydrologic system of the state is engineered to meet human water needs.[2]

Pesticides enter into surface water and groundwater through a variety of avenues. Rain and irrigation water wash pesticides away from farms and urban areas into surface waters. This pollution can be washed down rivers, sink into the groundwater below rivers, or cling to the sediment lining waterways and be released slowly. Runoff can also stream down inactive wells that are poorly sealed or drainage wells intended to clear water from low-lying areas. Pesticides which sink below the soil surface where they are applied can cling to water molecules and leach all the way through the topsoil and into groundwater aquifers. Often this leaching is aided by cracks running through the more dense sections of soil and clay. 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 or seep into groundwater aquifers.

1 California Department of Health Services, Office of Drinking Water, *Drinking Water into the 21st Century: Safe Drinking Water Plan for California: A Report to the Legislature,* January 1993, 30.

2 California Department of Water Resources, Division of Safety of Dams, *Bulletin 17-93,* 1993.

Table 1-2. Counties with Pesticide Detections at Ten or More Sites

County	Sites with Detections	Pesticides Detected	No. of Detections
Fresno	482	30	5,743
Tulare	365	21	2,326
Kern	167	19	991
Stanislaus	160	36	1,382
Los Angeles	148	21	1,991
Riverside	119	15	1,777
San Bernardino	92	12	815
San Joaquin	86	19	987
Merced	58	40	718
Orange	53	8	136
Monterey	26	9	65
Alameda	18	18	32
Madera	17	13	75
Ventura	17	11	68
San Luis Obispo	17	9	20
Solano	15	19	128
Tehama	15	10	68
Santa Barbara	15	13	29
Santa Clara	14	8	21
Yolo	13	12	42
Contra Costa	12	16	40
Yuba	11	6	36
San Diego	11	7	33
Glenn	11	8	32
Del Norte	10	4	79
Napa	10	3	10

Pesticides have been detected throughout the state

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, proximity to rivers, and the depth of groundwater aquifers. Clearly, contamination is worse where pesticides are used most heavily—California's Central Valley has the worst contamination problem in the state. But the problem is not limited to that region. Pesticides are used throughout the state, and the combination of factors that allow for pesticides to move into drinking water sources exists in many areas.

Pesticides have been detected in 1,877 groundwater wells and surface water sites in 46 of California's 58 counties in the past ten years.[7] Twenty-six counties have had detections in at least ten locations.

In California, 16.5 million people get their tap water from water suppliers that have had pesticide detections in their principal water sources.[8] Many water systems also supplement their supplies with water from the State Water Project (SWP), which regularly tests positive for pesticides (see page 38-9). The Department of Water Resources, which runs SWP, estimates that 20 million Californians receive some amount of SWP water.

Table 1-3. Large Water Suppliers with the Most Detections*

Water Supplier	Population Served	Detections	Sites with Detections	Pesticides Detected
Anaheim, City of	292,900	45	19	4
Bakersfield - CWSC	182,670	37	6	3
Bell, Bell Gardens–SCWC	48,500	16	4	3
Camrosa Water District	27,000	51	8	9
Claremont–SCWC	34,028	261	23	8
Coachella VWD–Cove Community	167,782	10	3	2
Corona, City of	104,000	37	5	1
Cucamonga CWD	128,000	1,384	19	3
Delano, City of	29,944	83	10	3
Downey, City of	91,000	47	9	5
East Bay MUD	1,300,000	10	6	6
Eastern Municipal WD	253,705	13	2	1
Fullerton, City of	117,420	14	6	3
La Verne, City of	30,897	54	4	1
Lake Hemet MWD	43,939	15	4	2
Los Angeles Dept. of Water & Power	3,700,000	50	14	3
Madera, City of	35,515	33	4	5
Manteca, City of	44,500	60	8	3
Merced, City of	61,400	30	4	2
Oceanside, City of	142,000	22	3	1
Riverside, City of	245,000	1,589	82	12
Rubidoux Community SD	25,000	22	6	3
Sacramento, City of	374,600	29	4	4
San Bruno, City of	39,000	11	1	1
Santa Clarita Water Co.	49,500	10	4	3
South Gate, City of	82,550	13	2	3
South San Francisco–CWSC	56,200	27	3	2
Stockton - CWSC	155,670	15	3	1
Stockton, City of	96,000	25	2	2
Tracy, City of	46,500	20	5	5
Tulare, City of	39,800	29	6	3
Upland, City of	66,383	132	6	1
Vallejo, City of	121,600	16	6	4
Yorba Linda Water District	70,000	49	14	8

* Water suppliers which serve at least 25,000 people with at least ten pesticide detections in the past ten years, excluding suppliers which treat water for pesticides.

Losing precious resources

Throughout the history of California, battles over water rights have been at the forefront of settlement and development issues. These battles have been the focus of political campaigns, Hollywood movies, and Supreme Court decisions. A formerly arid region has been transformed to support the most populous state in the country, which is also the nation's largest agricultural producer.

No one knows how long pesticides will remain in groundwater once aquifers are contaminated.

Water use in California already surpasses sustainable annual supply. Groundwater overdraft—taking more from an aquifer than is naturally replenished—results in resource loss, sea water intrusion, and sinking land. Overuse of surface water degrades habitat for fish and wildlife. The Department of Water Resources (DWR) estimates that we currently use 2% more water in average years than the hydrologic system can sustain, and 9% more in drought years.[9]

With California's population in a continual boom, water scarcity will become even more of a problem in the coming decades. If per capita water consumption rates do not drop substantially, water shortages will certainly lead to mandatory cutoffs and economic dislocations.

Contamination of water supplies will further exacerbate water shortages around California. As removing pesticides from a contaminated water body is often prohibitively expensive, the most common response to pesticide contamination of water supplies has been to abandon the polluted sources and search for new ones. With water already in short supply, California communities cannot afford to take this approach any longer. The only truly effective solutions are pollution prevention and increased water use efficiency.

Persistence

No one knows how long pesticides will remain in groundwater once aquifers are contaminated. As pesticide use skyrocketed over the past fifty years, conventional wisdom held that pesticides dissipate quickly in groundwater. In recent years, however, this belief has been shattered by field measurements.

Scientists predict the rate of pesticide decomposition through laboratory measurements of half-lives, the length of time required for the concentration of a pesticide to be reduced by half. It is generally assumed that pesticides with longer half-lives are more likely to leach to groundwater, since they have more time to filter through the soil before they break down, and persist longer once they reach the water. However, in the results of the first phase of the National Water-Quality Assessment Program, the largest nationwide study of pesticides in groundwater currently underway, scientists at the U.S. Geological Survey (USGS) were surprised to find a low correlation between half-lives and pesticide leaching, indicating that pesticides do not break down in soil and water as expected from laboratory experiments. The study's authors suggest that this unexpected result may be due to the "variable manner" in which half-lives are determined.[10]

A recent USGS report in California reveals another puzzling finding—the fumigant DBCP is present at high concentrations even in water that has percolated into groundwater aquifers years after use of the pesticide ended.[11] DBCP, which was determined by the Department of Pesticide Regulation (DPR) to have a soil half-life of 180 days,[12] is still leaching into groundwater at toxic levels 22 years after it was banned. Other studies estimate the half-life of DBCP to be as long as 141 years.[13] Further investigation by USGS put DBCP's half-life at 6.1 years, and estimated that DBCP will continue to cycle through the hydrologic system at dangerous levels for 70 years after use of the pesticide ended.[14]

A recent DPR study of herbicide leaching shows that the time between the application of a pesticide and its detection in groundwater can be as long as 33 years.[15] DPR has thus concluded that "since degradation of pesticides or their breakdown products is generally much slower in ground water than at the surface, it may take many years for residues in ground water to dissipate."[16] Unfortunately, DPR has used this long lag time to justify a wait-and-see approach, hoping that the minimal restrictions on pesticide applications recently established will result in major reductions in pesticide detections more than a decade from now.[17]

Few water suppliers treat drinking water to remove pesticides

The first defense against unsafe drinking water should always be to protect the source. DHS itself sees the need for "a strong wellhead protection program," arguing in its last comprehensive statewide analysis of drinking water quality in 1993 that "if one had been established and in place, many of the groundwater contamination problems experienced throughout the state may have been avoided."[18]

Once a water source is contaminated, treatment is the second line of defense. Pesticides, however, are very difficult to remove. Granular activated carbon (GAC) plants are needed to remove most pesticides. Packed tower aeration (PTA) also works for the few pesticides that are volatile.[19] These two types of treatment are extremely expensive and are used by very few water suppliers in the state. Even when these treatment types are used, they will only reduce the concentration of pesticides, not remove the pesticides altogether.

Construction costs for GAC treatment facilities start at $375,000 and run into the many millions of dollars.[20] The City of Fresno intends to spend up to $100 million over the next thirty years for GAC treatment to reduce the level of the soil fumigant DBCP in its public water supply.[21] The City of Riverside recently estimated initial costs of $57 million and ongoing operating costs of $6.7 million per year to remove DBCP from its water. This would cost each Riverside resident $195 per year, raising their bills by 43%.[22]

Only forty of the six hundred water suppliers that have detected pesticides in their water sources use the types of treatment that remove pesticides from water. These forty suppliers serve 2.2 million people. Fourteen million Californians are served by water suppliers that have detected pesticides in their sources and have no facilities in place to clean up pesticide contamination.[23]

Table 1-4. Largest Water Suppliers with Pesticide Treatment Capacity*

Water Supplier	Population Served	Treatment Type
Fresno, City of	390,350	GAC
Contra Costa Water District	225,000	GAC
Modesto, City of	180,320	GAC
Pasadena, City of	155,000	PTA
San Gabriel Valley Water Co.– El Monte	151,064	PTA
San Bernardino, City of	139,789	GAC
Pomona, City of	131,723	PTA
Orange, City of	116,800	PTA
Monterey District– Cal-Am Water Co.	108,271	GAC

* Data on treatment facilities from California Department of Health Services, "Permit, Inspection, Compliance, Monitoring, Enforcement Database," October 1998. See also endnote 23.

Testing Requirements and Response to Detections

Testing for regulated pesticides[1]

The 1986 amendments to the federal Safe Drinking Water Act (SDWA) require water suppliers to conduct periodic testing for all regulated chemicals. Large suppliers must collect a minimum of two samples three months apart every three years for each of the 27 pesticides that are regulated in California. Small suppliers must collect one sample every three years.[2]

If a pesticide is detected in a water source by a water supplier, but not above a level determined to be a threat to public health, the supplier must step up testing for the pesticide in that source to a rate between one and four times per year, at the discretion of the DHS district engineer.

When contaminants are found above Maximum Contaminant Levels (MCLs)—the maximum "safe" levels set for 27 pesticides based on laboratory studies—the water supplier is required to increase testing further. Large suppliers must test monthly for six months. Small suppliers must test quarterly for one year. Only when the average of all of these tests is above the health standard is the source deemed to be out of compliance. If the average is below the health standard, a supplier can reduce the testing frequency, provided that the annual average remains below the health standard.

Response to health standard violations

If the average is above the health standard, the supplier has three options. The cheapest response is to blend the contaminated water with other sources to reduce the level of contamination before the water enters the distribution system. If no clean sources are available to dilute the pollution, the supplier must stop using the source or build treatment facilities to remove a portion of the pesticides from the water (see previous page).[3] When sources are shut off, water suppliers can either close them down permanently or keep them inactive, hoping that pollution prevention activities will slowly reduce the level of contamination.

Testing for unregulated pesticides

EPA required testing for a secondary list of another 20 pesticides beginning in 1986. In one year out of five, groundwater sources were tested once, and surface water sources quarterly. To comply with the 1996 amendments to the Safe Drinking Water Act, EPA decreased this list to 15 pesticides in August 1999, and increased the testing requirement for groundwater sources from once to twice each five years.[4]

The 15 regional DHS offices also have the authority to require testing for any additional contaminant they determine to be a potential threat to a water source. These requirements are specific to each water source, and vary widely.

Source vs. tap concentrations

Testing is done at the source—at the wellhead for groundwater and at the water system intake for surface water. In the rare cases where water is treated for pesticides, water is tested after treatment. State law assumes the worst-case scenario: that all of a water supplier's consumers receive water at the tap with the same level of contamination found at the source. Due to the complexity of distribution systems, it is impossible to predict accurately how dilution may lower concentrations once water leaves a treatment plant or an untreated source. In most cases, some portion of the population will indeed be receiving the full dose of contamination.

1 "Regulated pesticides" refers to those that are controlled as drinking water contaminants by the California Department of Health Services. The use of all pesticides is regulated by the Department of Pesticide Regulation, but drinking water is regulated for only 27 pesticides (see page 20).

2 Large suppliers are public water systems serving 200 or more buildings. Small suppliers serve less than 200 buildings.

3 California Department of Health Services, *California Safe Drinking Water Act & Related Laws,* 6th Edition, 198-205.

4 U.S. EPA, *Revisions to the Unregulated Contaminant Monitoring Regulation for Public Water Systems: Final Rule* (pre-publication notice), 6 August 1999.

2 Pesticides Are Found Above Official Health Levels

Agencies monitoring drinking water quality in California have detected two pesticides throughout much of the state at levels higher than those deemed "safe" by regulators. In addition, risk analysts have recently determined that health effects may occur from exposure at concentrations below those official standards, and many pesticides have been detected at those lower concentrations.

Concentrations that violate legal limits

The only legally enforceable standards are the California Maximum Contaminant Levels (MCLs) set by the Department of Health Services (DHS) for 27 pesticides. Sixteen of these 27 pesticides have been detected at least once above MCLs, although most of those detections were not verified by follow-up testing. Two pesticides have been found repeatedly around the state above MCLs—DBCP and EDB.

DBCP

DBCP (1,2-dibromo-3-chloropropane) is a soil fumigant which was widely used for 20 years primarily in vineyards and orchards to kill nematodes, tiny root-eating worms. In 1977, due to the startling revelation that the chemical caused sterility in formulation plant workers, the California Department of Food and Agriculture suspended use of DBCP. Two years later, as DBCP began to show up in groundwater tests in Northern and Central California, U.S. EPA banned the pesticide nationally. DBCP was later shown to cause cancer and other health effects.

Since it was banned, there have been more detections of DBCP in California than of all other pesticides combined. In the Central Valley alone, DBCP has contaminated 7,000 square miles of groundwater.[24]

DHS set the Maximum Contaminant Level for DBCP at a level which is 100 times less protective than the standard for other MCLs, using a one in ten thousand cancer risk rather than the one in a million cancer risk used to set MCLs for all other carcinogens. Although risk assessment showed health hazards at concentrations of DBCP in drinking water of 0.002 parts per billion (ppb), DHS raised this to 0.2 ppb after their cost-benefit analysis. DHS took the position that "economic feasibility precluded regulating at a more stringent level."[25] California law requires MCLs to be set for carcinogens at a level which "avoids any significant risk to public health,"[26] yet in the field of risk assessment one death per ten thousand people is widely considered to be much more than "significant."

Even with this less stringent health standard, detections of DBCP have exceeded the MCL repeatedly. Government agency databases have records of 3,600 DBCP detections above the MCL in 315 active drinking water sources in the past ten years. These drinking water sources are used by water suppliers located in 15 counties across California, from Mendocino to Alameda to Los Angeles to Tulare to Merced.

Forty-four Fresno wells were shut down in the 1980s due to DBCP contamination, in one of the first major pesticide contamination cases in a major city.

Fresno, Riverside, Bakersfield

Fresno's battles with DBCP are well-known throughout the country. Forty-four Fresno wells were shut down in the 1980s due to DBCP contamination, in one of the first major pesticide contamination cases in a major city. Since Fresno draws all of its water from local groundwater, the city has had to scramble to drill new wells away from the plume of contamination. DBCP has been detected 423 times in the past ten years in the City of Fresno's water sources at levels that have exceeded the MCL of 0.2 ppb. A recent USGS study estimates that DBCP will be present in the groundwater of the eastern San Joaquin Valley at concentrations above the MCL until 2050.[27]

Riverside has also been struck hard by DBCP. DBCP has been detected above the MCL 353 times in the past ten years in Riverside water sources. Dozens of wells still show measurable levels of DBCP. At least seven wells are still testing above the MCL, although the water from those wells is diluted to reduce the contamination before it is delivered to consumers.

Around the time of its introduction in the 1950s, Dow Chemical, Shell Oil, and Occidental Chemical, the manufacturers of DBCP, knew it presented a health hazard.

Around the time of its introduction in the 1950s, Dow Chemical, Shell Oil, and Occidental Chemical, the manufacturers of DBCP, knew it presented a health hazard. A lawsuit brought by the City of Fresno against the manufacturers of DBCP also revealed that "defendants Dow and Shell failed to disclose past well contamination incidents or scientific data showing its potential to leach to groundwater, and failed to conduct requested testing."[28] The manufacturers settled before the jury could return a precedent-setting verdict on the case. The total value of the settlement was $80-100 million, depending on how many wells become contaminated in the future due to continued leaching of the pesticide from the soil down into the aquifers.[29] In all, Dow, Shell, and Occidental have settled with more than 30 cities in the San Joaquin Valley for hundreds of millions of dollars.[30]

In Bakersfield, the parents of children exposed to DBCP in drinking water at school have brought a lawsuit against the pesticide's manufacturers. A study commissioned by the plaintiffs found that over half of the men studied who had been exposed as children had developmental disorders or were experiencing reproductive problems. The limited, preliminary study will likely be followed up by a more rigorous independent study soon.[31] DBCP has been detected in Kern County over 700 times in the past ten years in 116 wells. Forty-seven Kern County water suppliers have detected DBCP in their sources at least once.

