introduced into the environment to further contribute to the existing problem. The aquifers of the state could then begin to cleanse through degradation, dispersion and discharge into surface water. This option would be relatively easy to administer and enforce compared to a system of use restrictions and PAs.

Disadvantages

The main drawback of this option is that it is not clear, based on current use patterns, whether atrazine use has the potential to exceed the ES in all areas of the state. A statewide prohibition may eliminate atrazine use at low rates in areas where unacceptable contamination would not occur. This could lead to undue economic hardship on certain corn growers.

The Department has estimated the economic impact of eliminating the use of atrazine in Wisconsin. The overall analysis was based on separate analyses for continuous corn, corn in rotation with alfalfa, and corn in rotation with other crops. The results indicated that the total economic cost of prohibiting atrazine use in Wisconsin would be between 1.6 and 10.9 million dollars. This wide range reflects the considerable cost differences between possible alternative weed control strategies. In situations where increased mechanical weed control is feasible, for instance, the analysis indicated that the economic impact could be greatly reduced.

SUMMARY AND CONCLUSIONS

Groundwater monitoring initiatives in Wisconsin have discovered that the herbicide atrazine and its chlorinated metabolites are present in a variety of wells and aquifers around the state. The atrazine in groundwater is believed to have resulted both from use (non-point source) and improper handling, storage and disposal (point source). The distribution of atrazine detections in the state is widespread. Most areas where testing has occurred have shown detections and certain areas have more acute contamination problems.

Regulatory authority for protection of groundwater from pesticides including atrazine falls under the Wisconsin Groundwater Law (Ch. 160, Stats.) and Ch. ATCP 31, Wis. Adm. Code. Both the Groundwater Law and ATCP 31 describe the measures DATCP must take in response to documented groundwater contamination by pesticides. For groundwater contamination above the Enforcement Standard (ES), the department must prohibit the activity or practice that caused or may affect the contamination. For levels of contamination below the ES, the appropriate regulatory response is more complex. ATCP 31.09 states that any substance-specific groundwater protection rule "shall be designed, to the extent technically and economically feasible, to minimize the level of pesticide substance in groundwater and maintain compliance with the preventive action limit for the pesticide substance statewide."

The Atrazine Rule, Ch. ATCP 30, Wis. Adm. Code, was promulgated in March 1991 to protect Wisconsin's groundwater. This rule restricted the use of atrazine on a statewide basis and established one atrazine management area (AMA) and six prohibition areas (PAs) in which the use of atrazine was further restricted or prohibited.

Amendments to the Atrazine Rule promulgated in March 1992 established five additional AMAs and eight additional PAs in areas of the state where groundwater contamination is more acute. The AMAs were located in portions of Columbia, Dane, Green, Lafayette, and St. Croix counties.

Additional amendments to the Atrazine Rule were promulgated in March 1993. These amendments further limited the use of atrazine in the entire state. Specifically, the maximum allowable atrazine application rates for the entire state were lowered to 0.75 pounds/acre for coarse textured soils and 1.0 or 1.5 pounds/acre for medium/fine textured soils. The 1.5 pounds/acre rate is allowed on medium and fine textured soils if no atrazine was applied the previous year. An exemption is allowed on seed and sweet corn if a rescue treatment is needed.

Additional amendments were promulgated in 1994, 1995, 1996, 1997, 1998 and 1999. These amendments created 50 new PAs, rescinded 3 PAs, and enlarged 18 existing PAs where the Enforcement Standard (ES) for atrazine had been attained or exceeded.

In 1998, Ch. ATCP 30, Wis Adm. Code, was expanded to include rules restricting the use of a number of pesticides in addition to Atrazine. These additional rules were previously located in Ch. ATCP 29, Wis Adm. Code. All pesticide use restrictions are now contained within Ch. ATCP 30, Wis. Adm. Code, and it has been renamed "Pesticide Product Restrictions".

Under this proposal, all statewide provisions in the current Atrazine Rule remain in effect. The proposed rule amendments would create two new PAs and enlarge one existing PA. These actions are based on groundwater sample results for atrazine and metabolites that the Department has received in the last year. The proposed PAs are based on a single well exceeding the ES. The proposed expansion of an existing PA is due to a newly discovered exceedence of the atrazine ES near the existing PA boundary.

The Environmental Impact Statement (EIS) contains: a description and discussion of the proposed rule; background information on atrazine, including information on the use of atrazine and findings of atrazine in groundwater; a discussion of the environment and persons affected by the proposed rule; and the significant economic effects of the proposed action. The EIS also discusses and compares possible alternative actions.

This EIS finds that promulgation of the proposed rule would not create any new adverse environmental impacts from the use of alternative herbicides. Alternative herbicides, due to differences in mobility and persistence, generally have less potential to contaminate groundwater as compared to atrazine. The major effect the proposed rule is expected to have on the environment is a reduction in additional groundwater contamination by atrazine across the state and in the PAs. This reduction in additional groundwater contamination will benefit the natural and human environments.

Several alternative regulatory strategies have been considered by DATCP staff. These include taking no action, and prohibiting atrazine use statewide. Eliminating atrazine use statewide may provide greater protection of groundwater than the proposed rule but may also lead to greater economic hardship for farmers who desire to continue using atrazine.

It should be recognized that atrazine use on some sites under this rule may lead to groundwater contamination that exceeds the PAL.

STATE OF WISCONSIN
DEPARTMENT OF AGRICULTURE,
TRADE AND CONSUMER PROTECTION

By E Chapman for Nick Neher
Nicholas J. Neher, Administrator,
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Dated: 10/18/99

owner is interviewed about atrazine use and handling practices around the well site. If it appears that the groundwater contamination is mainly from use of atrazine in the area (nonpoint source), a PA is proposed. If the groundwater contamination is believed to be mainly from point sources, a PA is not proposed unless it appears that use of atrazine in the area is significantly contributing to the existing contamination. In the case of isolated wells exceeding the ES, single well PAs are proposed. If clusters of wells exceeding the ES are identified, multiple well PAs are proposed.

