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Agency

Prevention
Pesticides and
Toxic Substances
(H7507C)

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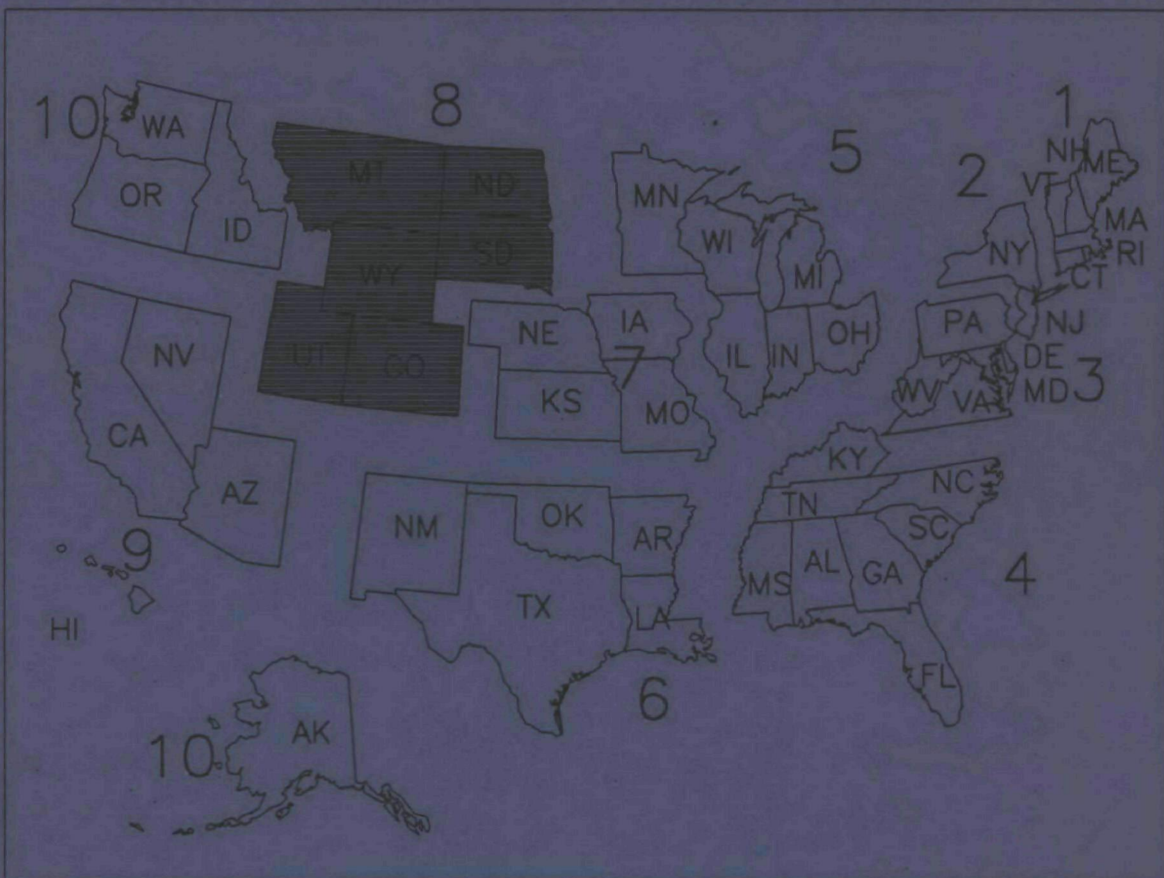
August 1992

EPA Pesticides In Ground Water Database

A Compilation Of Monitoring Studies: 1971-1991

Region 8



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Pesticides in Ground Water Database
A Compilation of Monitoring Studies: 1971 - 1991
Region 8

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August 1992

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I. INTRODUCTION

The U.S. Environmental Protection Agency/Office of Pesticide Programs (EPA/OPP) is responsible for protecting human and environmental health from unreasonable risk due to pesticide exposure. Monitoring efforts carried out during the last decade have shown that the nation's ground water can become contaminated with pesticides, particularly in areas with high pesticide use and vulnerable aquifers. Therefore, OPP has taken a strong preventive approach to the protection of this valuable resource. Regulatory activities have evolved to include, as a condition of registration or re-registration, a more rigorous evaluation of a pesticide's potential to reach ground water. OPP has also formed strong partnerships with other federal and state agencies responsible for various aspects of ground-water protection.