MCL revision

DHS is now considering a more protective MCL for DBCP. Legislation passed in 1996 requires DHS to review all MCLs at least once every five years.[32] DHS's process for complying with this new law has been to wait for the Office of Environmental Health Hazard Assessment (OEHHA) to issue Public Health Goals, and then determine whether an MCL review is warranted based on OEHHA's new assessment. As part of this process, DHS announced in April that "due to the facts that the MCL was not set at the *de minimus* risk level and that DBCP is still detected in some drinking waters supplied to the public, DHS is including this chemical" on the list of substances to be reviewed for possible MCL revision.[33]

EDB

Beginning in 1948, EDB (ethylene dibromide) was used as a soil fumigant. Like DBCP, it is persistent, mobile, and extremely toxic. These properties make the two fumigants effective in killing nematodes, but also lead to groundwater contamination, posing a severe threat to human health.

In 1984, when enough evidence was assembled to classify EDB as a potent carcinogen and a likely drinking water contaminant, the pesticide was banned. Since then, research has shown EDB also to be a mutagen and reproductive toxicant.

DHS set the Maximum Contaminant Level for EDB at 0.05 ppb. Over the past ten years, the pesticide has been detected above this level 233 times in 63 locations in 11 counties.

Other pesticides

Fifteen of the 25 other regulated pesticides have been detected above the MCL at least once, although only four have been found at such levels ten times or more. In addition to DBCP and EDB, 1,2-Dichloropropane has been found above its MCL in 45 tests, and heptachlor has been found above its MCL in

Table 2-1. MCL Exceedences by County

County	Sites with MCL Exceedences	Tests Exceeding MCL	DBCP MCL Exceeded	EDB MCL Exceeded	Other MCL Exceeded
Fresno	88	1,379	Y	Y	Y
Kern	54	285	Y	Y	
Stanislaus	32	308	Y	Y	
Tulare	32	188	Y		Y
Riverside	28	389	Y	Y	Y
San Bernardino	28	288	Y		Y
San Joaquin	26	355	Y	Y	
Los Angeles	23	567	Y	Y	Y
Merced	13	80	Y	Y	
Alameda	7	7	Y	Y	Y
Yolo	4	14		Y	Y
Del Norte	4	8			Y
Ventura	3	20	Y	Y	
Santa Clara	3	3			Y
Monterey	2	20	Y		
Madera	2	19	Y	Y	
San Mateo	2	10			Y
Tehama	2	6	Y		
Santa Barbara	2	2			Y
Contra Costa	1	2			Y
Lake	1	2			Y
San Diego	1	2			Y
Santa Cruz	1	2			Y
Butte	1	1			Y
Mendocino	1	1	Y		
Solano	1	1			Y

ten tests. All four of these pesticides are now banned.

Health threats from concentrations allowed by law

In 1996, legislation was passed requiring OEHHA and DHS to begin a revision of all existing drinking water standards. Since then OEHHA has reviewed recent scientific studies and issued Public Health Goals (PHGs) for 19 of the 27 regulated pesticides. PHGs for ten of those 19 pesticides are lower than the pesticide's MCL, indicating that these pesticides pose a health threat at concentrations lower than those that have been allowed by law. Pesticides have regularly been detected at levels higher than these new PHGs, but lower than MCLs. DHS may soon revise its MCLs to conform with the new PHGs.

Atrazine

Atrazine has been a popular weed killer across the U.S. since its introduction in 1958. In 1997, 46,000 pounds of atrazine were used in California, mostly on fodder crops such as grasses in cattle pastures and feed corn.[34]

Drinking Water Standards and Goals

The federal Safe Drinking Water Act (SDWA) established a system for creating minimum standards for drinking water quality. It ordered EPA to determine two sets of tolerance levels for contaminants in drinking water. Maximum Contaminant Level Goals (MCLGs) are concentrations beyond which adverse health effects are believed to occur. MCLGs are not enforceable. They are recommendations based strictly on health effects. Targeting these goals, but factoring in cost and feasibility, EPA then sets enforceable standards called Maximum Contaminant Levels (MCLs). Since 1974, when the act was first passed, EPA has chosen to regulate 83 contaminants, 23 of which are pesticides.[1]

The federal SDWA requires states wishing to control the monitoring and enforcement of drinking water quality to adopt standards that are at least as stringent as the federal standards. California enacted its own Safe Drinking Water Act in 1976 to administer the federal SDWA through the California Department of Health Services (DHS). The California SDWA requires DHS to establish MCLs for California for all contaminants that are regulated by EPA, and to establish additional state MCLs for contaminants of particular concern in California. DHS has established state MCLs for 27 pesticides—the 23 federally-regulated pesticides and four others which are not regulated by EPA.

The 1996 SDWA amendments require OEHHA to perform a new risk analysis for all regulated pesticides based only on health concerns, and to set target levels called Public Health Goals (PHGs).

Table 2-2. Drinking Water Standards and Goals (ppb)

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

These levels are the California equivalent of the federal MCLGs. OEHHA is encouraged to take into account the scientific evidence used by EPA in the development of MCLGs, but can adopt PHGs that are more or less stringent than the federal levels at its discretion.[2] OEHHA has established PHGs for 19 of the 27 regulated pesticides. Although the law requires them to finish the new PHGs in 1999, they are not planning to complete their work until the end of 2000.[3]

Lifetime exposure

Drinking water standards are set assuming continual exposure over a 70-year lifetime. Hence, exposure to pesticides above PHGs for a short period of time is not a significant risk to public health, according to OEHHA's risk assessment. California risk assessors believe that the doses required for chronic effects from short term exposure to pesticides are so high that they are not a concern for drinking water exposure. While this is clearly true for most effects, this may miss some reproductive and developmental effects from short term exposure, especially during windows of increased vulnerability, such as pregnancy and infancy.

Multiple exposure pathways

For non-carcinogens, the new Public Health Goals consider relative amounts of exposure through water and food. In addition to drinking water, OEHHA considers water exposure to include exposure through cooking, dermal exposure (through the skin), and inhalation of steam while bathing. The inhalation of pesticides in the air is not considered together with the oral ingestion of food and water.

For carcinogens, OEHHA does not include multiple exposure pathways in its PHG calculations. The reasons for this are never clearly stated. In their PHG support documents, OEHHA generally expresses that exposure through food does not need to be considered for carcinogens because the formula for calculating drinking water standards based on cancer potency is believed to be adequately conservative without doing so. At the same time, they acknowledge that, "This is an area of uncertainty and scientific debate and it is not clear how this assumption impacts the overall health risk assessment."[4]

Uncertainty factors

In calculating health standards, risk assessors use numerical "uncertainty factors" for considerations which they believe may add to increased toxicity but which they are not able to measure. Generally, they divide their results by ten for each factor they cannot otherwise quantify. The standard default uncertainty factor is 100—ten for the suspected variation between humans and laboratory animals and ten for variations between different groups of humans, especially those with compromised immune systems. Some public health officials characterize this as "an extra margin of safety." Others argue that since it is based on what is suspected to be a real difference in sensitivity, it is an approximation that is as likely to be an under-estimation as an over-estimation.

1 Five other regulated chemicals have been used as pesticides, but are more commonly used as industrial solvents and for other purposes, and are thus not included in this report. These five are benzene, methylene chloride, tetrachloroethylene, toluene, and xylene.

2 Eleven of the first 19 PHGs issued by OEHHA were less stringent than MCLGs. This includes seven pesticides with MCLGs of zero and four pesticides with MCLGs above zero.

3 Health and Safety Code § 116365 (e) (2); OEHHA, *Announcement of Chemicals Undergoing Evaluation in 1999 for PHG Development and Adoption*, 12 July 1999.

4 OEHHA, *Public Health Goal for Alachlor in Drinking Water*, December 1997, 12.

DHS set its MCL for atrazine at 3 ppb in 1989 based on non-cancer effects. Since then, atrazine has been classified as an endocrine disruptor,[35] and evidence of its cancer-causing potential has continued to mount. Although numerous studies from 1986 up to the present demonstrate carcinogenic effects, U.S. EPA still has not raised atrazine above Class C "possible 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.[36]

In its recent report on a four-year study on endocrine disruptors, the National Academy of Sciences concludes, "Elevated levels of the herbicide atrazine found in municipal water supplies in Iowa were associated with excess rates of cardiovascular, urogenital, and limb-reduction deficits."[37]

Despite the delay in listing atrazine as a "probable" or "known" human carcinogen, OEHHA set its new Public Health Goal for atrazine in drinking water 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.

Atrazine has been detected 161 times in the past ten years above the new PHG but below the MCL. These detections occurred in 83 locations in 17 California counties.

Atrazine degradates have also been detected at high levels. Although they may be equally toxic as the parent compound, testing for atrazine degradates is not required.[38] Including degradates in atrazine testing and analysis would significantly increase the number of wells exceeding the atrazine PHG. From the limited testing that has been done, data shows that atrazine degradates have been detected in 73% of the areas where atrazine has been detected in the groundwater.

Atrazine in Orange County

Orange County is one of the hardest-hit regions of California for atrazine contamination of drinking water sources. In Anaheim, Fullerton, and Yorba Linda, atrazine has been in the public water supply at detectable levels throughout most of the past ten years (see Table 2-3). While none of the detections exceeded the atrazine MCL of 3 ppb, many were higher than the new Public Health Goal of 0.15 ppb.

Table 2-3. Atrazine in Orange County (ppb)*

Year	Anaheim	Fullerton	Yorba Linda
1990	0.2	0.2	0.3
1991	0.1		0.2
1992	0.2	0.2	1.0
1993			0.1
1994	0.1	0.1	
1995	0.1	0.1	0.2
1996	trace	0.2	0.2

* Maximum level detected in each year. Data for Anaheim and Fullerton from Orange County Water District Historical Data Reports; data for Yorba Linda from annual water quality reports to consumers; additional data from government agency databases.

DBCP

Like atrazine, the Public Health Goal adopted for DBCP in 1999 was far below the Maximum Contaminant Level. While no new studies showed increased health risks, OEHHA based the PHG on a one in a million cancer risk—the level considered to be negligible in the world of risk assessment—rather than the weakened one-in-ten-thousand risk which DHS used for the MCL. The new PHG is thus 0.0017 ppb.

Since this is lower than common instrumentation can measure, all of the 12,500 detections of DBCP in the past ten years have been higher than the no significant risk level. These detections were made in over 800 locations in 23 California counties.

Recently, the City of Fresno has used GAC treatment plants to restore 25 of the wells they had shut down due to DBCP contamination. While GAC is the most effective method available for removing pesticides from water, it does not remove 100% of the contamination. The water which Fresno residents now get at their taps has an average DBCP concentration of 0.043 ppb—less than the 0.2 ppb MCL, but still 25 times higher than the 0.0017 ppb level of no significant cancer risk.[39]

The City of Riverside, which has yet to install GAC treatment plants to address the DBCP plume in its groundwater, delivers water with an average DBCP concentration of 0.08 ppb—nearly 50 times the level deemed "safe."[40]

Other pesticides

In addition to DBCP and atrazine, PHGs of eight other pesticides are below the enforceable health standard. These include 1,2-Dichloropropane, 1,3-Dichloropropene, chlordane, heptachlor, heptachlor epoxide, lindane, methoxychlor and oxamyl. Five of these eight pesticides have been detected at levels above the PHG but below the MCL—levels allowed by law which are higher than the concentration determined to affect human health.

Table 2-4. PHG Exceedences by County

County	Sites with PHG Exceedences	Tests Exceeding PHG	Atrazine PHG Exceeded	1,2-Dichloro-propane PHG Exceeded	Other PHG Exceeded
Fresno	219	4,389	Y	Y	Y
Stanislaus	110	1,088	Y	Y	Y
Kern	104	759	Y	Y	Y
Los Angeles	90	1,794	Y	Y	Y
San Bernardino	82	789		Y	Y
Tulare	81	874	Y	Y	Y
Riverside	72	1,681		Y	Y
San Joaquin	61	889	Y	Y	Y
Merced	30	346	Y	Y	Y
Orange	14	16	Y		Y
Tehama	9	35	Y		Y
Ventura	9	34	Y		Y
Del Norte	7	14		Y	Y
Solano	6	20	Y		Y
Alameda	6	6	Y		Y
San Diego	5	24		Y	Y
Yolo	5	14	Y	Y	Y
Sacramento	5	5	Y		Y
Monterey	4	30	Y		Y
San Mateo	3	25		Y	Y
Madera	3	23			Y
Santa Clara	3	3			Y
Glenn	2	3	Y		
Santa Barbara	2	2			Y
Sutter	1	5			Y
Kings	1	3	Y		
Lake	1	3			Y
Santa Cruz	1	2		Y	
Butte	1	1			Y
Mendocino	1	1			Y
San Luis Obispo	1	1			Y
Sonoma	1	1		Y	

3 New Evidence Shows Health Risks Below Official Health Levels

Pesticides detected above EPA cancer levels

New studies accepted by U.S. EPA for several currently regulated pesticides indicate that Maximum Contaminant Levels (MCLs) are not strict enough to provide adequate protection of human health. In addition, enough studies have been performed and accepted to create MCLs for many pesticides that are not currently regulated. Although this is true for both carcinogenic and non-carcinogenic pesticides, this analysis is limited to carcinogens.[41] EPA uses the accepted laboratory studies to set “cancer potency values”—threshold levels of exposure which lead to a risk of one or more excess case of cancer for every million people exposed.

Cancer levels for regulated pesticides

For five pesticides that are regulated as drinking water contaminants, projected health standards based on EPA cancer potency values are lower than the MCL set by the Department of Health Services (DHS).

Simazine

Simazine, an herbicide in the triazine class, is closely related to atrazine. In California, 764,000 pounds of simazine were used in 1997, largely on orchards, vineyards, and nuts. Simazine is among the pesticides detected most often and in most counties in California.

The Office of Environmental Health Hazard Assessment (OEHHA) is currently reviewing simazine to establish a new Public Health Goal (PHG), which is due at the end of 1999. Since simazine is structurally similar to atrazine, and as recent simazine studies have demonstrated carcinogenic effects, it is likely that the new PHG will be much lower than the current MCL of 4 ppb. If OEHHA uses the same studies and assumptions which EPA used in publishing its cancer potency value for simazine in July, 1999, the new PHG will be 0.3 ppb—13 times lower than the current MCL.

In 16 California counties, 335 simazine detections have exceeded 0.3 ppb, although only two of those detections were higher than the MCL of 4 ppb. Since DHS does not require water suppliers to report detections below 1 ppb, most simazine detections go unreported, even though many are at levels which risk assessors now believe may cause cancer.

Since it is much more widely used than atrazine, a reduction in the health standard for simazine could have a much larger effect on current California agricultural practices than a reduction for atrazine.

For five regulated pesticides, projected health standards based on EPA cancer potency values are lower than the Maximum Contaminant Level set by the Department of Health Services.

Molinate

Since the mid-1970s, California rice farmers have used molinate to control weeds. Molinate use in the past seven years has averaged 1.3 million pounds per year. DHS set the MCL for molinate at 20 ppb. Then, in 1980, researchers found evidence that the herbicide causes reproductive damage. In 1991, studies showed molinate also to be a carcinogen in laboratory studies. It is now listed as a possible human carcinogen.

If DHS uses EPA’s cancer potency value in its next revision of the molinate MCL in 2001, it will make the MCL over 60 times more strict than it is now, bringing it down to 0.3 ppb.

Molinate has been one of the most frequently detected pesticides in the Sacramento River for decades (see pages 39-41). In the 1980s, the herbicide was frequently detected in the City of Sacramento water supply at levels near the MCL. The Department of Pesticide Regulation restricted the use of molinate in order to bring the level of contamination down below the MCL, but only sought to bring it below 10 ppb. Currently, most detections of molinate in the Sacramento River are below the official MCL of 20 ppb, but above the level which may cause significant risk of cancer.

Other pesticides

The projected health levels based on EPA cancer potency values for three other pesticides are lower than the MCLs.

- *EDB*—EPA cancer level is 0.0004 ppb, 125 times lower than the MCL. OEHHA will establish a new PHG in 2001, and DHS will then consider an MCL review. EPA's MCL Goal is zero.
- *Toxaphene*—EPA cancer level is 0.03 ppb, 100 times lower than the MCL. Toxaphene was one of the most common insecticides in the U.S. until it was restricted in 1982 and banned altogether in 1990. EPA's MCL Goal is zero.
- *Alachlor*—EPA cancer level is 0.4 ppb, 5 times lower than the MCL. Alachlor is an herbicide used to treat corn and beans, with 51,000 pounds used in California in 1997. OEHHA established a PHG in 1998 which is ten times higher than it would be if it were based on the EPA cancer potency value.

EDB, the banned soil fumigant, has been detected repeatedly at levels violating the current MCL. If the MCL is lowered to a level that is fully protective of human health, many more water sources will be in violation. Alachlor and toxaphene have seldom been detected.