The various types of boundaries that can be used to delineate PAs include soil and geologic boundaries, groundwater or surface water divides, legal land descriptions, and public roads. For the three proposed new or expanded PAs, legal land descriptions, rivers and roads are used for boundaries. In some cases the boundaries correspond to roads. Surface water features are used to modify PA boundaries where appropriate. The advantages of using legal land descriptions for the smaller single well PAs is that the recharge area for a well can be approximated more accurately than by using roads. The disadvantage of legal land descriptions is that they can split individual farm fields.

Each of the two proposed new PAs is 2,560 acres (4 square miles) in size. The proposed expanded PA adds about 1,000 acres (2 square miles). This land area is thought to be a reasonable approximation of the recharge area for the contaminated wells. A PA may be smaller in size if a river or other groundwater divide exists near the well site.

Advantages and Disadvantages of the Proposed Rule

Advantages

The advantage of the proposed rule is that it prohibits the use of atrazine in areas of the state where well sampling has found atrazine levels above the ES. This action should allow the groundwater quality to gradually improve due to dilution, degradation and recharge of cleaner water to the aquifer.

Disadvantages

Current data for atrazine and metabolites indicate that more wells will exceed the ES as additional sampling programs are conducted. As a consequence, a disadvantage of this approach is that the rule could become increasingly complex as the need to delineate additional PAs increases. Also, this approach may allow continued use of atrazine in areas where the ES has been exceeded but groundwater testing has not yet occurred.

CHAPTER 2 - BACKGROUND INFORMATION

Findings of Atrazine In Wisconsin Groundwater

Grade A Dairy Farm Well Water Quality Survey

Between August 1988 and February 1989, The Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) conducted a survey of water quality at Grade A dairy farm wells in Wisconsin. Well water samples were collected from 534 randomly-selected Grade A dairy farms in Wisconsin and analyzed for many commonly used pesticides and nitrate-nitrogen. Of the 534 wells sampled, 66 contained atrazine above the detection level of 0.15 ppb. Thirty-nine wells contained atrazine above the PAL of 0.35 ppb and 3 wells were above the ES of 3.5 ppb. The average concentration for all wells containing atrazine was 1.0 ppb and the highest concentration found was 19.4 ppb.

From this study, a statistical estimate was made with 95% confidence that between 9 and 15% of Grade A wells in Wisconsin contain atrazine. In the South Central Agricultural Statistics District, which had the highest number of atrazine detects, it was estimated that 19 to 39% of Grade A wells contain atrazine. Dane County had by far the highest number of atrazine detects of any county.

Investigations at farms with contaminated wells did not conclusively identify the source of contamination. Further research is being supported by DATCP to help determine the source and extent of the atrazine contamination. This research is showing that the atrazine in Grade A wells can be the result of both use (non-point source) and improper handling, storage and disposal (point source).

DATCP Groundwater Monitoring Project for Pesticides

This study began in 1985 and utilizes monitoring wells to study pesticides in groundwater next to agricultural fields in highly susceptible areas. For this project, highly susceptible areas are defined as having sandy soil, shallow depth to groundwater, and irrigation. Groups of three monitoring wells have been installed at approximately fifty fields in the Central Sands, lower Wisconsin River valley, and other sandy soil areas of the state. The study was designed so that the findings in the monitoring wells reflect activities on the fields being monitored.

Atrazine has been used at 40 of the test sites and has been detected at 29 of the sites. Deethyl, deisopropyl, and diamino atrazine have been detected at 32, 11 and 5 of the sites, respectively. Some sites have had a detection of a metabolite in the absence of parent atrazine. The total

atrazine concentration (the sum of atrazine plus the three metabolites) has exceeded the 3.0 ppb enforcement standard at 16 of the 40 monitoring sites.

In 1998, a total of seven compounds were detected in groundwater. Three of these compounds (atrazine, alachlor ESA, and nitrate) were found at levels above an existing or proposed enforcement standard. The table below lists the compounds detected in 1998 and the frequency of detection in monitoring program wells. Alachlor ESA, a degradate of alachlor, was detected in 60% of the samples. Cyanazine amide, a degradate of cyanazine, which was first detected in 1997, was found in 14% of the samples in 1998.

Compounds Detected in Monitoring Wells for 1998

Compound	% Detected	% over PAL*	% over ES**
Nitrate	97	95	78
Alachlor ESA***	60	51	3
Atrazine (TCR)	43	42	14
Metribuzin	36	17	0
Metolachlor	13	5	0
Cyanazine Amide	14	NS****	NS****
Simazine	5	4	0

* PAL = Preventive Action Limit
** ES = Enforcement Standard
*** Based on an Interim Health Standard
**** NS = No Standard

This study has helped determine which pesticides need the most attention for groundwater protection purposes. It has also helped to identify which areas of the state are most susceptible to pesticide leaching and to indicate that not all sandy soil areas have the same susceptibility to groundwater contamination. The major conclusions of the study to date are that atrazine is the pesticide that is most frequently detected in groundwater and that the lower Wisconsin River valley is an area particularly susceptible to groundwater contamination by pesticides.

DATCP Rural Well Sampling Program

In the first half of 1990 DATCP conducted a groundwater sampling program in which 2,187 rural well owners had their well water tested for certain agricultural chemicals. The study was conducted in two phases. In the first phase, participating rural well owners submitted a water

sample that was analyzed for triazine compounds and nitrate-nitrogen. The triazine tests were performed using an immunoassay screening procedure. The second phase of the program consisted of an official follow-up sample with a conventional laboratory analysis from any well that had a triazine detection at or above 0.35 ppb or nitrate-nitrogen above 10 ppm. The program was established to provide a service to the public and provide information to DATCP on the occurrence of herbicides in groundwater. The geographic distribution of wells tested was largely determined by the location of rural well owners who participated in the program.

The results of the Rural Well Sampling Program indicated widespread atrazine contamination in groundwater in many areas of Wisconsin. Of the 2,187 wells sampled in phase 1 of the program, the immunoassay screening showed detections of triazine in 351 (16%). Two hundred and twenty (10%) were above the PAL for atrazine. Official followup samples were taken at 435 qualifying wells. Of these, 215 had atrazine detects, 127 were above the PAL and 11 were above the ES. Ten followup samples known to contain atrazine were also analyzed for the atrazine metabolites deethyl atrazine and deisopropyl atrazine. All ten samples contained deethyl atrazine and six samples contained deisopropyl atrazine.