The Pesticides in Ground Water Database (PGWDB) was created to provide a more complete picture of ground-water monitoring for pesticides in the United States. It is a collection of ground-water monitoring studies conducted by federal, state and local governments, the pesticide industry and private institutions. It consists of monitoring data and auxiliary information in both computerized and hard-copy form. This report, *Pesticides in Ground Water Database -- A Compilation of Monitoring Studies: 1971 - 1991*, was prepared to summarize and share the results of the studies in the PGWDB. It consists of 11 volumes: a National Summary and ten EPA regional summaries. Each volume provides a detailed description of the computerized PGWDB and a guide to reading and interpreting the data. The data are presented as maps, graphs and tables.

These data are extremely valuable, but must be interpreted carefully. In general, the PGWDB provides an overview of the ground-water monitoring efforts for pesticides in the United States, the pesticides that are being found in the nation's ground water, and the areas of the country that appear to be vulnerable to pesticide contamination.

When viewed as a whole, it might appear the data gathered for this report are representative of the United States and/or of general drinking water quality. This is not necessarily the case. For example, many studies included sampling of aquifers that supply drinking water, however these samples were usually taken at the well, not at the consumer's tap. Therefore, conclusions concerning finished water can only be drawn by careful examination of the data on a study by study basis. In addition, ground-water monitoring programs vary widely in sampling intensity and design from state to state. Not surprisingly, the states that sampled the greatest number of wells were often those that found the greatest number of contaminated wells. This should not be misconstrued to mean that the ground water in these states is more contaminated than that of other states, or that all ground water in these states is contaminated. On the contrary, an active, supported sampling program generally indicates a high regard for ground-water quality.

The database and this report are the result of the efforts of a great many individuals, significant among whom are the state officials and principal investigators who gave generously of their time to provide OPP with information concerning their work. In publishing this report, OPP intends not only to provide data, but also to identify points of contact, in order to share expertise among those responsible for the protection of the nation's ground-water resources.

To make this information available to as many decision makers in state and other federal agencies as possible, the computerized portion of the PGWDB will become a part of the Pesticide Information Network (PIN).[1] The PIN is a computerized collection of files that contain pesticide monitoring and regulatory information. The PIN functions much like a PC-PC bulletin board and can be accessed by anyone with a computer and a modem. The PIN is currently undergoing an expansion that will allow new types of information to be included and increase the number of simultaneous users. The new PIN will be available in 1993 and will contain the PGWDB, environmental fate chemical/physical parameters for pesticides, pesticide regulatory information (Restricted Use, Special Review, canceled and suspended) and a certification and training bibliography.

II. THE ROLE OF PESTICIDE MONITORING

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requires EPA to monitor the environment for pesticide residues [section 20, parts (b) and (c)]. The primary goal of pesticide monitoring is to improve the soundness of FIFRA risk/benefit regulatory decisions by providing information on the concentrations of pesticide residues and the effects that exposure to these residues have on human health and the environment. In addition, long-term changes in environmental quality can be detected through the analysis of monitoring data. OPP can use this information to measure the effectiveness of regulatory decisions and to indicate potential environmental problems.