Fifteen unprotective MCLs

Taking into account these five pesticides and the ten new Public Health Goals which are lower than the established MCLs, 15 of the 27 regulated pesticides do not have MCLs that are fully protective of human health (see Table 3-1).

Table 3-1. Pesticides with MCLs Higher Than Levels Believed to Threaten Public Health

Pesticide	DHS MCL (ppb)	Lower Health Level (ppb)
1,2-Dichloropropane	5	PHG: 0.5
1,3-Dichloropropene	0.5	PHG: 0.2
Alachlor	2	EPA Cancer Level: 0.4
Atrazine	3	PHG: 0.15
Chlordane	0.1	PHG: 0.03
DBCP	0.2	PHG: 0.0017
EDB	0.05	EPA Cancer Level: 0.0004
Heptachlor	0.01	PHG: 0.008
Heptachlor epoxide	0.01	PHG: 0.006
Lindane	0.2	PHG: 0.032
Methoxychlor	40	PHG: 30
Molinate	20	EPA Cancer Level: 0.3
Oxamyl	200	PHG: 50
Simazine	4	EPA Cancer Level: 0.3
Toxaphene	3	EPA Cancer Level: 0.03

Cancer levels for unregulated pesticides

Twenty-nine currently used pesticides that are not regulated as drinking water contaminants are possible or probable human carcinogens.[42] Since they have no MCLs, OEHHA has no current plans to develop a Public Health Goal for these pesticides. However, DHS has the authority to add any contaminant to the list of regulated chemicals which they judge to be a risk to public health. After OEHHA has completed the PHGs for regulated chemicals in 2001 and DHS has conducted MCL reviews based on those new PHGs, DHS may begin the process of establishing MCLs for unregulated pesticides by asking OEHHA to perform a risk analysis.

Diuron

Diuron is an herbicide used for a wide variety of agricultural and road maintenance purposes. It is the second most widely used herbicide on rights-of-way in the state. Diuron use in California averaged over 1.1 million pounds per year from 1991–97.

Classified by EPA as a Category 3 (slightly toxic) neurotoxin, diuron has been considered by regulators to be a less toxic alternative to other herbicides. Recently, however, studies have shown diuron to be a carcinogen and a reproductive toxicant. OEHHA took action in May 1999 to list diuron as a reproductive toxicant (Prop 65 list) based on studies published by EPA in 1994.[43] In addition, in its 1999 update of the potency of carcinogenic chemicals, EPA classifies diuron as a "known or likely" carcinogen and quantifies its cancer-causing potential.

If DHS chooses to regulate diuron and bases the MCL on the cancer potency value published by EPA, the MCL will be 1.8 ppb. Twenty-two of the 767 diuron detections in California have exceeded this level in the past ten years, according to statewide and federal databases. In the State Water Project, samples in every study period have tested above the EPA cancer level for diuron.[44]

Bromacil

Bromacil is an herbicide used mainly on orchards and rights-of-way. In California, 82,000 pounds were used in 1997. Bromacil is classified as a possible human carcinogen.

If DHS decides to regulate bromacil based on the EPA cancer potency value, the MCL will be 9 ppb. Seven of the 390 bromacil detections in California in the past ten years have been at concentrations higher than this level—in Los Angeles and Tulare counties.

Table 3-2. EPA Cancer Level Exceedences by County

County	Sites with EPA Cancer Level Exceedences	Simazine Cancer Level Exceeded	Diuron Cancer Level Exceeded	Molinate Cancer Level Exceeded	Other Cancer Level Exceeded
Tulare	79	Y	Y		Y
Fresno	40	Y	Y		Y
Orange	25	Y			
Los Angeles	20	Y			Y
Stanislaus	7	Y			
Kern	6	Y	Y		Y
Merced	6	Y		Y	Y
Solano	4	Y		Y	Y
Alameda	3	Y			Y
Riverside	3	Y			
San Diego	3	Y			Y
San Luis Obispo	3		Y		
Contra Costa	2	Y			Y
Glenn	2	Y		Y	
Sacramento	2			Y	Y
Yolo	2				Y
Butte	1	Y			
Colusa	1			Y	
Madera	1				Y
San Bernardino	1	Y			
San Joaquin	1	Y			
Santa Barbara	1				Y
Ventura	1				Y
Yuba	1				Y

Other pesticides
In addition to diuron and bromacil, MCLs could be established for 27 other currently used pesticides based on EPA cancer levels. Seventeen of these 29 pesticides have been detected at least once in the past ten years in California drinking water sources. Seven have been detected above the EPA cancer level. Many of them have not been tested for widely.

The uncertainty of risk assessment
Determining a level of contamination below which scientists are confident that no one will be significantly at risk is dubious for any toxic substance. For many contaminants, we cannot be certain that there is any "safe" level.

Three Cal/EPA scientists, including the chief of OEHHA's Pesticide and Environmental Toxicology Section, concluded in 1995 that after 20 years of relying on risk assessment for our policy decisions, there is still no consensus in the risk assessment community on methodology and reliability. Hence, the definition of "safety" is somewhat arbitrary. Traditional risk assessment has not been able to identify "safe" levels of exposure to reproductive toxicants, developmental toxicants, and some carcinogens. Since exposures to these chemicals can have lifelong effects, and since genetic damage may be inherited by successive generations, permitting these chemicals in our water supply has tremendous implications for public health.[45]

Endocrine disruptors confuse natural switches, threatening the nervous, reproductive, and immune systems.

Key factors are not considered

Endocrine disruptors
Of particular concern among developmental and reproductive toxicants are endocrine disruptors. These chemicals attack the body by mimicking hormones, the naturally occurring "chemical messengers" flowing through our blood. Hormones tell our bodily systems when to do their work, affecting growth, development, learning, and behavior. Hormones control our development and health starting before birth and continuing throughout our lives. Endocrine disruptors confuse these natural switches, threatening the nervous, reproductive, and immune systems.

The National Academy of Sciences recently completed a four-year study on endocrine disruptors. Despite the influence of scientists connected with the chemical industry on the 16-member panel, elements of the report confirmed the widely held belief that endocrine disruptors are a serious threat to health. "Adverse reproductive and developmental effects have been observed in human populations, wildlife, and laboratory animals as a consequence of exposure" to endocrine disruptors, according to the report.[46] And these chemicals are already prevalent in the environment, our diet, and our bodies: "Over 95% of adipose [fatty] tissue samples taken from the U.S. population contained detectable concentrations" of endocrine disruptors.[47]

Scientists do not know how much of these chemicals it takes to cause harm, but most suspect that the levels are lower than the levels seen as a threshold for cancer and other chronic diseases. According to one recent study, "we are beginning to realize that very low levels of exposure to some chemicals present in the environment disrupt the endocrine system, particularly during fetal development, at doses to which humans and animals are routinely exposed."[48] Yet the risk assessment community does not have an accepted procedure for quantifying the effects of endocrine disruptors on humans. Chemical testing protocols attempt to find the lowest dose which produces acute or chronic toxicity, but ignore the more subtle effects at lower doses.

Ten regulated pesticides are endocrine disruptors, yet endocrine disruption effects are taken into account for the Public Health Goal of only one pesticide—methoxychlor. An extra uncertainty factor of ten was added to the PHG calculation for this seldom-used insecticide because of its endocrine disrupting effects.[49]

Table 3-3. Endocrine Disruptors with Over 25,000 Pounds Used*

Pesticide	Pounds Used in 1997
Trifluralin	1,191,780
Methomyl	833,758
Malathion	773,782
Carbaryl	753,801
Aldicarb	530,066
Dicofol	512,562
2,4-D	428,874
Permethrin	324,598
Endosulfan	238,034
Methyl parathion	153,187
Benomyl	114,406
Alachlor	51,259
Atrazine	46,568
Metribuzin	27,972

* Illinois Environmental Protection Agency, *Report on Endocrine Disrupting Chemicals,* February 1997.

Exposure to multiple pesticides

As each individual pesticide is technically a different chemical, they are all treated separately in drinking water regulation. In reality, however, different pesticides can work together to cause increased health effects. Pesticides with similar chemical structures and mechanisms of toxicity can have *additive* effects, in which the total toxicity is the sum of the toxicity of the two components. Some combinations of pesticides have *synergistic* effects, in which different contaminants work together to produce a result that is exponentially more toxic than either of the components. Pesticides can also have *potentiating* effects, whereby one compound is not toxic except in the presence of another compound.

When MCLs were established, EPA and DHS were not required to consider the combined effects of exposure to multiple pesticides.[50] The 1996 amendments to the California Safe Drinking Water Act now require OEHHA to adopt Public Health Goals which take “possible synergistic effects” into account.[51] However, OEHHA does not consider any of the current research on this subject to be sufficient for the development of PHGs. While recent studies provide qualitative proof that additive or even synergistic effects exist for many chemicals, they do not provide sufficient data to quantify those effects.[52] Rather than adding an extra uncertainty factor for this lack of data, OEHHA continues to ignore combined effects in its numerical analyses.

There is clearly a need to consider combined effects, as some Californians are drinking water which contains a cocktail of pesticides.

In its recent study of San Joaquin Valley groundwater, USGS detected at least one pesticide in 59 out of 100 samples of domestic wells (see Table 3-4). Of these, more than one pesticide was detected in over two-thirds of the samples. Twenty-nine percent of the samples with detections contained three or more pesticides. Including monitoring wells, the picture was even worse—73% of the sites with detections had two or more pesticides in the water, and 25% had four or more.[53]

USGS found similar results for surface water in their studies of the Sacramento River, as shown in Table 4-7.

Table 3-4. USGS Sampling of Domestic Wells in San Joaquin Valley*

Number of Pesticides Detected	Number of Samples	Percent of Samples
1	19	32%
2	23	39%
3	8	14%
4	5	8%
5	3	5%
10	1	2%

* USGS, *Water Quality in the San Joaquin-Tulare Basins,* 1998.

Pesticides and their degradates

Compound effects can also be observed with pesticides and their degradates. Although transformation from one degradate to another may occur rapidly, many of these compounds are highly resistant to further breakdown.[54] While relative concentrations and health risks of parent compounds and degradates are not well documented, existing studies indicate that total residues of pesticides and their degradates can be as much as ten times higher than residues of the parent compounds alone,[55] and that degradates can be much more mobile and at least as persistent as the parent compound.[56] The pesticide

Pesticides Are Only One Part of the Mix

Nitrate: Nitrate is found in common fertilizers and in animal manure. The soil does not break it down, so water moving through the soil can transport nitrate to water bodies. High nitrate levels can cause a potentially fatal condition in infants known as blue baby syndrome. Nitrate has also been linked to stomach cancer and non-Hodgkin's lymphoma.[1]

Industrial chemicals: There are currently over 70,000 chemicals in production in the U.S., many of which have been little studied. Among the worst water polluters are industrial solvents and degreasers, such as trichloroethylene (TCE) and perchloroethylene. Household products also contain many hazardous chemicals. These wastes reach water bodies by legal discharges, improper disposal, and leaks and spills.

Microorganisms: Microbial contaminants such as cryptosporidium, giardia, and coliform are commonly found in lakes and rivers, especially when the water is contaminated with sewage and animal wastes. Exposure to high levels of these contaminants can cause gastroenteric diseases. Water suppliers have treatment systems in place to address most biological contaminants.

Gasoline: Leaking underground storage tanks have become a major threat to water sources. Tanks built decades ago have been leaking contaminants straight into the ground for years. Of particular concern are the toxic components of gasoline such as benzene, toluene, and MTBE.

Arsenic: Arsenic is a naturally occurring element found in the earth's crust. It is also synthesized for use as a wood preservative and was previously used as an ingredient for pesticides. Arsenic can enter the water through seepage from natural mineral deposits or from improper use and disposal. Large doses of arsenic can be fatal, while small doses may result in abnormal heart function, damage to blood and blood vessels, liver and kidney injury, and impaired nerve function.[2]

Pesticides and nitrates—a dangerous combination

The combined effect of exposure to a combination of pesticides and other toxic compounds is of great concern. In 1998, Dr. Warren Porter, a zoologist at the University of Wisconsin, released the results of a landmark study on exposure to a mix of pesticides and nitrates. In this five-year study, researchers looked at health effects from mixtures of nitrates and the popular pesticides aldicarb and atrazine at concentrations commonly found in groundwater. The study found that "endocrine, immune, and behavior changes occurred due to doses of mixtures, but rarely due to single compounds at the same concentrations."[3]

A 1995 study of groundwater in the San Joaquin Valley found mixtures of nitrates and pesticides to be common. Two-thirds of the wells sampled contained a combination of nitrates and pesticides, with multiple pesticides detected in 90% of those wells. Comparing the results with 1986–87 tests of the same wells, the study found that pesticide detections had remained fairly constant while nitrate detections increased sharply.[4]

1 J.H. Hotchkiss et al., *Nitrate, Nitrite, and N-nitroso Compounds: Food Safety and Food Safety Assessment* (Washington, DC: American Chemical Society) 1992, 400-18; M.H. Ward et al., "Drinking Water Nitrate and the Risk of Non-Hodgkin's Lymphoma," *Epidemiology* 7(5): 1996, 465-71; I. Bogardi et al., *Nitrate Contamination: Exposure, Consequence, and Control* (Berlin: Springer-Verlag) 1991, 309-15.

2 Agency for Toxic Substances and Disease Registry, *Public Health Statement: Arsenic*, March 1989.

3 Warren P. Porter, James W. Jaeger, and Ian H. Carlson, "Endocrine, Immune, and Behavioral Effects of Aldicarb (Carbamate), Atrazine (Triazine) and Nitrate (Fertilizer) Mixtures at Groundwater Concentrations," *Toxicology and Industrial Health* 15, 1999: 133-150.

4 Karen R. Burow, Sylvia V. Stork, and Neil M. Dubrovsky, U.S. Geological Survey, *Nitrate and Pesticides in Ground Water in the Eastern San Joaquin Valley, California: Occurrence and Trends* (Water-Resources Investigations Report 98-4040), 1998.

degrades which are found most frequently in drinking water sources—the degradates of atrazine and other herbicides in the triazine class—have the same types of toxic effects at roughly the same levels as the parent compound, according to studies submitted by the manufacturer of atrazine.[57]

The State of Wisconsin has taken the lead in regulating pesticide degradates in the case of atrazine. In that state, regulators now sum the concentrations of atrazine and its degradates, counting the group as a single compound.[58] California risk assessment managers acknowledge the need for this type of approach, but have failed to implement it. In its assessment of atrazine, OEHHA concluded that because degradates were not considered, "the PHG value for atrazine may underestimate the possible risk to humans."[59] In California, not only are pesticide degradates not regulated in combination with their parent compounds; they are not regulated at all.

The higher sensitivity of children

When they created drinking water standards 20 years ago, U.S. EPA and the California Department of Health Services were not required to take into account the increased sensitivity to pesticides of vulnerable subpopulations, most notably children. The most recent amendments to the Safe Drinking Water Act have added this requirement, yet the new round of Public Health Goals does not fully correct this error. Only one of the 19 new PHGs for pesticides—for oxamyl—is based on effects on children.

A 1993 study by the National Academy of Sciences showed a glaring need for extra caution to protect children. The report found "quantitative and occasionally qualitative differences in toxicity of pesticides between children and adults." Much of this difference is caused by differences in size and the fact that children consume more food and water per pound of body weight than adults. In addition, the committee of scientists found that "Quantitative differences in pesticide toxicity between children and adults are due in part to age-related differences in absorption, metabolism, detoxification, and excretion of xenobiotic compounds .... Differences in size, immaturity of biochemical and physiological functions in major body systems, and variation in body composition (water, fat, protein, and mineral content) all can influence the extent of toxicity."[60]

Pesticides with no enforceable standards

While over 600 pesticides are in use in California, the Department of Health Services has adopted Maximum Contaminant Levels for only 27 of them. No pesticide degradates are regulated, although several degradates are regularly detected in drinking water sources and have been shown to be highly toxic.

Table 3-5. Unregulated Pesticides Detected in California Drinking Water Sources*

Pesticide	Total Sites with Detections	Pounds Used in 1997
Diuron	351	1,228,114
Bromacil	179	82,424
Aldicarb**	22	530,066
Methyl bromide	20	15,663,832
Diazinon	18	955,108
Chlorthal	15	342,000
Carbaryl	12	753,801
Metolachlor	12	212,714
EPTC	11	579,245
Norflurazon	11	212,621
Chlorpyrifos	10	3,152,564
Cyanazine	10	470,838
Trifluralin	10	1,191,780

* Pesticides used in amounts higher than 25,000 pounds per year and detected in at least ten drinking water sources around California.

** Includes detections of aldicarb degradates.

4 State Agencies Are Failing to Protect Human Health and the Environment

The Department of Pesticide Regulation and groundwater contamination

The 1986 Pesticide Contamination Prevention Act is the principle law governing pesticide contamination of groundwater. This law establishes four key requirements of the Department of Pesticide Regulation (DPR):

1. To maintain a database of all pesticide testing in groundwater by all agencies.
2. To verify all positive detections reported by other agencies.
3. To identify pesticides which are most likely to leach to groundwater and conduct targeted monitoring for each of them.
4. To restrict or ban the use of pesticides that have been detected in groundwater, in order to prevent any further groundwater contamination.