The highest frequencies of atrazine detections are in the south central, southwest, and west central regions of the state. As in the Grade A Dairy Well Survey, Dane County had by far the highest number of atrazine detections. Several other counties, such as Columbia, Grant, Sauk, Iowa, Lafayette, Rock, Walworth, and St. Croix also had a considerable number of relatively widely distributed detections. Most of the detections were at levels near or below the PAL of 0.35 ppb, but a few detects were at levels considerably above the 3.5 ppb ES. The department believes that the atrazine in these rural wells is due both to agricultural use (non-point source) and improper handling, storage and disposal (point source).

Atrazine Metabolite Testing in the Rural Well Survey

As part of the Rural Well Survey, the CIBA-GEIGY Corporation received split samples from the 236 wells that had a triazine finding at or above 0.35 ppb. These samples were analyzed by CIBA-GEIGY for atrazine, deethyl atrazine, deisopropyl atrazine and diamino atrazine. This represents the most rigorous analysis to date for atrazine residues in Wisconsin groundwater for two reasons. First, this was the first analysis of Wisconsin groundwater for diamino atrazine. Second, the 0.1 ppb level of detection for all four analytes was considerably lower than the levels of detection at the Wisconsin state laboratories.

The results from these 236 wells showed atrazine present in 200 wells, deethyl present in 208 wells, deisopropyl present in 143 wells and diamino present in 195 wells. The average detect concentrations for these same four analytes were 1.1, 0.80, 0.45, and 1.0 ppb, respectively. The average total concentration (for total >0) was 3.0 ppb. These results indicate that 71 wells exceed the new ES for atrazine and metabolites. Only 15 of these wells would have exceeded the old ES for atrazine alone. The newly-discovered presence of diamino atrazine played an important role in the increased number of wells exceeding the ES.

Triazine Testing

From April 1991 to the present two laboratories, the Wisconsin State Laboratory of Hygiene (SLOH) and the Environmental Task Force (ETF) lab in Stevens Point, have offered immunoassay testing of triazines in groundwater. These testing services are available to the public and government agencies. The cost of the test is approximately $20/sample and the level of detection and reporting is 0.1 ppb.

As of October 1999, DATCP has received results from 23,611 triazine samples. Of these results, 8,672 (37%) had a detection. These samples have been collected by private citizens and government agencies. Many of the samples collected by government agency staff have been part of the Wisconsin Priority Watershed program. Considerable sampling has occurred in priority watersheds including portions of Chippewa, Eau Claire, Clark, Marathon, Wood, Dodge, Columbia, Green Lake, Lafayette, Green, Outagamie, Winnebago and Waupaca Counties. Most of the remaining triazine samples have been submitted by private citizens interested in having their drinking water tested.

These data show widespread triazine detections in eight counties where there has been testing in priority watersheds. The percentage of detections ranges from 34% in Chippewa, Clark and Winnebago Counties to 71% for Lafayette County. The percentage of detects equal to or greater than 0.3 ppb for these same eight counties ranges from 9% for Chippewa County to 37% for Lafayette County. The frequency of detections in these Priority Watersheds which encompass a range of soil and hydrologic conditions, indicate that atrazine has the potential to be present in groundwater in all areas of the state where it is used.

A 1999 groundwater sampling program in the Lake Mendota watershed in northern Dane and southern Columbia counties also showed a very high level of triazine detections. Of 248 samples collected in this program, 179 (72%) had detects of triazine. None of these wells exceeded the ES for atrazine.

DATCP Exceedence Survey

DATCP conducted a study in 1995 to measure changes in pesticide concentrations in wells that had previously exceeded an enforcement standard (ES). The sampling of wells with an ES exceedance has continued yearly. Most of these wells are in Atrazine Prohibition Areas. One-hundred-twenty-two (122) wells were resampled for this program in 1995. Sampling results for atrazine showed that 84% of the wells decreased in concentration and 16% increased. Forty-three percent of the wells were still above the atrazine enforcement standard and 57% below. Between 1995 and 1998 148 wells have been sampled as part of the survey. In 1998, 28% of the wells contained atrazine over the ES, a 15% decrease since 1995. Nitrate was found over the ES in 66% of the wells in 1998. Other pesticides have also been detected, including; alacalor, alachlor-ESA, acetochlor, cyanazine, cyanazine amide, metolachlor, metribuzin, prometon and simazine.

Well owners with previous exceedences were interviewed in 1995 to determine what changes, if any, they had made to their water supplies in response to the exceedence. About 50% of the well owners continued to use their contaminated well and about 25% had installed new wells at an average cost of $6,300. The remaining well owners drink bottled water, haul water, or use water treatment.

Atrazine Rule Evaluation Survey

DATCP conducted the Atrazine Rule Evaluation Survey between May 1994 and October 1996. The purpose of this study was to determine if the atrazine rule had been successful in reducing atrazine contamination in groundwater. This study was conducted in two phases so that comparisons could be made over tine. Between May and November 1994, 289 samples from private wells were collected for Phase 1. Between May and November of 1996, 278 samples were collected for Phase 2.

The results of the study showed that the concentration of atrazine and its chlorinated metabolites in groundwater declined significantly between Phase 1 and Phase 2 of the study. The average concentration in the wells declined from 0.96 ppb to 0.54 ppb over this time period. No significant change was documented between Phase 1 and Phase 2, however, for the percentage of wells containing a detection of atrazine.

Monitoring Reuse of Atrazine in Prohibition Areas

In 1998, DATCP began monitoring the reuse of the herbicide atrazine in areas of Wisconsin where its use has been prohibited since 1993 due to groundwater contamination. Requirements in chapter ATCP 31, Wis. Adm Code, require DATCP to gather scientific data to show if renewed atrazine use in these areas will cause further groundwater contamination. DATCP will test groundwater under 17 monitored fields (10-40 acres in size) quarterly for 5 years. Growers must plant corn in the first year of the study and at least 2 other years, and apply atrazine on corn. Products containing cyanazine or simazine cannot be used on monitored fields during the study, but other pesticides and fertilizers can be applied as needed. Growers choose the tillage and pesticide application methods best suited for their operations. Although it is too early in the project to make recommendations, 1998 summary data of the 14 sites installed at that time showed that atrazine concentrations increased from spring to winter at all but one site. Atrazine concentrations were over the enforcement standard (3.0 parts per billion) at 5 of 14 (36%) of sites in winter 1998, while the nitrate enforcement standard was exceeded at 12 of 14 (86%) of sites in winter 1998.