EPA has directly sponsored some large-scale pesticide monitoring projects, such as the National Monitoring Programs of the 1970s[2] and the recent National Survey of Pesticides in Drinking Water Wells.[3] This type of monitoring is intended to provide information on a national level involving large numbers of pesticides. It does not provide information concerning localized problems or long-term trends. This method of data gathering is also extremely resource-intensive. An alternative approach for OPP is to support and gather information from monitoring studies performed by others. Since the responsibility for protecting the nation's ground water is shared by federal and state governments, OPP's data-handling responsibilities not only include procuring the most current information for its own needs, but also sharing this information with its partners in state and federal agencies. The development of the Pesticides in Ground Water Database is a step in this direction.

III. BACKGROUND

OPP began collecting ground-water studies for the PGWDB in the early 1980s. In 1988, an effort was made to review and catalog these data. Summary results of this effort were computerized and then published in the *Pesticides in Ground Water Database: 1988 Interim Report*.[4]

Since the 1988 Interim Report was issued, many things have changed. State-sponsored projects, initiated in the late 1980s, have been completed and digitized; monitoring methodologies and computer technology have improved, and the quality and quantity of data have increased. Based on extensive use of the 1988 database by OPP's Ground Water Technology Section and the comments received from other users, both within and outside of OPP, the computerized database and the hard-copy report were restructured. The new computerized structure is more appropriate for the quality and quantity of the information currently available, as well as for that expected in the future. The new structure is both well and sample specific; that is, it contains description and location information for each well sampled and the results of each analysis. This structure allows ground-water monitoring data to be sorted in a variety of ways, such as by well depth, well location, and sampling date. The new report structure provides national, regional, state and county summaries so that readers can select the resolution appropriate for their needs.

Most of the data in the PGWDB have been produced directly by state agencies or by private institutions that are sponsored by federal or state agencies. Some pesticide industry-sponsored studies have also been included in the PGWDB. These studies were conducted to support the registration status of a particular pesticide and were generally conducted in areas that are vulnerable to ground-water contamination by pesticides.

The database is a compilation of data submitted in several different formats, including computerized and hard-copy sampling results as well as hard-copy reports containing study descriptions and summary information. Many states are now routinely storing their data in computerized form and have shared their data with OPP. Some of the hard-copy data are from older studies that were never computerized. Some are from studies that have been computerized, but OPP has not yet been able to obtain the data. OPP is also retaining hard-copy final reports for as many studies as possible. These reports provide vital information such as study design, well design, analytical methods, quality control and environmental conditions.

The focus of the PGWDB is quite narrow. It contains only ground-water monitoring data in which pesticides were included as analytes. Therefore, the PGWDB does not replicate STORET[5] or WATSTORE[6]. While these large databases contain some pesticide monitoring data and some ground-water data, their primary focus is general water quality. As a result, these databases contain a great deal more information about water quality, but lack many of the pesticide focused studies that are included in the PGWDB. Many states have used STORET to store water-quality data, including analyses for pesticides. STORET data were downloaded and added to the PGWDB when the data could be directly associated with specific study summaries or reports sent to OPP by state agencies. These state agencies provided their agency code, station codes, parameter codes, sampling dates and other pertinent information so that the correct data could be extracted from STORET.

Data from the National Survey of Pesticides in Drinking Water Wells (NPS)[3] have not been included in PGWDB, since these data have been recently and extensively presented elsewhere. We are currently working on electronically transferring the results of the NPS pesticide analyses so they will be available when the PGWDB becomes part of the PIN.

IV. THE COMPUTERIZED DATABASE

The computerized database consists of three files related to each other by study identification and unique well number. The first file contains information describing the study, the second contains information describing each well and the third contains sample information. Data elements stored in these files are presented in Figure 1. These data elements are based on EPA's recommended minimum set of data elements for ground-water monitoring published in *Definitions for the Minimum Set of Data Elements for Ground-Water Quality, July 22, 1990.*[8]