Under previous administrations, DPR largely failed in each of the above requirements.

Actions to stop ongoing contamination are failing

The Pesticide Contamination Prevention Act was intended "to prevent further pesticide pollution of the groundwater aquifers of this state which may be used for drinking water supplies."[61] When a pesticide is detected in a groundwater well due to agricultural use, that pesticide is submitted into the Pesticide Detection Response Process (PDRP). A subcommittee of DPR's Pesticide Registration Evaluation Committee (PREC), consisting of one representative each from DPR, DHS, and the State Water Resources Control Board, reviews the evidence and can make one of four determinations:

- Further groundwater contamination can be prevented by restricting use of the pesticide.
- The pesticide must be banned.
- The concentrations detected are negligible and no action is necessary.
- Restrictions on the pesticide would cause such severe economic hardship to the state that continued use is justified.

The DPR director can then adopt the subcommittee's findings or overrule them in whole or in part.[62]

Of the 11 pesticides which are still in use and have been detected with DPR verification in groundwater, eight have gone through the PDRP.

Atrazine, simazine, bromacil, diuron, and prometon went through the PDRP in 1986–88. For each of them, the PREC subcommittee recommended that use of the pesticide be restricted in areas where it had been detected. The DPR director responded by creating Pesticide Management Zones (PMZs), within which pesticide use was limited. Atrazine and prometon were banned within PMZs. Simazine, bromacil, and diuron were banned only from non-crop uses within PMZs, such as rights-of-way (i.e., roadsides and train tracks). Growers wanting to use these three pesticides on crops within PMZs need only apply for a permit from a licensed advisor, who is charged with informing the grower of the risks of improper pesticide application.

When aldicarb went through the PDRP in 1989, the PREC subcommittee concluded that there is no "current or modified agricultural use of aldicarb which can be employed with a high probability that groundwater would not be polluted," and that the pesticide should therefore be banned from all agricultural use.[63] Director Henry Voss disagreed, arguing that aldicarb had already been banned in Humboldt and Del Norte counties and conditions permitting aldicarb leaching to groundwater did not exist in any other area of California, despite the subcommittee's presentation of studies showing that aldicarb had leached to groundwater nationwide under widely varying conditions. Voss ruled that aldicarb did not pollute or threaten to pollute California groundwater due to current agricultural practices, and therefore no action needed to be taken. However, despite this official ruling, Voss still reduced the amount of aldicarb allowed per acre by 50% on all crops and banned aldicarb from use on certain crops during the rainy winter months.[64]

Bentazon went through the PDRP in 1989–90. The subcommittee recommended and the DPR director concurred that use of the pesticide could be limited to prevent future groundwater contamination. Bentazon was prohibited on rice, prohibited in Humboldt and Del Norte counties, and restricted to use on cropland irrigated by sprinklers.

Ineffective solutions

The use restrictions resulting from the PDRP for the seven pesticides that were reviewed in 1986–90 have clearly failed for each of the pesticides. Since the restrictions went into effect, various agencies have continued to detect each of the pesticides in groundwater throughout the state, ranging from detections in 16 wells in five counties for bentazon to detections in 530 wells in 29 counties for simazine. In all, wells in 31 counties have had detections of at least one of these pesticides since regulations were adopted to prevent any future groundwater contamination.

Use of these seven pesticides has remained fairly constant throughout the 1990s, ranging from 2.1 million to 2.4 million pounds per year.

In the PREC subcommittee's review of aldicarb, they ruled that PMZs are not a legal response to preventing groundwater contamination under the Pesticide Contamination Prevention Act. The subcommittee stated that "the Act requires modified agricultural uses which will give 'a high probability that the [pesticide] would not pollute' groundwater. Since a PMZ is designated in an area only after groundwater pollution by a pesticide has already occurred and been detected, the PMZs will have no value in preventing groundwater pollution by aldicarb from occurring."[65] This determination was overruled single-handedly by the DPR director, and PMZs thus have remained California's principle mechanism for "preventing" groundwater contamination by pesticides throughout the 1990s.

Norflurazon

In its recent review of norflurazon, the PREC subcommittee did not use the PMZ approach, yet did not replace it with a better system.

In 1998, norflurazon was submitted to the Pesticide Detection Response Process based on verified detections in Fresno County, making it the first pesticide to go through the process since 1990. Norflurazon is an herbicide manufactured by Novartis, and applied mainly to fruit and nuts. It is a developmental and reproductive toxicant, and is classified as a possible human carcinogen by EPA. Because of its high solubility and low affinity for binding to the soil, DPR had identified norflurazon as a likely leacher.

In 1994, norflurazon was detected in one well in Fresno County by the U.S. Geological Survey, but this detection was apparently not reported to DPR. In 1996, DPR selected norflurazon for monitoring because of increased use in sensitive areas and recent detections in groundwater in Florida. In this review, it was detected in Tulare and Fresno counties, with verified detections in eight wells in Fresno County.[66] In response, DPR prohibited norflurazon use in very limited areas—the inner slope of drainage canals and areas managed to recharge groundwater. In addition, they pledged to further study "Best Management Practices" for possible future use restrictions and to monitor the success or failure of the new regulations.[67]

A new approach

Regulators at DPR now admit the failure of the PMZ system, and are in the process of developing a new approach. They have classified all agricultural lands in the state according to vulnerability to groundwater contamination based on climate and soil type. DPR used this data to create a computerized statistical model known as CALVUL, for California Vulnerability Model. CALVUL attempts to model the transport of pesticides through the soil into groundwater.

In the new regulations, PMZs will be replaced with Groundwater Protection Areas (GWPAs), areas judged by the CALVUL model to be vulnerable to pesticide contamination. The seven pesticides which are now restricted in PMZs, plus four others with similar chemical properties, will be restricted in GWPAs. Application and irrigation methods will need to meet guidelines for reduced risk of groundwater contamination when these pesticides are used within GWPAs.

New regulations will allow for increased use of some pesticides that are known groundwater contaminants.

While this new regulatory system is clearly geared more toward pollution prevention than the PMZ system, it will also allow for increased use of some pesticides that are known groundwater contaminants. Atrazine and prometon are among the pesticides most commonly found in groundwater throughout the country under varying conditions. Since 1990, both have been banned from use within PMZs in California. Under the new system, they will be allowed in GWPAs as long as irrigation and application methods meet groundwater protection guidelines. The success of keeping these pesticides from contaminating drinking water sources won't be known for years, as they slowly react with the environment after their reintroduction.

Abandoning other regulatory tools

In anticipation of the new system, DPR staff have abandoned some tools they traditionally used to strengthen the PMZ process. When PMZs were first created, “adjacent section monitoring” was an important part of the plan. DPR monitored areas next to PMZs for the same pesticides that had been found within existing PMZs. If pesticides were detected in adjacent sections, those sections also became PMZs. From 1988–95, DPR sampled the groundwater of 415 adjacent sections, and detected pesticides in 218 of them.[68] Despite this 53% success rate in finding pesticide contamination and taking steps to prevent further contamination, adjacent section monitoring was suspended in 1995.

In addition, DPR has abandoned all “compliance monitoring,” which had assured that growers were complying with PMZ regulations. Although compliance monitoring had repeatedly uncovered evidence of the misuse of pesticides, DPR decided in 1995 to stop checking.

DPR is slow to check for risky pesticides

The Pesticide Contamination Prevention Act requires DPR to identify those pesticides most likely to leach to groundwater and to conduct targeted sampling of wells to determine if use restrictions are necessary for those pesticides. The act lays out a three-step process for doing this.

1. Collect data on the chemical properties of all pesticides—including soil mobility, water solubility, half-life, and others.
2. Compare the chemical properties of pesticides known to have leached to groundwater with those that have not. Establish benchmark values—called Specific Numerical Values (SNVs)—beyond which pesticides are considered to be likely groundwater contaminants.
3. Place all pesticides with chemical properties above the SNVs, and which are intended to be applied directly to the soil or in other manners likely to promote leaching, on the Groundwater Protection List (GWPL).

DPR then uses this list to prioritize pesticides for groundwater sampling.

DPR established the Groundwater Protection List in 1986 and has revised it five times since. The list now contains 63 pesticides identified as having a high likelihood of leaching to groundwater, plus the seven pesticides that have been found in California groundwater with DPR verified detections due to current agricultural practices.[69]

Delays at DPR

DPR did not begin monitoring for pesticides on the GWPL until 1992. In the seven years since then, they have satisfied the testing requirements for only 19 of the 63 pesticides identified as having high leaching potential. Moreover, the rate of testing has declined in recent years. From a high of five pesticides reviewed in 1994, the number of studies dropped to three in 1995 and 1996. In 1997, GWPL monitoring was performed for only one pesticide—norflurazon. In 1998, two pesticides were studied. If DPR maintains this rate, they won't finish sampling for all pesticides on the priority list until the year 2015.

The verified detections of norflurazon in 1997 demonstrate the value of testing for pesticides with high leaching potential. Nine pesticides on the Groundwater Protection List which DPR has yet to test for have been detected in groundwater by other agencies.

DPR's detection verification system excludes valuable data

DPR does not take reports of detections from other agencies as indication of the actual presence of a pesticide, but rather as a warning of possible groundwater contamination. In order to verify a detection, DPR requires that a second sample from the same source be tested using a different laboratory or a different testing method. Since the DPR Division of Environmental Monitoring does not have the resources to follow up on all reported detections, the set of verified detections they present to DPR's Division of Registration and Health Evaluations leaves out valuable data. Even when DPR is able to retest wells with reported detections, the delay between initial detection and follow-up testing often causes the follow-up tests to come up negative, due to a variety of factors. When no follow-up tests are performed or when follow-up tests turn out negative, DPR concludes that the pesticide was never present in the first place.

If DPR were to base its decision-making on a more complete set of data which included the unconfirmed tests submitted by other agencies, any errors arising from the inclusion of mistaken detections would be small in comparison with the error of ignoring all of the detections which nobody bothers to confirm.

Delays in follow-up testing

Of the many instances where other agencies reported a pesticide detection in a particular area before DPR had found it there, DPR's database contains complete records of all sampling dates in only 129 cases.[70] In all other cases, sampling dates for some tests are blank. In the cases with complete information, the first DPR sampling for the reported pesticide in the reported area was done an average of 25 months after the initial detection by another agency. This time lag is due in part to delays in the other agencies reporting detections and in part to DPR constraints in the amount of testing they do. In 115 of these 129 cases, DPR was unable to find evidence of the pesticide in their delayed follow-up tests.

In some cases, follow-up testing does not reveal the presence of a pesticide because the pesticide has completely dissipated or the original detection was erroneous. More often, however, negative follow-up tests may not detect the original contaminant due to movement of the plume of contamination within the aquifer[71] and seasonal pesticide use.[72] Since many of DPR's groundwater samples are taken from monitoring wells, in the period between initial and follow-up sampling the plume may actually be drawn closer to the drinking water wells that are continually operating.

Table 4-1. Comparison of DPR Verified Detections and All Reported Groundwater Detections

	DPR	All Agencies
Number of pesticides and degradates found	16	85
Number of wells contaminated	617	1,953

No follow-up testing performed
Follow-up sampling is never performed for many detections by other agencies. Analysis of DPR's master database reveals that DPR has never attempted to verify 3,844 confirmed pesticide detections which other agencies have reported to DPR's Environmental Monitoring Branch, including detections of 22 pesticides in 94 areas.

In their annual reports, DPR fails to differentiate between cases where follow-up testing was not performed and cases where it was performed but came up negative. For reported detections that were not verified, DPR states that no further action will be taken on reported detections "because either no additional wells were available for sampling or the reported residues were not found during follow-up sampling conducted by DPR."[73]

An analysis of master databases reveals that 8,403 records of pesticide detections at DHS are missing from DPR's data.

DPR does not collect all available data

Data not gathered
According to the Pesticide Contamination Prevention Act, DPR "shall maintain a statewide database of wells sampled for pesticide active ingredients. All agencies shall submit to the director, in a timely manner, the results of any well sampling for pesticide active ingredients and the results of any well sampling that detect any pesticide active ingredients."[74] Despite this requirement, there are many tests performed by other agencies that never show up in the DPR database, including positive detections at high levels.

An analysis of master databases reveals that 8,403 records of pesticide detections at DHS are missing from DPR's data. Eighty-three pesticides were detected in this missing data. Twenty-one pesticides were detected above official health levels, and 19 others have no official health levels.

EPA's database of pesticides in water contains 953 records of pesticide detections which are not in the DPR data.[75] The 55 pesticides in this data set include eight with tests above official health levels and 11 with no levels.

Data not accepted
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. For this reason, the U.S. Geological Survey considers MDLs "only to indicate relative analytical precision and detection sensitivity," and does not consider an MDL to be "a lower limit for reporting concentrations."[76] 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 its analyses, USGS includes all positive detections below MDLs, but designates concentrations as estimated values. USGS considers it necessary to use all available information for better early warning and trend detection. They find that "lower detection limits make it possible to detect trends and protect source-water before it becomes significantly contaminated." In using pesticide detections to calculate the potential for future contamination, USGS finds that "including low-level detections produces a more rigorous risk analysis."[77] Rather than using low-level detections for these purposes, DPR counts positive detections below MDLs as non-detections.

The Department of Health Services and drinking water quality

The California Department of Health Services (DHS), one of the largest departments in California state government, has a broad mission related to medical care and public health. Part of this mission is handled by the

DHS Drinking Water Program, which "assures protection of the public through the regulation and monitoring of public water systems."

In several regards, DHS has fallen short of this goal:

- Some of the concentrations of pesticides allowed in the public water supply are greater than the levels determined to pose a risk of cancer and other health effects.
- DHS has not set standards for some other pesticides believed to damage health at the levels at which people are currently exposed.
- DHS ignores valuable data in determining the extent of pesticide contamination of drinking water sources.
- Small water suppliers are allowed to skirt the law.

MCLs do not fully protect human health

As stated above (pages 17-22), Maximum Contaminant Levels (MCLs) for 15 of the 27 regulated pesticides are higher than the level believed to be a health risk. These MCLs range from 0.01 ppb to 700 ppb, with 20 of them higher than 1 ppb. In contrast, the European Union has set the drinking water standard for all pesticides at 0.1 ppb.

California law allows DHS staff to set MCLs higher than the level at which health effects are believed to occur if they claim that a cost-benefit analysis forces them to compromise public health. In addition, until the 1996 amendments to the California Safe Drinking Water Act, there was no requirement for DHS to revise its MCLs based on new scientific understanding. DHS under the Wilson Administration failed to accept any of the new studies showing that MCLs had originally been set too high.

In their coming review of MCLs for possible revision, DHS now has the opportunity to correct these shortcomings. In July 1999, DHS issued draft guidelines for reviewing MCLs which indicate that they will conduct a full MCL review of all contaminants for which the new Public Health Goal (PHG) is lower than the established MCL.[78] This review could have a major impact on the protection of public health.

DHS does not consider all available data

By ignoring pesticide detections below weak statewide reporting levels and by not collecting all available data, DHS bases its policy decisions on an incomplete picture of the extent of pesticide contamination of California drinking water sources.

DHS ignores many positive detections

Detections at estimated trace levels
Like DPR, DHS ignores all positive detections below method detection limits (MDLs). Rather than reporting detections at low concentrations as estimated values, DHS treats them as non-detections. (see previous page).

Some of the concentrations of pesticides allowed in the public water supply are greater than the levels determined to pose a risk of cancer and other health effects.

Accurate results from more sensitive equipment
In addition, DHS applies the lowest common denominator to its assessment of all testing sensitivity. Rather than taking the simple step of using the MDLs for each type of equipment and method used by the various labs around the state, DHS sets statewide levels, called Detection Limits for Purposes of Reporting (DLRs). These limits are uniform throughout the state, based on the minimum technological standards which DHS expects contract labs to have. Hence, more precise results reported by labs which use more sophisticated instrumentation and testing procedures are ignored if they fall below the statewide DLR.

Some reporting limits are higher than health levels
For some pesticides, the reporting limits prevent detections to be reported at levels which pose a health risk. DLRs for 21 of the 27 regulated pesticides are so high that detections at or near health levels do not get reported. Even when a health level is exceeded,

DHS does not want water suppliers to report detections if the concentration is below the DLR.

DLRs for 11 of the 27 pesticides for which enforceable health standards have been set are above the level of no significant health risk. DLRs for ten others are near the lowest health level—within a factor of ten. Thus, only six of the 27 regulated pesticides have DLRs low enough to enable the Department of Health Services to know when contamination problems are approaching dangerous levels (see Table 4-2).

Comparing the detection limits set by DHS to those used by other agencies, we see that there is plenty of room for improvement (see Table 4-3).

All data is not collected

California law requires water suppliers to submit the results of all water quality tests to DHS. However, much of this data falls through the cracks. A 1998 survey by the California State Auditor reveals that 35% of the water analysis data which contract labs submitted to DHS did not appear in DHS's database. DHS lacks any process to verify that water suppliers have submitted all of their sampling results.[79]

Also, DHS does not consider the testing results from most small water suppliers. California law gives jurisdiction to the DHS Office of Drinking Water only for water suppliers with at least 200 service connections. Primary enforcement responsibility for suppliers with less than 200 connections rests with Local Primacy Agencies (LPAs), which are only required to report to DHS testing results which exceed MCLs. By not collecting data on detections below MCLs, DHS is missing a valuable tool for spotting regional trends of contamination, and may miss current contamination in water suppliers whose sources are near an area where pesticides have been detected.