Atrazine Registration Information

"Atrazine" is the accepted common name for the compound 2-chloro-4-ethylamino-6-isopropylamino-s-triazine. This name is recognized by the American National Standards Institute.

Atrazine was initially registered in the United States in 1958 by CIBA-GEIGY for weed control in corn. Additional labels were subsequently approved for other agricultural crops by the U.S. Department of Agriculture (USDA) and since 1970 by the U.S. Environmental Protection Agency (EPA). Atrazine has been registered for control of broadleaf and grass weeds in corn, sorghum, rangeland, sugarcane, macadamia orchards, guava, pineapple, turf grass sod, conifer reforestation, Christmas tree plantations, grass in orchards, proso millet, ryegrass, wheat, grass seed fields and for nonselective vegetation control in chemical fallow and non-crop land. A large portion of atrazine use has been to control weeds on corn and sorghum in the 28 states were these crops are grown. Manufacturers produced about 100-125 million pounds of atrazine in 1980 and about 15-25 million pounds were exported.

A number of herbicides have been registered for use in combination with atrazine. Some of these include alachlor, butylate, metolachlor, paraquat, propachlor, cyanazine, bentazon and simazine. Herbicide mixtures are often used in situations where atrazine alone is not completely effective due to the spectrum of weeds, soil conditions and other environmental factors.

Atrazine Use in Wisconsin

Atrazine Use on Crops

In Wisconsin, use of atrazine on crops has been primarily on corn including field corn, silage corn, sweet corn and seed corn. The Wisconsin Agricultural Statistics Service (WASS) reported that in 1998, 3,700,000 acres of corn for grain, and 111,600 acres of sweet corn were planted. This is a total of 3,811,600 acres of corn planted in these two categories. Data on seed corn acreage are not routinely collected by WASS.

Atrazine controls many annual grass and broadleaf weeds in corn and can be applied preplant (surface applied or incorporated), preemergence, or postemergence. The label application rates for preplant and preemergence uses of atrazine are dependent on soil texture and organic matter content. Prior to the 1990 label changes and the 1991 Wisconsin Atrazine Rule, the label application rates ranged from 2 pounds of active ingredient (a.i.)/acre on coarse textured soils to 4 pounds a.i./acre on fine textured soils with higher organic matter.

Atrazine has also been applied with oil as a postemergence treatment. This is a foliar spray and controls weeds by direct contact. The historical label rates for this application were 2 pounds a.i./acre if broadleaf and grass weeds were present or 1 pound if only broadleaf weeds were present.

Another important use of atrazine has been for control of quackgrass, a perennial grass weed that can be a significant problem in corn production. Atrazine can be applied for quackgrass control as either a split or single application. Prior to the 1991 Atrazine Rule and the 1990 label changes, the split applications consisted of 2 pounds of atrazine broadcast in the spring or fall followed by a second application in the spring before, during or after planting. For a single application, 3 to 4 pounds were applied in the fall or spring followed by a plowing 1-3 weeks later.

Wisconsin Pesticide Use Surveys

Several pesticide use surveys have been conducted in Wisconsin to provide information on atrazine use patterns.

1969. This early survey, conducted as part of a Great Lakes initiative with Illinois, Indiana, Michigan and Minnesota, provides information on pesticide use in Wisconsin for the 1969 growing season. In 1969, 1,995,000 acres of corn were treated at least once with herbicides. Herbicide use on corn accounted for 82% of the total crop acreage treated with herbicides. Approximately 10 years after it first started to be used, atrazine was by far the most commonly used herbicide on corn. Atrazine alone and in combination with other herbicides was applied to 91% of the corn acreage receiving a preemergence herbicide treatment and 83% of the acreage treated postemergence. The herbicides that were used in combination with atrazine for preemergence applications were propachlor, linuron, and prometryne. The average rate of atrazine application was 1.5 - 2.0 pounds a.i./acre.

1978. Another major pesticide use survey was conducted in Wisconsin in 1978 by the Wisconsin Agriculture Reporting Service. In 1978, 3,750,000 acres of corn were planted and 3,589,000, or 96%, were treated with herbicides. Atrazine was used on 3,000,000 acres, or 80% of the corn acres planted, making it by far the most commonly used herbicide. The average rate of application was 1.5 pounds atrazine a.i./acre and a total of 4,410,000 pounds of a.i. were used. The South Central, Southwest, and West Central Crop Reporting Districts accounted for the highest number of acres treated with atrazine and the largest quantity of active ingredient applied. Quackgrass and foxtail were the most common target weeds for atrazine applications.

1985. In 1985, a major pesticide use survey was conducted by WASS to collect information needed for managing pesticides in groundwater. In 1985, herbicides were applied to 98% of the 4,300,000 acres of corn planted. Atrazine was applied to 3,362,000, or 77%, of the corn acreage. The average rate of application was 1.6 pounds of atrazine a.i./acre and the total quantity of atrazine used in the state was 5,165,000 pounds of a.i. The South Central, Southwest, and West

Central Crop Reporting Districts were again the areas of highest atrazine use. Quackgrass, foxtail and velvetleaf were the most common target weeds for atrazine applications.

1990. In 1990, a pesticide use survey was conducted by WASS in a manner similar to the 1985 survey so that direct comparisons in pesticide use trends could be made. The number of acres planted to corn in 1990 was 3,700,000, down 14% from 1985. Atrazine was applied to 56% of the corn acres in 1990 compared to 77% in 1985. The average atrazine application in 1990 was 1.43 pounds of atrazine a.i./acre compared to 1.6 pounds in 1985. The overall effect is a 43% reduction in the quantity of atrazine used on corn in Wisconsin from 1985 to 1990.

1991. In March 1992 the United States Department of Agriculture National Agricultural Statistics Service published pesticide use information for the 1991 crop year. This report indicated that atrazine was used on 52% of the corn acres in Wisconsin at an average application rate of 1.04 pounds a.i./acre. A total of 2,048,000 pounds were applied in 1991 in Wisconsin.

1992. In October 1993 the United States Department of Agriculture National Agricultural Statistics Service published pesticide use information for the 1992 crop year. This report indicated that atrazine was used on 59% of the corn acres in Wisconsin at an average application rate of 0.89 pounds a.i./acre. A total of 2,088,000 pounds were applied in 1992 in Wisconsin.

1993. In March 1994 the United States Department of Agriculture National Agricultural Statistics Service published pesticide use information for the 1993 crop year. This report indicated that atrazine was used on 48% of the corn acres in Wisconsin at an average application rate of 0.89 pounds a.i./acre. A total of 1,447,000 pounds were applied in 1993 in Wisconsin.

1994. In March 1995 the United States Department of Agriculture National Agricultural Statistics Service published pesticide use information for the 1994 crop year. This report indicated that atrazine was used on 52% of the corn acres in Wisconsin at an average application rate of 0.84 pounds a.i./acre. A total of 1,626,000 pounds were applied in 1994 in Wisconsin.

1995. In March 1996 the United States Department of Agriculture National Agricultural Statistics Service published pesticide use information for the 1995 crop year. This report indicated that atrazine was used on 51% of the corn acres in Wisconsin at an average application rate of 1.02 pounds a.i./acre. A total of 1,887,000 pounds were applied in 1995 in Wisconsin.

1996. In 1996, a pesticide use survey was conducted by WASS in a manner similar to the 1985 and 1990 surveys so that direct comparisons in pesticide use trends could be made. The number of acres planted to corn in 1996 was 3,900,000, up from 3,700,00 acres in 1990. Atrazine was applied to 51% of the corn acres in 1996 compared to 56% in 1990. The average atrazine application in 1996 was 0.75 pounds of atrazine a.i./acre compared to 1.4 pounds in 1990. The overall effect is a 50% reduction in the quantity of atrazine used on corn in Wisconsin from 1990 to 1996.

1997. In May 1998 the United States Department of Agriculture National Agricultural Statistics Service published pesticide use information for the 1997 crop year. This report indicated that

atrazine was used on 64% of the corn acres in Wisconsin at an average application rate of 0.80 pounds a.i./acre. A total of 1,940,000 pounds were applied in 1997 in Wisconsin.

1998. In May 1999 the United States Department of Agriculture National Agricultural Statistics Service published pesticide use information for the 1998 crop year. This report indicated that atrazine was used on 56% of the corn acres in Wisconsin at an average application rate of 0.87 pounds a.i./acre. A total of 1,789,000 pounds were applied in 1998 in Wisconsin.

Summary of Trends in Atrazine Use

All sources of information on pesticide use in Wisconsin indicate that the use of atrazine has declined since 1985. The two components of pesticide use that are usually considered are the number of acres on which a compound is used and the rate of application, often expressed in pounds of a.i./acre/year. These two components together indicate the quantity of pesticide material used.

It is clear that the number of atrazine-treated acres in Wisconsin declined significantly between 1985 and 1998. The pesticide use surveys conducted by WASS indicate that the percentage of corn acres treated with atrazine decreased from 77% in 1985 to 56% in 1998. It is likely that this downward trend in atrazine use has resulted from an increased awareness of its environmental and carry-over problems and from the implementation of the atrazine rule. It appears that atrazine use has now stabilized at or near current levels.

The average atrazine application rate decreased from 1.6 pounds a.i. in 1985 to 0.87 pounds a.i. in 1998. Some of this reduction is likely due to the atrazine rule. Other opportunities for reducing application rates include using atrazine in combination with other herbicides, applying atrazine in a band over the corn rows, and using additional mechanical weed control practices. Many farmers have utilized these strategies to reduce their atrazine application rates. In some cases, however, the atrazine rate that farmers are using is already at a level where further reductions are not possible. In these cases, further reducing atrazine use would mean switching to non-atrazine weed control strategies.

There are several reasons why farmers are reducing or eliminating their use of atrazine. One reason is the concern about carryover of atrazine phytotoxicity into the following year. Most crops that commonly follow corn in a rotation can be damaged by significant atrazine residues remaining in the soil. The importance of this consideration has increased recently as more farmers are realizing the benefits of crop rotation. If the number of years of corn in a dairy rotation is reduced, for example, use of atrazine becomes less desirable because of carryover problems in new alfalfa seedings.

Another major reason for the decline in atrazine use appears to be concern over environmental problems such as groundwater contamination. Several important studies in the last ten years have documented atrazine contamination in groundwater and many farmers have responded to this threat by shifting their weed control strategies away from atrazine. These farmers have

realized that a water supply contaminated with pesticides is a liability to their family, their farm operation, and their real estate investment.

Other reasons for farmers reducing atrazine use are: the implementation of the Department's atrazine rule, changes in the crops being planted, conversion to lower chemical input farming practices, weed resistance, and many new weed-control products on the market. In reality, an individual farmer's decision to discontinue or reduce the reliance on atrazine may be based on a combination of these reasons. The specific reason that precipitates the final decision probably varies from case to case, but groundwater contamination has certainly been a major factor.

Environmental Fate of Atrazine

Behavior in Soil

The environmental fate - and in particular the leaching potential - of a pesticide applied to the soil is dependent on the characteristics of the environment and the chemical compound. For the chemical itself, the leaching potential is related to its mobility and persistence. Mobility refers to the water solubility and soil adsorbance of the chemical and persistence is measured by the rate of degradation of the compound in the soil. For a pesticide to leach to groundwater as a result of field applications, it must have relatively high mobility and persistence in the soil.

Atrazine has environmental fate characteristics that indicate a high leaching potential and explain its widespread occurrence in groundwater. It is moderately mobile in the soil with a water solubility of 33 ppm and a soil adsorption coefficient of 3.2. (The soil adsorption coefficient is the ratio of the amount of a pesticide adsorbed to soil to the amount dissolved in water). Persistence in soil is the factor that appears to give atrazine its high leaching potential; literature values indicate a surface soil half-life of 4 to 57 weeks depending on environmental conditions.