Another batch of data which DHS ignores is the testing done by other government agencies. DPR, EPA, and USGS all do substantial pesticide sampling, much of which is performed on drinking water sources. DHS policy holds that these agencies do not test public drinking water wells, and they therefore do not considered their data. In fact, while the majority of wells sampled by other agencies are domestic wells or wells drilled for monitoring contamination, these agencies also test many wells used by public water systems. Thirty-one percent of the detections in the DPR database

Table 4-2. DHS Reporting Limits—Comparison to Health Levels (all in ppb)

Pesticide	MCL	PHG	EPA Cancer Level	DHS Reporting Limit	Comparison to Lowest Health Level
1,2-Dichloropropane	5	0.5		0.5	equal
1,3-Dichloropropene	0.5	0.2		0.5	OVER
2,4,5-TP (Silvex)	50			1	
2,4-D	70	70		10	near
Alachlor	2	4	0.4	1	OVER
Atrazine	3	0.15		1	OVER
Bentazon	18	200		2	near
Carbofuran	18			5	near
Chlordane	0.1	0.03		0.1	OVER
Dalapon	200	790		10	
DBCP	0.2	0.0017		0.01	OVER
Dinoseb	7	14		2	near
Diquat dibromide	20			4	near
Endothall	100	580		45	near
Endrin	2	1.8		0.1	
Ethylene dibromide	0.05		0.001	0.02	OVER
Glyphosate	700	1000		25	
Heptachlor	0.01	0.008		0.01	OVER
Heptachlor epoxide	0.01	0.006	0.004	0.01	OVER
Lindane	0.2	0.032		0.2	OVER
Methoxychlor	40	30		10	near
Molinate	20		0.3	2	OVER
Oxamyl	200	50		20	near
Picloram	500	500		1	
Simazine	4		0.3	1	OVER
Thiobencarb	70			1	
Toxaphene	3		0.03	1	OVER

from tests conducted by DPR are from public water systems.

Even when data is collected, it often does not make it into DHS information systems in a timely manner. According to a 1998 report by the Bureau of State Audits, "the Department of Health Services needs to improve its procedures to ensure that public water systems submit laboratory results promptly so agencies can identify and alleviate contamination quickly." The report recommends that DHS make electronic data submission a condition for laboratory certification, and that labs submit testing results within five days.[80]

Incomplete picture skews policy decisions

For all of these reasons, DHS paints an incomplete picture of water quality for the public, and uses incomplete information in its own decision making. For example, in its announcement that atrazine is under review for a possible change in its MCL, DHS states that "occurrence data indicates no detections since 1985."[81] This is a startling claim, as the document most directly related to the health standard review states quite the opposite. The decision to review the atrazine MCL is based on the new Public Health Goal for atrazine which OEHHA issued in February 1999. In the supporting document, OEHHA is clear about the extent of atrazine contamination of water:

> **Atrazine and the closely related triazine simazine are the most geographically widespread pollutants detected within 23 California counties in 1993....Residues of atrazine (parent compound) have been reported in 21 counties at concentrations ranging from 0.02 to 8.5 ug/l. Some of California's water suppliers exceed the current MCL for atrazine. In California, 192 wells had detectable atrazine or its metabolites and four were above the MCL of 3 ppb.[82]**

Despite this unambiguous statement, DHS discarded all data showing evidence of atrazine in California drinking water sources.

Table 4-3. Detection and Reporting Limits of Four Agencies* (all in ppb)

Pesticide	DHS	DPR	USGS	DWR
2,4,5-TP (Silvex)	1		0.021	0.1
2,4-D	10	0.1	0.035	0.1
Alachlor	1	0.1	0.002	0.05
Atrazine	1	0.1	0.001	0.02
Bentazon	2	0.1	0.0014	
Carbofuran	5	0.1	0.003	2
Glyphosate	25	1		100
Lindane	0.2	0.05		0.01
Methoxychlor	10	0.5		0.01
Molinate	2	0.1	0.004	
Oxamyl	20	0.05	0.018	2
Picloram	1		0.05	0.1
Simazine	1	0.1	0.005	0.02
Thiobencarb	1	0.1	0.002	0.02

* DHS limits are from DHS, *Detection Limits for Purposes of Reporting (DLRs) of Regulated and Commonly Reported Chemicals as Established by the California Department of Health Services,* 19 November 1998; DPR limits from DPR Well Inventory Database – figure shown is the most often used MDL in tests conducted by DPR; USGS is from USGS, *Occurrence and Distribution of Dissolved Pesticides in the San Joaquin River Basin, California* (98-4032), 1998 and USGS, *Methods of Analysis and Quality-Assurance Practices of the U.S. Geological Survey Organic Laboratory, Sacramento, California* (94-362), 1994; DWR limits are from DWR, *Water Quality Assessment of the State Water Project, 1994-1995,* June 1997.

Shortcomings of Consumer Confidence Reports

For several years, California law has required water suppliers to provide customers with charts summarizing water quality tests. These reports give basic information on whether any of a list of contaminants have been found in drinking water sources. The reports are currently being redesigned to comply with the new federal standards laid out in the 1996 amendments to the federal Safe Drinking Water Act, and are now called "Consumer Confidence Reports" (CCRs).

CCRs tell a very small part of the water quality story. Consumers, noting that few of the listed chemicals were detected, and none of them above health standards, are led to believe that they are not at risk from contaminated water. But this misses detections of pesticides below DHS's reporting limits and the detection of pesticides that are not on the list of chemicals covered by the reports.

"They're basically summaries, simple distillations. They don't really capture that much information," says a spokesperson for the DHS Office of Drinking Water. "There's no way that that report can really tell a consumer what's going on with his water."*

Another shortcoming of CCRs is that they only go to the person paying the water bill, an issue with economic and environmental justice implications. Although landlords are required to pass them on to everyone who relies on water from their properties, there is no enforcement of this requirement. Most renters and farmworker labor camp tenants never see their water quality reports.

*Alexis Milea, DHS Office of Drinking Water, personal communication, 16 November 1998.

Small water suppliers are not required to follow the law

Water suppliers that serve less than 200 buildings may be exempted from testing requirements for specific pesticides if the supplier can establish that they are not vulnerable to contamination by those pesticides. Additionally, those small suppliers not granted waivers often fail to meet DHS's minimum pesticide testing requirements. DHS reported in 1993 that 45% of small water suppliers were out of compliance with monitoring requirements for pesticides and other organic chemicals.[83] DHS has not performed a comprehensive survey since that time,[84] and reporting violations for most small water suppliers are not included in DHS's annual reports.[85]

Most of the water suppliers not complying with testing requirements are small rural suppliers. These small suppliers are at the highest risk of pesticide contamination, as they are generally close to areas of heavy pesticide application, draw their water from shallow aquifers, and are subject to less scrutiny than large water suppliers. Based on the limited data that is available for small water suppliers, cancer risks could be as much as four times higher for small suppliers than for large suppliers.[86] Ninety-six percent of the water suppliers with no pesticide data in the DHS database are small suppliers.

Table 4-4. Highest Concentrations of Pesticides Detected in State Water Project (ppb)*

Pesticide	1989–91	1992–93	1994–95	Lowest Health Level
2,4-D	0.4	0.2	0.7	70
Atrazine	0.5			0.15
Chlorpyrifos			0.3	❖
Cyanazine			0.2	0.035
Dacthal		0.1	1.1	20
Diazinon	0.1	0.2	0.2	❖
Dimethoate			0.1	❖
Diuron	4.0	16.0	4.7	1.8
MCPA		0.3	0.5	❖
Methidathion		0.1		❖
Pronamide	1.2			❖
Simazine	0.6		0.8	0.3
Triclopyr	0.1			❖
Trifluralin	0.7			5

❖ No health levels have been determined for these pesticides.

* California Department of Water Resources, *Water Quality Assessment of the State Water Project, 1994–95,* June 1997; *State Water Project Water Quality, 1992 and 1993,* October 1995; *State Water Project Water Quality, 1989 to 1991,* December 1992.

Surface water contamination and regulation

Pesticide contamination of surface water is not regulated as strictly as groundwater contamination. The Pesticide Contamination Prevention Act's clear goal of no new contamination and specific guidelines for DPR to achieve that goal have no equivalent for surface water. As long as Maximum Contaminant Levels are upheld for the 27 regulated pesticides, California law does not give a state agency the rigid mandate to protect California surface waters from pesticide contamination. Since problems aside from MCL exceedences have become obvious, however, the Department of Pesticide Regulation and the State Water Resources Control Board have written new regulations to address surface water contamination issues.

Surface water contamination studies

Targeted studies have repeatedly shown pesticide contamination of surface water to be a serious problem. Looking at these studies individually, rather than as part of all statewide data as in previous sections of this report, we can get a clear picture of specific contamination problems.

State Water Project

The largest single surface water operation for drinking water supply is the State Water Project (SWP). With water storage in Lake Oroville and San Luis Reservoir, and drawing water from the Sacramento-San Joaquin River Delta, the SWP delivers nearly a trillion gallons of water each year via 660 miles of aqueducts and pipelines to nearly two-thirds of California's population.[87]

The California Department of Water Resources (DWR), which administers the SWP, has detected 14 pesticides in the seven years of testing for which they have published results (see Table 4-4). Four of the nine detected pesticides for which health levels exist have been detected above the level determined to impact human health—atrazine, cyanazine, diuron, and simazine. Three of the pesticides—2,4-D, diazinon, and diuron—have shown up in sampling continually throughout the testing period. Surprisingly, DWR does not test for molinate—one of the pesticides most commonly detected by other agencies in the Sacramento River, which the SWP uses to transport a majority of its water.[88]

Table 4-5. USGS Pesticide Detections in the Sacramento River*

	Samples Taken	No Detections		One or More Detected		Two or More Detected	
		Number of Samples	Percent of Samples	Number of Samples	Percent of Samples	Number of Samples	Percent of Samples
Jan–July	379	87	23%	292	77%	175	46%
Total	602	269	45%	333	55%	182	30%

* Dorene MacCoy, Kathryn L. Crepeau, and Kathryn M. Kuivila, USGS, *Dissolved Pesticide Data for the San Joaquin River at Vernalis and the Sacramento River at Sacramento, California, 1991–94,* 1995.

Sacramento River

The Sacramento River is the largest river in California, stretching from Mount Shasta in the north to the Sacramento-San Joaquin Delta over 300 miles to the south. Around one-third of the state's water flows through the river.[89] The river provides drinking water to communities along its banks from Redding to Sacramento, cities using water from the State Water Project, and other communities that draw water from the Sacramento-San Joaquin Bay Delta. An estimated 22 million Californians drink water from the Bay Delta alone.[90]

USGS studies

The U.S. Geological Survey has performed two major surveys of pesticides in the Sacramento River, sampling the water at or near the City of Sacramento. The first study included frequent tests for a small number of pesticides—analyzing 600 samples taken from May 1991 to March 1994 for seven pesticides. The second study looked at a larger number of pesticides with less frequent testing—screening for 87 pesticides on 25 dates from November 1996 to August 1998.

In the first study, USGS detected pesticides in 55% of the samples taken (see Table 4-5). In 30% of the samples, two or more pesticides were found. Much of this contamination occurred in the first half of the year. From January through July of each year, an average of 77% of the samples contained measurable levels of pesticides. Two or more pesticides were present in 46% of the samples in those months.[91]

Diazinon, molinate, and simazine were detected most frequently. In the months when these pesticides were most likely to be present in agricultural run-off, 80–93% of samples tested positive for these three chemicals (see Table 4-6).

Table 4-6. Pesticide Detections in the Sacramento River During Peak Contamination Period*

	Total Tests	Detections	Percentage Positive	Peak Period	Tests During Peak Period	Detections During Peak Period	Percentage Positive
Atrazine	409	52	13%	Nov 25–Mar 25	134	42	31%
Carbofuran	480	37	8%	May 15–June 15	45	16	36%
Diazinon	531	151	28%	Jan 10–Mar 10	174	161	93%
Methidathion	351	52	15%	Jan 25–Mar 3	91	52	57%
Molinate	300	79	26%	May–July	86	73	85%
Simazine	489	193	39%	Jan–Apr	250	199	80%
Thiobencarb	300	22	7%	May 20–June 20	33	17	52%

* Dorene MacCoy, Kathryn L. Crepeau, and Kathryn M. Kuivila, USGS, *Dissolved Pesticide Data for the San Joaquin River at Vernalis and the Sacramento River at Sacramento, California, 1991–94,* 1995.

In its second Sacramento River study, USGS detected 21 of the 87 pesticides sampled for. Diazinon, molinate, and simazine again showed up positive in repeated sampling, with detections in 36%, 68%, and 60% of the samples, respectively. Detections of thiobencarb increased from the earlier study to 48% of samples analyzed. Diuron and metolachlor, which were not screened in the first study, showed up in 54% and 76% of samples, respectively.[92]

In this study, USGS detected multiple pesticides in Sacramento River water on 23 of the 25 sampling dates (see Table 4-7).

Table 4-7. USGS Detection of Multiple Pesticides in the Sacramento River*

Date	Number of Pesticides Detected
1996	
15-Nov	0
5-Dec	3
1997	
6-Jan	2
11-Feb	4
11-Mar	4
14-Apr	5
28-Apr	5
8-May	8
22-May	10
5-Jun	6
20-Jun	3
14-Jul	6
29-Jul	6
12-Aug	11
23-Sep	0
23-Oct	4
20-Nov	8
12-Dec	6
1998	
9-Feb	6
19-Mar	4
7-Apr	3
21-May	3
9-Jun	3
30-Jul	6
13-Aug	3

* USGS, *Sacramento River at Freeport, CA* (raw data), 1998.

City of Sacramento molinate sampling

Rice farming is among the main culprits of pesticide contamination of surface water. Rice farmers apply pesticides to the water that is held on their swampy fields, then drain the water straight into streams and rivers.

As evidence of molinate's potential to cause reproductive damage accumulated in the 1980s, sampling for molinate in the Sacramento River turned up alarming levels of contamination. In 1987, the City of Sacramento sued the state to take action. The lawsuit was settled in 1992, when DPR agreed to require rice farmers to adjust their use of molinate to reduce its outflow to the river. Rice farmers now must hold the water in the fields for 28 days after molinate is applied before releasing it into the river, allowing for more of the herbicide to break down, dissipate, or be absorbed by the crop.

Table 4-8. Percentage of Sacramento River Tests with Molinate Detections*

Year	Percent Positive	Maximum Concentration (ppb)
1998	57%	0.7
1997	100%	1.3
1996	30%	0.1
1995	15%	0.2
1994	60%	0.4
1993	71%	1.7
1992	39%	0.3
1991	53%	0.6
1990	79%	6.5
1989	86%	4.5
1988	97%	4.8
1987	89%	5.7
1986	100%	13.6
1985	79%	9.6
1984	95%	10
1983	49%	2
1982	81%	16

* City of Sacramento, Division of Water, annual Rice Herbicide Analysis reports. These are tests by the city at the intake to their water system on the Sacramento River.

The MCL for molinate is currently set at 20 ppb. However, the EPA cancer level is 0.3 ppb, and the MCL is scheduled for possible review after OEHHA issues a new Public Health Goal in 2001 (see page 23).

DPR studies

In 1990, DPR and the Central Valley Regional Water Quality Control Board established performance goals for five rice pesticides in the Sacramento Valley, target concentrations to protect beneficial uses of surface water. A 1998 DPR study to evaluate the success of programs designed to reduce pesticide concentrations in rice field outflows detected all five pesticides—molinate, thiobencarb, carbofuran, methyl parathion, and malathion. Concentrations of three of the pesticides exceeded the performance goals (see Table 4-9).

DPR more recently has focused its attention on diazinon as the pesticide of highest concern in the Sacramento River. Diazinon is an insecticide sprayed mainly on dormant orchards in the winter months to control pests that do not die during the winter season. Two 1998 DPR studies reported detections of diazinon in the Sacramento River using data from 1996–98. In the 1996–97 dormant spray season, DPR detected diazinon in 28% of water samples, despite unusually heavy rains—which normally serve to dilute pesticide residues—and smaller than average applications of diazinon during the study period. The highest concentration of diazinon detected was 0.086 ppb.[93] In the 1997–98 dormant spray season—the El Nino winter with exceptionally heavy rainfall—DPR detected diazinon in 36% of the samples taken, in concentrations ranging up to 0.17 ppb.[94] Methidathion was also detected in the first study, and diuron, simazine, and bromocil were also detected in the second study.

Table 4-9. DPR Evaluation of Rice Pesticide Performance Goals*

Pesticide	% of Tests with Detections above Performance Goal	Highest Concentration Detected (ppb)	Performance Goal (ppb)
Molinate	45%	25	10
Thiobencarb	20%	3.5	1.5
Carbofuran	25%	0.7	0.4

* K.P. Bennett et al., Department of Pesticide Regulation, *Rice Pesticides Monitoring in the Sacramento Valley, 1995,* February 1998.

Regulation of surface water

Until recently, there has been no formal structure to handle pesticide contamination of surface water. To fill this void, agencies within Cal/EPA have developed a plan for addressing contamination problems. The new system is untested, but may gain momentum soon.