Because of the large number of management, environmental and climatic variables involved in the behavior of atrazine in the soil, it is currently impossible to establish a correlation between atrazine application rates and residue levels in groundwater. Even if a correlation could be established, it would only be applicable to the specific site where the research was conducted and to the weather conditions that prevailed during the course of the experiments.

Toxicology of Atrazine

CHAPTER 6 - ALTERNATIVES TO THE PROPOSED ACTION

No Action Beyond the Existing Rule

Under this option, no new PAs would be delineated. The existing Chapter ATCP 30 promulgated in April 1999 would continue to apply to all areas of the state.

Advantages

An advantage of this option is that no additional rulemaking or compliance actions would be required for the Department. Also, from a weed control perspective, growers in the proposed PAs could continue using atrazine at the existing statewide levels.

Disadvantages

The main disadvantage of this option is that it would not provide adequate groundwater protection in the areas where exceedences of the atrazine ES have been found. A lack of response would not meet the department's mandates under the Groundwater Law.

Statewide Prohibition

Under this option atrazine use would be completely eliminated. No atrazine could be used for any crop in any part of the state. A prohibition on atrazine use could be imposed for the 2000 growing season or phased-in over 2-3 years. This is obviously the most restrictive action the Department could take in response to atrazine contamination in groundwater. This action should receive consideration because the NR 140 groundwater ES includes atrazine and the three chlorinated metabolites. Sampling results for atrazine and metabolites have indicated that this new ES is being exceeded much more frequently than the old ES that was based solely on parent atrazine.

Advantages

The biggest advantage of this option is that it would provide the highest degree of groundwater and public health protection from contamination by atrazine. No additional atrazine would be

introduced into the environment to further contribute to the existing problem. The aquifers of the state could then begin to cleanse through degradation, dispersion and discharge into surface water. This option would be relatively easy to administer and enforce compared to a system of use restrictions and PAs.

Disadvantages

The main drawback of this option is that it is not clear, based on current use patterns, whether atrazine use has the potential to exceed the ES in all areas of the state. A statewide prohibition may eliminate atrazine use at low rates in areas where unacceptable contamination would not occur. This could lead to undue economic hardship on certain corn growers.

The Department has estimated the economic impact of eliminating the use of atrazine in Wisconsin. The overall analysis was based on separate analyses for continuous corn, corn in rotation with alfalfa, and corn in rotation with other crops. The results indicated that the total economic cost of prohibiting atrazine use in Wisconsin would be between 1.6 and 10.9 million dollars. This wide range reflects the considerable cost differences between possible alternative weed control strategies. In situations where increased mechanical weed control is feasible, for instance, the analysis indicated that the economic impact could be greatly reduced.

SUMMARY AND CONCLUSIONS

Groundwater monitoring initiatives in Wisconsin have discovered that the herbicide atrazine and its chlorinated metabolites are present in a variety of wells and aquifers around the state. The atrazine in groundwater is believed to have resulted both from use (non-point source) and improper handling, storage and disposal (point source). The distribution of atrazine detections in the state is widespread. Most areas where testing has occurred have shown detections and certain areas have more acute contamination problems.

Regulatory authority for protection of groundwater from pesticides including atrazine falls under the Wisconsin Groundwater Law (Ch. 160, Stats.) and Ch. ATCP 31, Wis. Adm. Code. Both the Groundwater Law and ATCP 31 describe the measures DATCP must take in response to documented groundwater contamination by pesticides. For groundwater contamination above the Enforcement Standard (ES), the department must prohibit the activity or practice that caused or may affect the contamination. For levels of contamination below the ES, the appropriate regulatory response is more complex. ATCP 31.09 states that any substance-specific groundwater protection rule "shall be designed, to the extent technically and economically feasible, to minimize the level of pesticide substance in groundwater and maintain compliance with the preventive action limit for the pesticide substance statewide."

The Atrazine Rule, Ch. ATCP 30, Wis. Adm. Code, was promulgated in March 1991 to protect Wisconsin's groundwater. This rule restricted the use of atrazine on a statewide basis and established one atrazine management area (AMA) and six prohibition areas (PAs) in which the use of atrazine was further restricted or prohibited.

Amendments to the Atrazine Rule promulgated in March 1992 established five additional AMAs and eight additional PAs in areas of the state where groundwater contamination is more acute. The AMAs were located in portions of Columbia, Dane, Green, Lafayette, and St. Croix counties.

Additional amendments to the Atrazine Rule were promulgated in March 1993. These amendments further limited the use of atrazine in the entire state. Specifically, the maximum allowable atrazine application rates for the entire state were lowered to 0.75 pounds/acre for coarse textured soils and 1.0 or 1.5 pounds/acre for medium/fine textured soils. The 1.5 pounds/acre rate is allowed on medium and fine textured soils if no atrazine was applied the previous year. An exemption is allowed on seed and sweet corn if a rescue treatment is needed.

Additional amendments were promulgated in 1994, 1995, 1996, 1997, 1998 and 1999. These amendments created 50 new PAs, rescinded 3 PAs, and enlarged 18 existing PAs where the Enforcement Standard (ES) for atrazine had been attained or exceeded.

In 1998, Ch. ATCP 30, Wis Adm. Code, was expanded to include rules restricting the use of a number of pesticides in addition to Atrazine. These additional rules were previously located in Ch. ATCP 29, Wis Adm. Code. All pesticide use restrictions are now contained within Ch. ATCP 30, Wis. Adm. Code, and it has been renamed "Pesticide Product Restrictions".

Under this proposal, all statewide provisions in the current Atrazine Rule remain in effect. The proposed rule amendments would create two new PAs and enlarge one existing PA. These actions are based on groundwater sample results for atrazine and metabolites that the Department has received in the last year. The proposed PAs are based on a single well exceeding the ES. The proposed expansion of an existing PA is due to a newly discovered exceedence of the atrazine ES near the existing PA boundary.

The Environmental Impact Statement (EIS) contains: a description and discussion of the proposed rule; background information on atrazine, including information on the use of atrazine and findings of atrazine in groundwater; a discussion of the environment and persons affected by the proposed rule; and the significant economic effects of the proposed action. The EIS also discusses and compares possible alternative actions.