The Pesticide Management Plan

California law requires DPR to use its authority in the registration of pesticides "to protect the environment from environmentally harmful pesticides," and charges the State and Regional Water Boards with "the coordination and control of activities related to water quality."[95] Because of this overlapping authority, these two agencies within Cal/EPA adopted an interagency plan in 1997 which lays out a four-stage process for controlling pesticide contamination of surface water.

The first stage of the Surface Water Protection Program is outreach and education. This includes courses for pest control advisors, participation at agricultural meetings, and developing a handbook, a pamphlet, and a fact sheet.

When pesticides are detected, mitigation begins with self-regulation by the agricultural community. Growers, pesticide manufacturers, and pesticide applicators are asked to develop agricultural "Best Management Practices" that limit pesticide runoff.

When self-regulation does not end contamination of surface water, DPR first exerts its authority, followed by action from the Water Boards. DPR's actions may include restricting the pesticide, establishing use requirements, or banning the pesticide. If this fails to end the problem, the Water Boards may take disciplinary action against responsible parties.

This regulatory system is untested in its first two years. In 1999, DPR has acknowledged diazinon contamination of surface water to be a serious problem, and has just begun the process of taking action to remedy the problem. A number of parties in the agricultural community have expressed interest in participating, but no plans or regulations have yet been developed.

5 Conclusion and Recommendations

Many Californians are exposed to pesticides in their drinking water. For some, the levels they are exposed to are clearly a health risk. For others, we are uncertain what the risk may be. The known risk together with the factors of uncertainty demonstrate that pesticide contamination of drinking water is a significant problem.

In the Central Valley and the Inland Empire, the water of many communities is known to be unsafe. The Sacramento River carries toxic levels of pesticides to people throughout the state. The State Water Project delivers water that may be hazardous to a majority of Californians. People drinking from domestic wells usually don't know how bad their water is, but are probably the worst off.

Many pesticide detections exceed the threshold concentrations which risk assessors believe may cause significant risk of cancer, reproductive problems, developmental disorders, and neurological damage. Evidence of health effects from exposure to endocrine disruptors and mixtures of contaminants below these levels shows the thresholds to be uncertain. Due to restrictive reporting limits, many detections go unreported.

As new studies demonstrate risks to be higher than previously believed, those charged with protecting our drinking water supply have been slow to act. By allowing pesticides to be used before their effects are well understood, we are participating in a grand experiment, the failure of which is increasingly obvious.

Rather than relying on risk assessment to determine health risks after pesticides have been released into the environment, California regulatory agencies should be guided by the precautionary principle. Simply stated, this would involve three fundamental concepts in the regulation of pesticides.

1. When there is reasonable suspicion of harm, precautionary measures should be taken even if some factors are not fully understood or quantifiable by the scientific community.

2. The burden of proof to demonstrate harmlessness should rest with the manufacturers of pesticides.

3. Before any pesticide is approved for use against a pest problem, the full range of alternatives should be examined.

Recommendations

Recommendations for the Department of Pesticide Regulation

- Phase out the use of all pesticides that are continually contaminating drinking water sources.
- Protect groundwater effectively by beginning to honor the spirit of the Pesticide Contamination Prevention Act.
- Take decisive action to protect surface water.
- Step up efforts to encourage the use of least-toxic pest control methods.

More specifically:

1. Immediately begin a phaseout of all uses of the pesticides which are known to contaminate groundwater, including atrazine, bromacil, diuron, and simazine. Since their verification as groundwater contaminants, the management plans for these pesticides have failed to prevent further groundwater contamination, and each of them has also been shown to contaminate surface water. Use modifications have failed to effectively protect against further contamination by these four carcinogenic pesticides.

2. Immediately begin a phaseout of molinate due to its contamination of surface water. This rice herbicide continues to plague the Sacramento River years after use restrictions were enacted. Molinate is a mobile and persistent carcinogen for which there is no safe use.

3. Demonstrate leadership in preventing further contamination of surface water. DPR

should institute a system for surface water much like the system which the law requires for groundwater, and implement it effectively:

- Identify all pesticides which are likely surface water contaminants.
- Collect all testing data for pesticides in surface water.
- Phase out or restrict the use of pesticides that have been found in surface water in order to prevent all future contamination.

4. Collect all available data on pesticide contamination of groundwater. State law requires that the results of all sampling for pesticides in groundwater be submitted to DPR and assembled into a central database. DPR has not done this effectively. By not including all available data in its analyses, DPR is ignoring the early warning signs of emerging contamination problems that can rapidly become widespread. DPR should:

- Make sure that other agencies submit data from all groundwater testing in a timely manner.
- Consider positive test results below method detection limits as detections, with the levels marked as estimated. DPR's current system of treating these detections as non-detections skews their assessment of the extent of contamination.
- Consider unverified detections submitted by other agencies to be accurate unless proven wrong with prompt follow-up testing. The agencies conducting the vast majority of water quality tests in California have no incentive to comply with DPR's rigid detection verification requirements. If DPR is unable to retest a source soon after the initial detection, they should consider the original detection to be valid.

5. Require testing for common pesticide degradates. Unless specific studies prove that a degradate is less harmful, count the degradate contamination in combination with the parent compound. The health effects of pesticide degradates are not well understood, and some studies indicate that risks are high. Therefore, precaution is in order. In the absence of evidence that pesticides and their degradates do not act in tandem, concentrations within a water sample should be summed.

6. Complete testing quickly for pesticides on the list of likely groundwater contaminants. The detection of norflurazon demonstrates the need to target pesticides whose chemical properties encourage movement to groundwater. There are still many pesticides that need to go through this process—some have been on the list of likely contaminants since it was created in 1986, and others were recently added.

7. Don't use the new CALVUL system as an excuse to continue allowing the misuse of pesticides. Predicting which areas are particularly vulnerable to groundwater contamination is useful, but will be effective in preventing contamination only if strict limits are implemented and enforced. Also, as some amount of contamination occurs in all climates and soil types, DPR should not permit an increase in the allowable rates of pesticide application in the areas judged by the CALVUL model to be less vulnerable to contamination.

8. Resume adjacent section monitoring and compliance monitoring. While the PMZ process has not been effective in preventing groundwater contamination, it has led to the discovery of contamination problems in many areas adjacent to PMZs. If DPR does not check for those problems, they will continue to grow unchecked. And pesticide use restrictions need to be enforced. Growers should not be allowed to ignore pesticide restrictions without fear of illegal pesticide use being exposed by DPR compliance monitoring.

9. Work to make least-toxic pest control the norm in California agriculture, roadside maintenance, and other settings. Sustainable alternatives to synthetic pesticides have been proven successful, and their use should be encouraged to spread as rapidly as possible. If all of the environmental and social costs associated with the heavy use of synthetic pesticides were taken into account, and if least-

toxic pest control methods were given the amount of support which is now given to the use of chemical pesticides, the use of least-toxic methods by California growers would increase exponentially.

10. Increase funding immediately for the oversight of pesticide use through a general fund allocation request. As those who profit from the use of pesticides should pay for the costs to society of pesticide use, the mill tax should be raised to cover these costs when it comes up for renewal in coming years. DPR should also restructure the mill tax according to toxicity and risk. Pesticide applicators and manufacturers who use the most dangerous pesticides should pay the most for monitoring and mitigation.

Recommendations for the Department of Health Services

- Revise the enforceable drinking water standards to make them fully protective of public health.
- Consider all available data in the development of public policy.
- Do not allow small water suppliers to slip through the regulatory cracks.

More specifically:

1. Make Maximum Contaminant Levels fully protective of public health. Californians deserve to be provided with drinking water that does not put them at undue risk for chronic disease. As the new Public Health Goals show that MCLs allow levels of contamination that can harm human health, DHS should act quickly to correct this shortcoming.

2. Review all health standards regularly. Ultimately, the effects of all contaminants that share common attack mechanisms should be considered as a group. As our understanding of the way that separate contaminants work together progresses, we should apply that knowledge to the protection of public health.

3. Do not ignore valuable water quality data. DHS should base its policy decisions on the most complete water quality picture possible. Discarding pesticide detections below the weak reporting limits skews their understanding of the extent of pesticide contamination in California drinking water sources. The risk of including mistaken testing results would be small in comparison with the error of ignoring large chunks of valuable data.

4. Require small water suppliers to comply with testing requirements. Since small water suppliers are generally more vulnerable to pesticide contamination, it is a severe health risk to allow them to pump out untested drinking water. Some small local water agencies will need financial assistance to ensure the safety of their water. No water supplier should be exempt from testing without thorough proof of a lack of vulnerability.

5. Increase the budget of the Drinking Water Program so that they can do their job right. The Davis Administration needs to make the financial commitment to make its programs effective. Include in this budget increase adequate money for the source water assessment project and wellhead protection programs.

Recommendations for individuals

1. Call or write Governor Davis to express your concern about pesticide contamination of drinking water sources. Urge him to ask state agencies to take swift action to address this problem, and to allocate funds for this purpose. Governor Gray Davis, State Capitol, Sacramento, CA 95814; (916) 445-2841.

2. Find out what's in your water (see next page).

3. Call on your local school and local government to stop using toxic pesticides. Most schools routinely spray pesticides throughout the areas where children study, eat, and play, including pesticides that are known to cause cancer and developmental disorders. Organize concerned parents to get the school board to adopt a policy of integrated pest management for the school system. Similarly, many local governments are heavy users of pesticides for parks and other public areas. Pressure your city council to change the city's pest management guidelines. For more information and to learn how to organize a local campaign, contact the Pesticide Watch Education Fund, (415) 292-1488.

4. Convince local authorities to maintain the roadsides in your community without the use

of pesticides. Many roadside maintenance agencies, such as Caltrans or county departments of public works, eliminate roadside weeds through the intensive spraying of herbicides. Organize your neighbors to urge the agency to adopt a policy that restricts herbicide use and prioritizes the use of non-toxic controls such as mowing or planting native vegetation. For more information, contact the Pesticide Watch Education Fund.

5. Buy organic foods. Organic produce and processed food made from organic ingredients are increasingly available at competitive prices throughout California. In addition to eating healthier, you will be encouraging the use of least-toxic pest control methods by California growers. As more farms go organic, less pesticides will make their way into drinking water supplies.

6. Use least-toxic pest control methods at home. In the house, keep pests out by caulking all cracks rather than resorting to killing the pests that get in. Use low toxicity baits instead of spreading toxins throughout the house. In the garden, pull weeds by hand rather than applying toxic weed killers. Use beneficial insects or biopesticides to control insects. When using any type of pesticide, apply it only to problem areas rather than spreading it across an entire lawn. Never apply any pesticide near a stream or lake. If you hire others to do your gardening, employ certified organic landscapers. For more information, contact the Bio-Integral Resource Center (BIRC), (510) 524-2567.

How to Find Out More about Your Water

Consumers who want to know more about the quality of their tap water should contact their local water department. If you have a water bill, look for a water quality information number printed on the bill. If you don't pay the bill and don't know who to call, the public works department of your city or county is listed in the phone book, and can point you to the right place.

Annual water quality reports, soon to be replaced by Consumer Confidence Reports, are the first place to start. Request a copy from your water department and see which chemical have been detected. Pesticides are listed under the "Organic Chemicals" heading. Realize, however, that these reports paint an incomplete picture.

To investigate further, you can file a written request with your local water department for documents pertaining to any cases involving pesticide detections in local water sources. If your local water department serves more than 10,000 homes, since 1998 it has been required to produce a Public Health Goals Report every three years if it detects any contaminants in the local water supply above PHGs. This report contains a description of all contaminants, health risks, and plans of action the department intends to take to reduce the level of contamination. Any citizen can request a copy of the report from the water department. As there is no legal requirement to distribute these reports, they may not see the light of day unless concerned citizens dig them out and share them with the local media.

What to do if your water is contaminated

The best response to a contaminated local water supply is to organize politically and demand that the County Agricultural Commissioner and the state Department of Pesticide Regulation restrict the use of pesticides to prevent future contamination. If a contamination problem is expected to persist over a considerable length of time, the local water supplier should install treatment facilities to remove the pesticides from the water.

To ensure your personal safety if you believe that pesticides are in your local water at a level that poses a significant health threat, you need to find an alternative water source. Unfortunately, very few home filter systems remove pesticides from water, although some are effective in removing other types of contaminants.

Bottled water is generally thought to be more pure than tap water, but recent evidence suggests that this is not always the case.* Bottled water is not regulated as strictly as tap water, and some brands are no more than filtered water from the public water supply. Ask the bottled water companies for information on their water sources, and choose a brand which comes from mountain springs.

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Pollution Prevention Begins at the Source

To protect a water supply before it becomes contaminated, people concerned about pesticide contamination of drinking water have a potentially powerful new tool —the Drinking Water Source Assessment and Protection program required by the federal Safe Drinking Water Act amendments of 1996. In California, this assessment will be conducted for the state's 14,000 water suppliers by the year 2003. Individual water utilities can voluntarily assess their sources now for the program. The utilities that choose not to do this will have their assessments conducted by the Department of Health Services in conjunction with permit review.

Source water assessment requires three steps:

1) **Delineation**: Show the drinking water source area, including all areas from which contaminants can drain to the water body.
2) **Inventory**: Document all of the activities within the source water area that could potentially threaten the water supply.
3) **Susceptibility**: Determine how vulnerable the water supply is to contamination from the activities identified in the inventory. This determination is based on hydrogeological factors, proximity to the water source, prevalence of the activity in the source water area, and control measures in place to prevent contamination.

Once the assessment is completed, water utilities must include a summary of the assessment in the Consumer Confidence Report (CCR) mailed annually to consumers. Communities can then encourage their local water utility to begin source water protection activities, some of which may be eligible for funding under the Drinking Water State Revolving Fund.

There is still time to have an impact on the quality of the source water assessment done for a particular water source. Here's how:

1) Find out the timetable for the assessment in your area.
2) Encourage the water utility to conduct a thorough assessment, rather than having the Department of Health Services conduct a superficial assessment.
3) Make sure that the assessment, regardless of who's doing it, includes:
   a) the full recharge area of the groundwater basin or the full drainage area for a surface water source.
   b) the names of specific pollution sources.
   c) adequate opportunity for public input and review.
4) Encourage your water district to make information from the assessment widely available.
   a) Include an accurate summary with a source water map in the CCR.
   b) Post the assessment on a Web site, and have copies available at the public library.
5) Sponsor a community meeting to discuss threats to drinking water sources, and to explain the Source Water Assessment Program and Consumer Confidence Reports.
6) Get your water supplier to move from assessment to protection. Make sure that this program includes broad participation from community-based interests. Encourage the utility to apply for state funding to support its protection efforts.

For more information on source water assessment and help with materials, contact Clean Water Action at 415-362-3040.

Endnotes

1 Jack Barbash and Elizabeth Resek, *Pesticides in Ground Water: Distribution, Trends, and Governing Factors* (Chelsea, MI: Ann Arbor Press, 1996), 153.

2 Mark Arax, "Banned DBCP Still Haunts San Joaquin Valley Water," *Los Angeles Times*, 12 June 1995.

3 Food and Agriculture Code § 13141 (d).

4 All data drawn from government agency databases for this report are from the Drinking Water Quality Monitoring Database of the California Department of Health Services, the Well Inventory Database of the California Department of Pesticide Regulation, the STORET database of U.S. EPA, and the NAWQA data from the U.S. Geological Survey. Duplicate tests were removed, and only tests of active drinking water sources were analyzed. All detection statistics in this report, unless otherwise cited, come from analysis of these databases. More local data can be found in Appendix C.

5 Many pesticides are transformed into different chemical forms shortly after being released into the environment. These degradates are also referred to as transformation products, breakdown products, metabolites, and other names. They are often more mobile than their parent compounds. While they are less well understood, studies have shown that some degradates can be as toxic or more toxic than their parent compounds.

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7 Not including sources that are inactive. For surface water, some of these sites are different locations along the same river.

8 Population figures are from the DHS *Water Systems* database.

9 California Department of Water Resources, *California Water Plan Update, Bulletin 160-98*, 1998, 10(2).

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20 Douglas Kirk, Fresno City Water Division, personal communication, 3 March 1999.

21 *Jury Verdicts Weekly* 40(1), "Interesting Settlement: City of Fresno v. Shell Oil Company; and Dow Chemical Company et al," 5 January 1996.

22 Riverside Public Utilities, *Public Health Goals (PHGs) Report*, 1998.

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Appendix A
Methodology

Drinking water determination
DHS: The few tests of irrigation wells and monitoring sites which DHS includes in its Drinking Water Quality Monitoring Database were eliminated.

DPR: Tests of wells marked as public water systems or domestic wells were used from the DPR Well Inventory Database.

EPA: Tests of groundwater from the EPA STORET database were used only when the well number matched a well number from the DHS database. EPA surface water tests were included when a description of the sampling site matched a description of drinking water sources from the "Screen File" database of the State Water Resources Control Board.

Only active or standby drinking water sources are included in this report. This leaves out many pesticide detections in inactive drinking water wells, even though many sources now marked as inactive were active at the time of testing. Detections in inactive wells can also be an indication of likely contamination in nearby wells that are still in use.