This EIS finds that promulgation of the proposed rule would not create any new adverse environmental impacts from the use of alternative herbicides. Alternative herbicides, due to differences in mobility and persistence, generally have less potential to contaminate groundwater as compared to atrazine. The major effect the proposed rule is expected to have on the environment is a reduction in additional groundwater contamination by atrazine across the state and in the PAs. This reduction in additional groundwater contamination will benefit the natural and human environments.

Several alternative regulatory strategies have been considered by DATCP staff. These include taking no action, and prohibiting atrazine use statewide. Eliminating atrazine use statewide may provide greater protection of groundwater than the proposed rule but may also lead to greater economic hardship for farmers who desire to continue using atrazine.

It should be recognized that atrazine use on some sites under this rule may lead to groundwater contamination that exceeds the PAL.

STATE OF WISCONSIN
DEPARTMENT OF AGRICULTURE,
TRADE AND CONSUMER PROTECTION

By E Chapman for Nick Neher
Nicholas J. Neher, Administrator,
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owner is interviewed about atrazine use and handling practices around the well site. If it appears that the groundwater contamination is mainly from use of atrazine in the area (nonpoint source), a PA is proposed. If the groundwater contamination is believed to be mainly from point sources, a PA is not proposed unless it appears that use of atrazine in the area is significantly contributing to the existing contamination. In the case of isolated wells exceeding the ES, single well PAs are proposed. If clusters of wells exceeding the ES are identified, multiple well PAs are proposed.

The various types of boundaries that can be used to delineate PAs include soil and geologic boundaries, groundwater or surface water divides, legal land descriptions, and public roads. For the three proposed new or expanded PAs, legal land descriptions, rivers and roads are used for boundaries. In some cases the boundaries correspond to roads. Surface water features are used to modify PA boundaries where appropriate. The advantages of using legal land descriptions for the smaller single well PAs is that the recharge area for a well can be approximated more accurately than by using roads. The disadvantage of legal land descriptions is that they can split individual farm fields.

Each of the two proposed new PAs is 2,560 acres (4 square miles) in size. The proposed expanded PA adds about 1,000 acres (2 square miles). This land area is thought to be a reasonable approximation of the recharge area for the contaminated wells. A PA may be smaller in size if a river or other groundwater divide exists near the well site.

Advantages and Disadvantages of the Proposed Rule

Advantages

The advantage of the proposed rule is that it prohibits the use of atrazine in areas of the state where well sampling has found atrazine levels above the ES. This action should allow the groundwater quality to gradually improve due to dilution, degradation and recharge of cleaner water to the aquifer.

Disadvantages

Current data for atrazine and metabolites indicate that more wells will exceed the ES as additional sampling programs are conducted. As a consequence, a disadvantage of this approach is that the rule could become increasingly complex as the need to delineate additional PAs increases. Also, this approach may allow continued use of atrazine in areas where the ES has been exceeded but groundwater testing has not yet occurred.

CHAPTER 2 - BACKGROUND INFORMATION

Findings of Atrazine In Wisconsin Groundwater

Grade A Dairy Farm Well Water Quality Survey

Between August 1988 and February 1989, The Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) conducted a survey of water quality at Grade A dairy farm wells in Wisconsin. Well water samples were collected from 534 randomly-selected Grade A dairy farms in Wisconsin and analyzed for many commonly used pesticides and nitrate-nitrogen. Of the 534 wells sampled, 66 contained atrazine above the detection level of 0.15 ppb. Thirty-nine wells contained atrazine above the PAL of 0.35 ppb and 3 wells were above the ES of 3.5 ppb. The average concentration for all wells containing atrazine was 1.0 ppb and the highest concentration found was 19.4 ppb.

From this study, a statistical estimate was made with 95% confidence that between 9 and 15% of Grade A wells in Wisconsin contain atrazine. In the South Central Agricultural Statistics District, which had the highest number of atrazine detects, it was estimated that 19 to 39% of Grade A wells contain atrazine. Dane County had by far the highest number of atrazine detects of any county.

Investigations at farms with contaminated wells did not conclusively identify the source of contamination. Further research is being supported by DATCP to help determine the source and extent of the atrazine contamination. This research is showing that the atrazine in Grade A wells can be the result of both use (non-point source) and improper handling, storage and disposal (point source).

DATCP Groundwater Monitoring Project for Pesticides

This study began in 1985 and utilizes monitoring wells to study pesticides in groundwater next to agricultural fields in highly susceptible areas. For this project, highly susceptible areas are defined as having sandy soil, shallow depth to groundwater, and irrigation. Groups of three monitoring wells have been installed at approximately fifty fields in the Central Sands, lower Wisconsin River valley, and other sandy soil areas of the state. The study was designed so that the findings in the monitoring wells reflect activities on the fields being monitored.

Atrazine has been used at 40 of the test sites and has been detected at 29 of the sites. Deethyl, deisopropyl, and diamino atrazine have been detected at 32, 11 and 5 of the sites, respectively. Some sites have had a detection of a metabolite in the absence of parent atrazine. The total

atrazine concentration (the sum of atrazine plus the three metabolites) has exceeded the 3.0 ppb enforcement standard at 16 of the 40 monitoring sites.

In 1998, a total of seven compounds were detected in groundwater. Three of these compounds (atrazine, alachlor ESA, and nitrate) were found at levels above an existing or proposed enforcement standard. The table below lists the compounds detected in 1998 and the frequency of detection in monitoring program wells. Alachlor ESA, a degradate of alachlor, was detected in 60% of the samples. Cyanazine amide, a degradate of cyanazine, which was first detected in 1997, was found in 14% of the samples in 1998.