EPA cancer levels
All EPA cancer potency values were taken from the most recent update of the *Office of Pesticide Programs List of Chemicals Evaluated for Carcinogenic Potential.* Only values for possible or probable human carcinogens were used (class B or class C), although EPA published potency values for four pesticides which are still classified as class D or class E human carcinogens – 2,4-D, glyphosate, malathion, and picloram.

To calculate projected drinking water standards based on EPA's cancer potency values, OEHHA's formula for calculating PHGs based on carcinogenic effects were used.*

$$\text{Concentration} = \frac{\text{Acceptable Risk x Body Weight}}{\text{Cancer Potency Value x Daily Water Consumption}}$$

While OEHHA sometimes uses assumptions which result in stricter standards, they use the following baseline assumptions for most of their analyses.

Acceptable Risk = 10^{-6}, the one-in-a-million extra theoretical lifetime risk of cancer.
Body Weight = 70 kg
Daily Water Consumption = 2 liters per day

Applying the cancer potency value as published by EPA thus translates easily into a concentration of the contaminant in water associated with "negligible" lifetime cancer risk.

County designation
When water sources in one county are used by consumers in another county, the source was attributed to the county where the water is consumed.

Dates of detection
All detections are classified according to the study year, the year in which the results were published. Because there is often a lag time between sampling and reporting, some of the detections are slightly older than the reporting year associated with them. This report analyzes nine years of data, from study year 1990 through 1998, although much of the data from the 1998 study year and some from the 1997 study year have not yet been released. For simplification, this data set is referred to as "the past ten years" and "since 1990."

* OEHHA's support documents for the Public Health Goals are available online at oehha.ca.gov/scientific/public_health.html.

Appendix B

List of Abbreviations

CALVUL	California Vulnerability Model, a new statistical tool being developed by DPR to model pesticide leaching to groundwater
CCR	Consumer Confidence Report, an annual report to consumers on the quality of the public water supply
DBCP	1,2-dibromo-3-chloropropane, a soil fumigant
DHS	Department of Health Services
DLR	Detection Limit for purposes of Reporting, the minimum level of contamination to qualify for reporting to DHS
DPR	Department of Pesticide Regulation
DWR	Department of Water Resources
EDB	Ethylene dibromide, a soil fumigant
EPA	U.S. Environmental Protection Agency
GWPL	Groundwater Protection List, the list of pesticides most likely to contaminate groundwater based on their chemical properties
MCL	Maximum Contaminant Level, the enforceable contamination standard beyond which contaminated water cannot be distributed
MCLG	Maximum Contaminant Level Goal, an unenforceable target level set by the EPA which does not take into account a cost benefit analysis
MDL	Method Detection Limit, the level of precision at which testing methods are judged to be entirely accurate
OEHHA	The Office of Environmental Health Hazard Assessment, the division of Cal/EPA which performs risk assessments
PCPA	Pesticide Contamination Prevention Act, the main law governing pesticide contamination of groundwater
PDRP	Pesticide Detection Response Process, the process for determining a course of action after a pesticide has been detected in groundwater
PHG	Public Health Goal, the unenforceable contamination target level for California above which public health is significantly at risk
PMZ	Pesticide Management Zone, an area where pesticide use is restricted due to the previous detection of pesticides in groundwater
ppb	Parts per billion—equivalent to micrograms per liter
PREC	Pesticide Registration Evaluation Committee, the unit in DPR that decides whether to grant permits for the sale of specific pesticides
SDWA	Safe Drinking Water Act
SNV	Specific Numerical Value, benchmarks for chemical properties, beyond which pesticides are judged to be likely groundwater contaminants
SWP	State Water Project
SWRCB	State Water Resources Control Board
USGS	U.S. Geological Survey, a federal agency that assesses the quality of water resources nationwide

Appendix C

Pesticide Detections by County

The following table summarizes all pesticide detections of currently active drinking water sources from study years 1990–98 in the databases of the Department of Health Services, the Department of Pesticide Regulation, the U.S. Environmental Protection Agency, and the U.S. Geological Survey. This does not include the many detections which these agencies fail to collect from local water suppliers and others.

County	Pesticide	Detections	Sites with Detections	Highest Concentration Detected (ppb)	Most Recent Detection	MCL Exceed–ences	PHG Exceed–ences	EPA Cancer Level Exceedences	Pesticide With No Standard
Alameda	2,4–D	2	2	0.31	93	–	–	–	
	Aldicarb sulfoxide	1	1	7.2	95	–	–	–	NS
	Atrazine	2	2	0.7	96	–	2	–	
	Bentazon	2	1	0.6	90	–	–	–	
	DBCP	2	2	0.28	96	1	2	–	
	Diazinon	1	1	0.025	94	–	–	–	NS
	Dicamba	1	1	0.051	94	–	–	–	NS
	Dieldrin	1	1	0.03	94	–	–	1	
	Dimethoate	1	1	0.1	94	–	–	–	NS
	Dinoseb	1	1	1	94	–	–	–	
	EDB	7	7	330	95	5	–	–	
	Heptachlor	1	1	0.024	92	1	1	–	
	Heptachlor epoxide	1	1	0.008	90	–	1	–	
	Methyl bromide	2	2	0.6	95	–	–	–	NS
	Picloram	1	1	1	94	–	–	–	
	Propachlor	1	1	0.25	94	–	–	–	NS
	Simazine	4	3	0.95	96	–	–	1	
	Toxaphene	1	1	0.5	94	–	–	1	
Alpine	Pebulate	2	1	0.01	94	–	–	–	NS
Amador	Simazine	1	1	0.22	96	–	–	–	
Butte	2,4–D	1	1	3.6	91	–	–	–	
	Atrazine	3	2	0.08	97	–	–	–	
	Bromacil	3	2	0.5	97	–	–	–	
	DBCP	1	1	0.13	90	–	1	–	
	Dichlorprop	1	1	6.8	94	–	–	–	NS
	Dichlorprop, butoxyethanol ester	1	1	6.8	91	–	–	–	NS
	Endothall	2	2	160	94	1	–	–	
	Simazine	1	1	1.5	91	–	–	1	
Calaveras	3–Hydroxycarbofuran	2	2	4.1	93	–	–	–	NS
	Aldicarb sulfoxide	1	1	3.1	94	–	–	–	NS
	Bentazon	2	2	0.65	94	–	–	–	
	Diuron	2	2	1	93	–	–	–	
	Hexazinone	2	1	0.21	97	–	–	–	NS
	Lindane	1	1	0.03	93	–	–	–	
Colusa	2,4–D	1	1	0.38	91	–	–	–	
	Dacthal	2	2	1.6	94	–	–	–	
	Molinate	1	1	2.4	93	–	–	1	
	Paraquat	1	1	16	94	–	–	–	NS
	Prometon	2	1	0.085	95	–	–	–	NS
	Simazine	6	3	0.12	94	–	–	–	
Contra Costa	2,4–D	2	2	0.32	96	–	–	–	
	ACET (atrazine/ simazine degradate)	1	1	0.12	95	–	–	–	NS

County	Pesticide	Detections	Sites with Detections	Highest Concentration Detected (ppb)	Most Recent Detection	MCL Exceed-ences	PHG Exceed-ences	EPA Cancer Level Exceedences	Pesticide With No Standard
	Aldicarb sulfone	2	2	6	93	–	–	–	NS
	Atrazine	2	1	0.073	95	–	–	–	
	Bromacil	2	1	0.092	95	–	–	–	
	Butachlor	1	1	0.38	97	–	–	–	NS
	Carbofuran	1	1	5	93	–	–	–	
	Chloropicrin	1	1	1	97	–	–	–	NS
	Deethyl atrazine	2	2	0.13	95	–	–	–	NS
	Dicofol	2	1	10	94	–	–	2	
	Diuron	2	1	0.07	91	–	–	–	
	Endothall	6	6	2.5	92	–	–	–	
	Glyphosate	1	1	110	93	–	–	–	
	Prometon	3	2	0.09	95	–	–	–	NS
	Simazine	5	3	7.47	95	2	–	1	
	Thiobencarb	7	6	1	92	–	–	–	
Del Norte	1,2–Dichloropropane	13	6	22	95	7	13	–	
	1,3–Dichloropropene	1	1	1.9	90	1	1	–	
	Aldicarb sulfone	31	9	0.49	92	–	–	–	NS
	Aldicarb sulfoxide	34	8	1.49	92	–	–	–	NS
Fresno	1,2–Dichloropropane	24	9	6.4	96	2	22	–	
	1,3–Dichloropropene	2	2	1	92	2	2	–	
	ACET (atrazine/simazine degradate)	172	89	4	97	–	–	–	NS
	Atrazine	22	15	0.74	97	–	7	–	
	Bromacil	94	41	8	97	–	–	–	
	Butylate	1	1	0.002	93	–	–	–	NS
	Carbaryl	1	1	0.013	93	–	–	–	
	Chlorpyrifos	1	1	0.006	93	–	–	–	NS
	Cis–1,3–Dichloropropene	1	1	1	91	–	–	–	NS
	DACT	46	29	6.9	97	–	–	–	NS
	Dacthal	1	1	0.003	93	–	–	–	
	DBCP	4,360	258	6	98	1,293	4,358	–	
	DDE	1	1	0.001	93	–	–	–	
	Deethyl atrazine	7	6	2	97	–	–	–	NS
	Diazinon	2	2	0.01	94	–	–	–	NS
	Dicamba	1	1	0.01	92	–	–	–	NS
	Dieldrin	1	1	0.007	93	–	–	1	
	Diuron	194	97	2.2	97	–	–	4	
	EDB	384	28	5.9	98	82	–	–	
	Ethalfluralin	1	1	0.005	93	–	–	–	
	Ethoprop	1	1	0.009	95	–	–	–	
	Malathion	2	2	0.1	95	–	–	–	NS
	Napropamide	1	1	0.03	94	–	–	–	NS
	Norflurazon	12	9	0.79	97	–	–	–	NS
	Ortho–dichlorobenzene	1	1	1.2	95	–	–	–	NS
	Picloram	1	1	1.1	93	–	–	–	
	Prometon	11	5	0.55	97	–	–	–	NS
	Simazine	379	183	0.93	97	–	–	65	
	TPA (dacthal degradate)	17	13	6.88	95	–	–	–	NS
	Trifluralin	2	2	0.007	93	–	–	–	
Glenn	Atrazine	12	4	0.36	93	–	3	–	
	Captan	2	1	0.11	90	–	–	–	
	Deethyl atrazine	2	1	0.18	93	–	–	–	NS

County	Pesticide	Detections	Sites with Detections	Highest Concentration Detected (ppb)	Most Recent Detection	MCL Exceed-ences	PHG Exceed-ences	EPA Cancer Level Exceedences	Pesticide With No Standard
	Diuron	2	1	0.62	90	–	–	–	
	Endosulfan I	1	1	34.7	93	–	–	–	NS
	Molinate	3	1	10	91	–	–	3	
	Prometon	4	2	0.35	93	–	–	–	NS
	Simazine	6	3	0.78	93	–	–	1	
Imperial	Chlorpyrifos	2	2	0.01	92	–	–	–	NS
	Diazinon	4	2	0.1	92	–	–	–	NS
	Hexazinone	1	1	0.55	95	–	–	–	NS
	Malathion	2	1	0.06	92	–	–	–	NS
	S,S,S–Tributylphosphor–otrithioate	2	1	0.01	92	–	–	–	NS
Inyo	EDB	1	1	0.03	90	–	–	–	
Kern	1,2–Dichloropropane	63	20	2.4	98	–	44	–	
	2,4–D	4	3	2.6	96	–	–	–	
	Alachlor	3	3	1	95	–	–	3	
	Atrazine	11	6	0.4	95	–	2	–	
	Bromacil	6	3	0.614	96	–	–	–	
	Butachlor	1	1	0.38	95	–	–	–	NS
	Chlorothalonil	1	1	0.4	93	–	–	–	
	Dalapon	1	1	1	96	–	–	–	
	DBCP	713	116	6.1	98	212	713	–	
	Deethyl atrazine	7	5	0.5	95	–	–	–	NS
	Dinoseb	5	5	0.18	93	–	–	–	
	Diuron	10	6	6.5	97	–	–	1	
	EDB	135	30	4.7	98	73	–	–	
	Endrin	1	1	0.2	96	–	–	–	
	Penoxalin	1	1	0.5	96	–	–	–	NS
	Prometon	1	1	0.008	95	–	–	–	NS
	Simazine	10	5	1	96	–	–	2	
	Thiobencarb	3	3	0.8	90	–	–	–	
	TPA (dacthal degradate)	15	10	15	91	–	–	–	NS
Kings	Atrazine	3	1	0.52	92	–	3	–	
	Diuron	15	8	1.8	95	–	–	–	
	Prometon	4	1	1	95	–	–	–	NS
	Simazine	4	4	0.11	95	–	–	–	
Lake	Chlordane	1	1	0.05	90	–	1	–	
	Heptachlor	1	1	0.02	90	1	1	–	
	Heptachlor epoxide	1	1	0.1	90	1	1	–	
	Simazine	5	5	0.11	97	–	–	–	
Los Angeles	1,2–Dichloropropane	3	2	1.18	98	–	2	–	
	ACET (atrazine/simazine degradate)	7	6	0.16	93	–	–	–	NS
	Atrazine	79	39	5.71	94	1	58	–	
	Bentazon	1	1	2	90	–	–	–	
	Beta–BHC	2	2	0.08	96	–	–	–	NS
	Bromacil	7	5	507	95	–	–	2	
	Dalapon	2	2	3	93	–	–	–	
	DBCP	1,731	65	15.2	98	547	1,731	–	
	Deethyl atrazine	20	11	0.32	93	–	–	–	NS
	Diuron	18	10	1.6	94	–	–	–	
	EDB	43	14	0.7	98	16	–	–	
	Endosulfan I	2	2	0.45	94	–	–	–	NS

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	Endosulfan sulfate	1	1	0.15	95	–	–	–	NS
	Endrin	1	1	20	90	1	1	–	
	Heptachlor	1	1	0.06	94	1	1	–	
	Lindane	1	1	0.4	92	1	1	–	
	Methyl bromide	1	1	2.6	96	–	–	–	NS
	Ortho–dichlorobenzene	1	1	7.1	96	–	–	–	NS
	Prometon	5	3	0.09	95	–	–	–	NS
	Simazine	53	33	1.3	95	–	–	28	
	TPA (dacthal degradate)	12	7	1.93	91	–	–	–	NS
Madera	1,2–Dichloropropane	1	1	0.3	93	–	–	–	
	Atrazine	5	4	0.1	95	–	–	–	
	Dacthal	1	1	0.54	95	–	–	–	
	DBCP	23	3	3.2	97	10	23	–	
	Deethyl atrazine	4	4	0.03	95	–	–	–	NS
	Dicamba	1	1	0.01	92	–	–	–	NS
	Dieldrin	1	1	0.018	93	–	–	1	
	Diuron	8	5	0.38	97	–	–	–	
	EDB	9	1	0.87	96	9	–	–	
	Methyl bromide	1	1	1.3	92	–	–	–	NS
	Oxamyl	1	1	8	93	–	–	–	
	Simazine	10	6	0.26	97	–	–	–	
	TPA (dacthal degradate)	10	3	1.5	97	–	–	–	NS
Mendocino	DBCP	1	1	0.25	97	1	1	–	
	Methomyl	1	1	19	94	–	–	–	NS
	Simazine	8	6	0.12	97	–	–	–	
Merced	1,2–Dichloropropane	1	1	1.4	92	–	1	–	
	2,4–D	3	1	1.2	93	–	–	–	
	Alachlor	4	1	0.03	93	–	–	–	
	Aldicarb sulfoxide	4	4	2.9	93	–	–	–	NS
	Atrazine	30	8	0.39	95	–	2	–	
	Butylate	1	1	0.01	94	–	–	–	NS
	Carbaryl	6	3	0.08	94	–	–	–	
	Carbofuran	8	1	0.1	93	–	–	–	
	Chlorpyrifos	17	2	0.05	94	–	–	–	NS
	Coumaphos	1	1	1	93	–	–	–	NS
	Cyanazine	22	2	1.3	94	–	–	17	
	Dacthal	14	3	0.04	94	–	–	–	
	DBCP	343	33	1.88	98	70	343	–	
	Deethyl atrazine	7	6	0.14	95	–	–	–	NS
	Demeton	1	1	1	93	–	–	–	NS
	Diazinon	25	3	1	94	–	–	–	NS
	Dichlorprop	1	1	0.11	93	–	–	–	NS
	Diuron	14	7	1	95	–	–	–	
	EDB	26	6	0.22	96	10	–	–	
	EPTC	26	3	40	94	–	–	–	NS
	Ethylene dichloride	1	1	2.9	92	–	–	–	NS
	Linuron	1	1	0.29	93	–	–	1	
	Malathion	5	2	0.06	94	–	–	–	NS
	MCPA	1	1	0.12	93	–	–	–	NS
	Merphos	1	1	1	93	–	–	–	NS
	Methomyl	4	1	0.67	93	–	–	–	NS
	Metolachlor	17	1	0.05	93	–	–	–	

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	Molinate	18	4	4	94	–	–	6	
	Naled	1	1	5	93	–	–	–	NS
	Napropamide	5	1	0.05	93	–	–	–	NS
	Norflurazon	2	1	0.44	93	–	–	–	NS
	Oryzalin	1	1	1	93	–	–	1	
	Pebulate	8	1	0.04	93	–	–	–	NS
	Prometon	7	5	0.67	94	–	–	–	NS
	Pronamide	6	1	0.02	93	–	–	–	
	Propargite	3	1	0.09	94	–	–	–	
	Simazine	43	15	1.14	95	–	–	5	
	Thiobencarb	5	2	0.51	94	–	–	–	
	Trichlorobenzenes	1	1	0.8	96	–	–	–	NS
	Trifluralin	34	3	0.11	94	–	–	–	
Monterey	Atrazine	2	2	0.7	95	–	1	–	
	Bromacil	2	1	0.088	96	–	–	–	
	Dacthal	2	1	0.68	91	–	–	–	
	DBCP	29	5	0.504	96	20	29	–	
	Diazinon	1	1	0.2	90	–	–	–	NS
	Diuron	1	1	0.05	96	–	–	–	
	MTP	2	1	2.55	91	–	–	–	NS
	Simazine	2	2	0.25	93	–	–	–	
	TPA (dacthal degradate)	24	15	7.46	92	–	–	–	NS
Napa	Carbaryl	1	1	2.3	90	–	–	–	
	EDB	1	1	0.039	95	–	–	–	
	Methyl bromide	8	8	0.7	97	–	–	–	NS
Orange	ACET (atrazine/simazine degradate)	1	1	0.14	93	–	–	–	NS
	Atrazine	38	29	1	95	–	10	–	
	Bromacil	2	2	0.13	95	–	–	–	
	DBCP	6	5	0.08	92	–	6	–	
	Dimethoate	1	1	0.4	92	–	–	–	NS
	Diuron	6	3	0.2	93	–	–	–	
	Prometryn	1	1	0.1	92	–	–	–	NS
	Simazine	81	46	1	95	–	–	43	
Placer	Bromacil	4	2	0.5	92	–	–	–	
Riverside	1,2–Dichloropropane	44	8	8	97	16	41	–	
	2,4,5–TP (Silvex)	1	1	10	91	–	–	–	
	2,4–D	1	1	100	91	1	1	–	
	ACET (atrazine/simazine degradate)	6	4	6	95	–	–	–	NS
	Atrazine	1	1	0.1	93	–	–	–	
	Bromacil	13	6	7.3	95	–	–	–	
	DBCP	1,637	91	3.54	98	359	1,637	–	
	Diuron	17	8	0.96	95	–	–	–	
	EDB	15	7	6.755	96	10	–	–	
	Endrin	1	1	0.2	91	–	–	–	
	Lindane	1	1	4	91	1	1	–	
	Methoxychlor	1	1	100	91	1	1	–	
	Picloram	2	1	0.34	92	–	–	–	
	Simazine	36	18	0.41	95	–	–	5	
	Toxaphene	1	1	5	91	1	–	–	
Sacramento	2,4–D	4	4	0.1	93	–	–	–	

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	Atrazine	3	2	0.19	95	–	1	–	
	Dalapon	4	4	1	93	–	–	–	
	DBCP	4	4	0.01	93	–	4	–	
	Dieldrin	1	1	0.004	95	–	–	1	
	Diuron	2	1	0.14	91	–	–	–	
	Molinate	17	1	6.5	91	–	–	17	
	Simazine	4	2	0.15	94	–	–	–	
San Benito	Methyl bromide	1	1	3.4	92	–	–	–	NS
San Bernardino	1,2,4–Trichlorobenzene	1	1	2.7	96	–	–	–	NS
	1,2–Dichloropropane	9	3	0.92	94	–	2	–	
	ACET (atrazine/ simazine degradate)	1	1	0.14	95	–	–	–	NS
	Alachlor	1	1	9	91	1	1	–	
	Atrazine	2	1	0.12	95	–	–	–	
	Chlordane	1	1	0.4	91	1	1	–	
	DBCP	779	81	3.4	98	281	779	–	
	Deethyl atrazine	1	1	0.17	95	–	–	–	NS
	Diuron	4	2	0.48	95	–	–	–	
	EDB	4	4	0.03	90	–	–	–	
	Heptachlor	6	6	0.22	93	5	6	–	
	Simazine	6	3	0.3	95	–	–	2	
San Diego	1,2–Dichloropropane	23	4	6.7	98	2	23	–	
	Cyanazine	1	1	0.5	90	–	–	1	
	DBCP	1	1	0.01	90	–	1	–	
	Methyl bromide	1	1	0.64	92	–	–	–	NS
	Metolachlor	2	2	0.5	97	–	–	–	
	Metribuzin	2	2	0.25	97	–	–	–	NS
	Simazine	3	2	3.4	91	–	–	3	
San Joaquin	1,2–Dichloropropane	3	1	0.83	95	–	3	–	
	2,4–D	2	1	10.9	91	–	–	–	
	ACET (atrazine/simazine degradate)	3	3	0.57	97	–	–	–	NS
	Atrazine	18	10	2.8	97	–	10	–	
	Bromacil	9	4	0.85	96	–	–	–	
	Carbaryl	2	1	0.03	93	–	–	–	
	Carbofuran	8	1	0.03	93	–	–	–	
	Dacthal	5	1	0.02	93	–	–	–	
	DBCP	876	63	34	98	351	876	–	
	Deethyl atrazine	10	9	0.78	97	–	–	–	NS
	Diazinon	5	1	0.15	93	–	–	–	NS
	Diuron	4	3	0.25	97	–	–	–	
	EDB	15	11	0.17	97	4	–	–	
	EPTC	4	1	0.01	93	–	–	–	NS
	Hexazinone	6	3	0.11	97	–	–	–	NS
	Methyl bromide	1	1	1	95	–	–	–	NS
	Metolachlor	5	2	0.02	94	–	–	–	
	Pronamide	5	1	0.12	93	–	–	–	
	Simazine	6	2	0.42	97	–	–	1	
San Luis Obispo	2,4,5–T	1	1	0.02	90	–	–	–	NS
	Carbon disulfide	4	4	5	94	–	–	–	NS

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	Dacthal	1	1	0.03	92	–	–	–	
	DBCP	1	1	0.04	94	–	1	–	
	Diuron	3	3	4.5	92	–	–	3	
	EDB	1	1	0.05	94	–	–	–	
	Endrin	1	1	0.03	91	–	–	–	
	Ortho–dichlorobenzene	1	1	0.6	92	–	–	–	NS
	TPA (dacthal degradate)	7	4	4	93	–	–	–	NS
San Mateo	1,2–Dichloropropane	26	2	7.5	98	9	24	–	
	Endrin	1	1	90	90	1	1	–	
	Trichlorobenzenes	1	1	3.9	97	–	–	–	NS
Santa Barbara	Carbon disulfide	5	4	2	96	–	–	–	NS
	Chlorpyrifos	2	1	0.06	93	–	–	–	NS
	Diazinon	2	1	0.06	93	–	–	–	NS
	Diquat	1	1	2	95	–	–	–	
	EDB	1	1	0.02	92	–	–	–	
	Glyphosate	1	1	20	94	–	–	–	
	Heptachlor	2	2	0.25	92	2	2	–	
	Linuron	3	1	0.32	96	–	–	2	
	Methoxychlor	1	1	0.04	92	–	–	–	
	Metolachlor	1	1	0.01	96	–	–	–	
	Prometryn	2	1	0.2	93	–	–	–	NS
	Pronamide	1	1	0.09	96	–	–	–	
	TPA (dacthal degradate)	7	5	11	91	–	–	–	NS
Santa Clara	1,3–Dichloropropene	3	3	1.7	91	3	3	–	
	2,4–D	1	1	0.3	95	–	–	–	
	Aldicarb sulfone	1	1	16.9	93	–	–	–	NS
	Dacthal	2	2	0.7	90	–	–	–	
	EDB	1	1	0.01	93	–	–	–	
	Methyl bromide	1	1	0.6	97	–	–	–	NS
	Ortho–dichlorobenzene	2	1	7.2	91	–	–	–	NS
	TPA (dacthal degradate)	10	4	1.38	91	–	–	–	NS
Santa Cruz	1,2,4–Trichlorobenzene	4	1	21	92	–	–	–	NS
	1,2–Dichloropropane	2	1	56	90	2	2	–	
	Dicamba	3	2	0.14	97	–	–	–	NS
	Ortho–dichlorobenzene	8	1	1.6	95	–	–	–	NS
Siskiyou	EPTC	3	3	0.09	92	–	–	–	NS
	Malathion	1	1	0.01	92	–	–	–	NS
	Metolachlor	1	1	0.04	92	–	–	–	
	Metribuzin	2	1	0.06	92	–	–	–	NS
	Pronamide	1	1	0.01	92	–	–	–	
	Simazine	2	1	0.01	92	–	–	–	
	Terbufos	2	1	0.03	92	–	–	–	NS
Solano	Atrazine	33	7	12	95	1	17	–	
	Bentazon	12	5	6.9	93	–	–	–	
	Captan	1	1	0.5	90	–	–	–	
	Carbaryl	1	1	55	93	–	–	1	
	Carbofuran	4	1	0.03	93	–	–	–	
	Dacthal	10	1	0.01	93	–	–	–	
	DBCP	3	1	0.2	93	–	3	–	
	Deethyl atrazine	1	1	0.3	95	–	–	–	NS
	Diazinon	13	1	0.34	93	–	–	–	NS
	EDB	1	1	0.039	95	–	–	–	

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	Hexazinone	2	1	0.092	95	–	–	–	NS
	Metolachlor	13	1	0.02	93	–	–	–	
	Molinate	2	2	1.6	93	–	–	2	
	Napropamide	5	1	0.05	93	–	–	–	NS
	Prometon	3	1	0.3	95	–	–	–	NS
	Pronamide	6	1	0.02	93	–	–	–	
	Propoxur	1	1	4	93	–	–	–	
	Simazine	15	3	1.7	93	–	–	1	
	Trifluralin	2	1	0.02	93	–	–	–	
Sonoma	1,2–Dichloropropane	1	1	0.55	96	–	1	–	
	Carbon disulfide	3	3	1.6	92	–	–	–	NS
	Diquat	1	1	4	94	–	–	–	
	Picloram	1	1	4.8	97	–	–	–	
Stanislaus	1,2–Dichloropropane	1	1	0.52	90	–	1	–	
	2,4–D	1	1	0.28	94	–	–	–	
	2,4–DP, Isooctyl Ester	3	2	0.01	92	–	–	–	NS
	ACET (atrazine/simazine degradate)	1	1	0.34	97	–	–	–	NS
	Alachlor	1	1	0.24	94	–	–	–	
	Atrazine	16	12	0.24	95	–	2	–	
	Benfluralin	6	1	0.01	95	–	–	–	NS
	Bromacil	2	1	0.24	95	–	–	–	
	Carbaryl	9	2	0.14	95	–	–	–	
	Carbofuran	2	1	0.03	95	–	–	–	
	Chlorpyrifos	11	4	0.09	95	–	–	–	NS
	Cyanazine	6	5	0.01	95	–	–	–	
	Dacthal	9	2	0.26	95	–	–	–	
	DBCP	1,085	114	166	98	298	1,085	–	
	DDE	2	1	0.03	95	–	–	–	
	Deethyl atrazine	6	6	0.02	95	–	–	–	NS
	Diazinon	29	6	0.62	95	–	–	–	NS
	Dinoseb	1	1	0.08	95	–	–	–	
	Diuron	14	6	0.29	97	–	–	–	
	Dyfonate	2	1	0.02	94	–	–	–	NS
	EDB	23	10	0.21	97	10	–	–	
	EPTC	7	4	0.66	95	–	–	–	NS
	Ethalfluralin	2	1	0.07	94	–	–	–	
	Hexazinone	2	1	0.27	97	–	–	–	NS
	Malathion	9	3	0.06	95	–	–	–	NS
	Metolachlor	6	4	1.3	95	–	–	–	
	Metribuzin	3	3	0.03	95	–	–	–	NS
	Molinate	2	1	0.09	94	–	–	–	
	Napropamide	12	5	0.07	95	–	–	–	NS
	Pebulate	2	1	0.03	94	–	–	–	NS
	Penoxalin	4	1	0.05	95	–	–	–	NS
	Prometon	12	5	5.3	95	–	–	–	NS
	Simazine	64	30	1.3	95	–	–	13	
	Tebuthiuron	1	1	0.01	94	–	–	–	NS
	Terbacil	2	2	0.16	94	–	–	–	NS
	Trifluralin	24	4	0.35	95	–	–	–	
Sutter	DBCP	5	2	0.12	97	–	5	–	
	EDB	2	2	0.044	96	–	–	–	

County	Pesticide	Detections	Sites with Detections	Highest Concentration Detected (ppb)	Most Recent Detection	MCL Exceed-ences	PHG Exceed-ences	EPA Cancer Level Exceedences	Pesticide With No Standard
	Simazine	5	3	0.12	96	–	–	–	
Tehama	ACET (atrazine/simazine degradate)	3	2	0.11	93	–	–	–	NS
	Atrazine	27	7	1.6	95	–	24	–	
	Bentazon	1	1	0.3	94	–	–	–	
	Bromacil	5	2	0.28	90	–	–	–	
	DBCP	11	2	0.55	96	6	11	–	
	Deethyl atrazine	4	2	0.34	93	–	–	–	NS
	Diuron	2	1	0.06	94	–	–	–	
	EDB	2	2	0.03	93	–	–	–	
	Paraquat	2	2	1.58	94	–	–	–	NS
	Simazine	11	5	0.2	95	–	–	–	
Trinity	Atrazine	1	1	0.069	94	–	–	–	
	Deethyl atrazine	2	2	0.013	95	–	–	–	NS
	Simazine	1	1	0.016	94	–	–	–	
Tulare	1,2,4–Trichlorobenzene	1	1	1.3	92	–	–	–	NS
	1,2–Dichloropropane	7	2	7	96	1	7	–	
	ACET (atrazine/simazine degradate)	129	94	4.8	97	–	–	–	NS
	Atrazine	50	27	0.3	95	–	11	–	
	Bentazon	3	3	3.3	90	–	–	–	
	Bromacil	238	108	23	97	–	–	5	
	Cyanazine	2	2	0.023	95	–	–	–	
	DACT	25	18	5.1	97	–	–	–	NS
	DBCP	856	82	2.9	98	187	856	–	
	Deethyl atrazine	19	13	0.52	97	–	–	–	NS
	Dicamba	3	3	0.01	92	–	–	–	NS
	Diuron	448	185	3.95	97	–	–	14	
	EDB	6	3	0.03	94	–	–	–	
	Hexazinone	7	2	0.22	95	–	–	–	NS
	Methyl bromide	1	1	7	94	–	–	–	NS
	Monuron	7	3	0.17	90	–	–	–	NS
	Norflurazon	2	1	0.32	97	–	–	–	NS
	Picloram	1	1	0.1	93	–	–	–	
	Prometon	16	6	0.36	95	–	–	–	NS
	Simazine	504	221	2.4	97	–	–	163	
	TPA (dacthal degradate)	1	1	0.06	91	–	–	–	NS
Tuolumne	Methyl bromide	2	2	2.5	91	–	–	–	NS
	Ortho–dichlorobenzene	3	1	0.61	90	–	–	–	NS
Ventura	Atrazine	10	5	0.33	93	–	5	–	
	Bentazon	1	1	2	93	–	–	–	
	Bromacil	3	1	0.32	93	–	–	–	
	Carbaryl	1	1	10	93	–	–	1	
	Dalapon	5	5	17	93	–	–	–	
	DBCP	29	5	0.63	97	13	29	–	
	Diuron	1	1	0.46	93	–	–	–	
	EDB	13	2	0.58	92	7	–	–	
	Methyl bromide	1	1	0.7	91	–	–	–	NS
	Picloram	1	1	1	96	–	–	–	
	Simazine	3	2	0.26	96	–	–	–	
Yolo	1,2–Dichloropropane	6	1	56	93	6	6	–	
	Alachlor	2	1	0.58	93	–	–	2	

County	Pesticide	Detections	Sites with Detections	Highest Concentration Detected (ppb)	Most Recent Detection	MCL Exceed-ences	PHG Exceed-ences	EPA Cancer Level Exceedences	Pesticide With No Standard
	Aldicarb	3	3	6.4	97	–	–	–	NS
	Atrazine	8	3	0.87	95	–	5	–	
	Carbaryl	1	1	24	95	–	–	1	
	Dalapon	1	1	19	97	–	–	–	
	DBCP	2	1	0.096	97	–	2	–	
	Dicamba	2	1	0.33	96	–	–	–	NS
	EDB	11	6	0.17	97	7	–	–	
	Endrin	1	1	13	90	1	1	–	
	Ortho–dichlorobenzene	1	1	12	93	–	–	–	NS
	Simazine	4	2	0.14	95	–	–	–	
Yuba	3–Hydroxycarbofuran	1	1	33	92	–	–	–	NS
	Aldicarb	1	1	14	92	–	–	–	NS
	Bentazon	31	9	3	97	–	–	–	
	Carbaryl	1	1	6.4	92	–	–	1	
	Methomyl	1	1	11	92	–	–	–	NS
	Paraquat	1	1	0.91	97	–	–	–	NS