Compounds Detected in Monitoring Wells for 1998

Compound	% Detected	% over PAL*	% over ES**
Nitrate	97	95	78
Alachlor ESA***	60	51	3
Atrazine (TCR)	43	42	14
Metribuzin	36	17	0
Metolachlor	13	5	0
Cyanazine Amide	14	NS****	NS****
Simazine	5	4	0

* PAL = Preventive Action Limit
** ES = Enforcement Standard
*** Based on an Interim Health Standard
**** NS = No Standard

This study has helped determine which pesticides need the most attention for groundwater protection purposes. It has also helped to identify which areas of the state are most susceptible to pesticide leaching and to indicate that not all sandy soil areas have the same susceptibility to groundwater contamination. The major conclusions of the study to date are that atrazine is the pesticide that is most frequently detected in groundwater and that the lower Wisconsin River valley is an area particularly susceptible to groundwater contamination by pesticides.

DATCP Rural Well Sampling Program

In the first half of 1990 DATCP conducted a groundwater sampling program in which 2,187 rural well owners had their well water tested for certain agricultural chemicals. The study was conducted in two phases. In the first phase, participating rural well owners submitted a water

sample that was analyzed for triazine compounds and nitrate-nitrogen. The triazine tests were performed using an immunoassay screening procedure. The second phase of the program consisted of an official follow-up sample with a conventional laboratory analysis from any well that had a triazine detection at or above 0.35 ppb or nitrate-nitrogen above 10 ppm. The program was established to provide a service to the public and provide information to DATCP on the occurrence of herbicides in groundwater. The geographic distribution of wells tested was largely determined by the location of rural well owners who participated in the program.

The results of the Rural Well Sampling Program indicated widespread atrazine contamination in groundwater in many areas of Wisconsin. Of the 2,187 wells sampled in phase 1 of the program, the immunoassay screening showed detections of triazine in 351 (16%). Two hundred and twenty (10%) were above the PAL for atrazine. Official followup samples were taken at 435 qualifying wells. Of these, 215 had atrazine detects, 127 were above the PAL and 11 were above the ES. Ten followup samples known to contain atrazine were also analyzed for the atrazine metabolites deethyl atrazine and deisopropyl atrazine. All ten samples contained deethyl atrazine and six samples contained deisopropyl atrazine.

The highest frequencies of atrazine detections are in the south central, southwest, and west central regions of the state. As in the Grade A Dairy Well Survey, Dane County had by far the highest number of atrazine detections. Several other counties, such as Columbia, Grant, Sauk, Iowa, Lafayette, Rock, Walworth, and St. Croix also had a considerable number of relatively widely distributed detections. Most of the detections were at levels near or below the PAL of 0.35 ppb, but a few detects were at levels considerably above the 3.5 ppb ES. The department believes that the atrazine in these rural wells is due both to agricultural use (non-point source) and improper handling, storage and disposal (point source).

Atrazine Metabolite Testing in the Rural Well Survey

As part of the Rural Well Survey, the CIBA-GEIGY Corporation received split samples from the 236 wells that had a triazine finding at or above 0.35 ppb. These samples were analyzed by CIBA-GEIGY for atrazine, deethyl atrazine, deisopropyl atrazine and diamino atrazine. This represents the most rigorous analysis to date for atrazine residues in Wisconsin groundwater for two reasons. First, this was the first analysis of Wisconsin groundwater for diamino atrazine. Second, the 0.1 ppb level of detection for all four analytes was considerably lower than the levels of detection at the Wisconsin state laboratories.

The results from these 236 wells showed atrazine present in 200 wells, deethyl present in 208 wells, deisopropyl present in 143 wells and diamino present in 195 wells. The average detect concentrations for these same four analytes were 1.1, 0.80, 0.45, and 1.0 ppb, respectively. The average total concentration (for total >0) was 3.0 ppb. These results indicate that 71 wells exceed the new ES for atrazine and metabolites. Only 15 of these wells would have exceeded the old ES for atrazine alone. The newly-discovered presence of diamino atrazine played an important role in the increased number of wells exceeding the ES.

Triazine Testing

From April 1991 to the present two laboratories, the Wisconsin State Laboratory of Hygiene (SLOH) and the Environmental Task Force (ETF) lab in Stevens Point, have offered immunoassay testing of triazines in groundwater. These testing services are available to the public and government agencies. The cost of the test is approximately $20/sample and the level of detection and reporting is 0.1 ppb.

As of October 1999, DATCP has received results from 23,611 triazine samples. Of these results, 8,672 (37%) had a detection. These samples have been collected by private citizens and government agencies. Many of the samples collected by government agency staff have been part of the Wisconsin Priority Watershed program. Considerable sampling has occurred in priority watersheds including portions of Chippewa, Eau Claire, Clark, Marathon, Wood, Dodge, Columbia, Green Lake, Lafayette, Green, Outagamie, Winnebago and Waupaca Counties. Most of the remaining triazine samples have been submitted by private citizens interested in having their drinking water tested.

These data show widespread triazine detections in eight counties where there has been testing in priority watersheds. The percentage of detections ranges from 34% in Chippewa, Clark and Winnebago Counties to 71% for Lafayette County. The percentage of detects equal to or greater than 0.3 ppb for these same eight counties ranges from 9% for Chippewa County to 37% for Lafayette County. The frequency of detections in these Priority Watersheds which encompass a range of soil and hydrologic conditions, indicate that atrazine has the potential to be present in groundwater in all areas of the state where it is used.

A 1999 groundwater sampling program in the Lake Mendota watershed in northern Dane and southern Columbia counties also showed a very high level of triazine detections. Of 248 samples collected in this program, 179 (72%) had detects of triazine. None of these wells exceeded the ES for atrazine.

DATCP Exceedence Survey

DATCP conducted a study in 1995 to measure changes in pesticide concentrations in wells that had previously exceeded an enforcement standard (ES). The sampling of wells with an ES exceedance has continued yearly. Most of these wells are in Atrazine Prohibition Areas. One-hundred-twenty-two (122) wells were resampled for this program in 1995. Sampling results for atrazine showed that 84% of the wells decreased in concentration and 16% increased. Forty-three percent of the wells were still above the atrazine enforcement standard and 57% below. Between 1995 and 1998 148 wells have been sampled as part of the survey. In 1998, 28% of the wells contained atrazine over the ES, a 15% decrease since 1995. Nitrate was found over the ES in 66% of the wells in 1998. Other pesticides have also been detected, including; alacalor, alachlor-ESA, acetochlor, cyanazine, cyanazine amide, metolachlor, metribuzin, prometon and simazine.