FIGURE 1. Data Elements for the Pesticides in Ground Water Database

STUDY FILE	WELL FILE	SAMPLE FILE
Study Number	Study Number(s)	Study Number
Study Title	Unique Well Number[1]	Unique Well Number[1]
Sponsoring Agency(ies)	State and County FIPS Codes[2]	Pesticide[7]
Project Officer(s) (PO)	Latitude and Longitude[3]	Concentration (ug/L)
PO Address(es)	Depth to Water Table (m)	Limit of Detection (ug/L)
PO Telephone(s)	Well Depth (m)	Sample date
USEPA Region	Depth to Top and Bottom of Screen Interval (m)	Analytical Method[8]
Starting and Ending Dates	Well Type[4]	Origin of Contamination[9]
Publication Date	Well Log & Other Information[5]	
Abstract	Altitude[6]	

1. This is a unique identifier assigned to each well in the well file. Many states have assigned a unique identifier to wells sampled. In these cases, the number was retained, and used in the PGWDB as that well's unique well number.

2. The Federal Information Processing Standard (FIPS) alphabetic or numeric codes for states (example MI is the alphabetic code for Michigan, 26 in the numeric code for Michigan). County codes are three digit numeric codes.

3. Coordinate representations that indicate a location on the surface of the earth using the equator (latitude) and the Prime Meridian (longitude) as origin. Coordinates are measured in degrees, minutes, and seconds with an indicator of north or south, and east or west.

4. Wells have been classified as follows:
   Drinking water public community - a system of piped drinking water that either has at least 15 service connections or serves at least 25 permanent residents.
   Drinking water public non-community - wells serving public facilities such as fire stations, schools, or libraries.
   Drinking water private - privately owned wells serving a residence or farm.
   Non-drinking water monitoring - wells installed specifically for monitoring ground water.
   Non-drinking water other - wells used for irrigation, industrial application, etc.

5. This field will allow storage of limited well log or other information about the well, such as construction details.

6. The vertical distance from the National Reference Datum to the land surface or other measuring point in meters.

7. Pesticides are tracked by their Chemical Abstracts System (CAS) number. There is also a cross-reference file that contains all pesticide synonyms and other OPP reference numbers. Any chemical that is currently or has ever been registered as a pesticide by the USEPA, Office of Pesticide Programs is eligible to be included in the PGWDB. Some chemicals might be more commonly associated with industrial processes; however, if these chemicals are now or were previously registered and used as pesticides, monitoring results will be included in the database.

8. A short name, reference or description of the analytical method which was used. This field is not intended to hold the entire method.

9. An origin of contamination is listed for each analysis performed as follows:
   NFU - Known or suspected normal field use
   PS - Known or suspected point source
   UNK - Unknown source of contamination

These files will be available through the PIN in 1993. The data management software for this system is ORACLE running under UNIX. However, OPP will accept and translate data created in nearly any format, operating system or medium. To access the PIN, contact User Support at 703-305-7499.

V. THE 1992 PESTICIDES IN GROUND WATER DATABASE REPORT

The 1992 PGWDB report is a summary and presentation of all the data OPP currently has available, both in computerized and in hard-copy form, concerning pesticides in ground water. The report is organized as a National Summary and ten EPA regional summaries. Each volume provides background information on pesticide monitoring, a description of the computerized portion of the database and a guide to reading and interpreting the data presented in the report.

The National Summary contains summary results of the data collection effort for all states and a discussion of the data. The regional volumes contain data from the individual states in each EPA Region. Each regional volume contains state summaries, which consist of: 1) a short overview of the state's philosophy and pertinent regulations concerning ground-water quality and pesticides, 2) a summary of each study or monitoring effort sent to OPP, and 3) summary data for each state presented in tables, graphs and maps. In essence, the study summaries were written by the principal investigators of each study. Whenever possible, the author's abstracts, summaries and conclusions were reproduced *verbatim*, so that the tone and intent of their work would not be misinterpreted.

There are two appendices in each volume of the report. Appendix I contains a Pesticide Cross Reference Table, which provides pesticide names, synonyms and the regulatory status and lifetime Health Advisory (HA) Level or Maximum Contaminant Level (MCL)[7] for each pesticide. Appendix II provides a brief overview and reference information for the NPS.

Summary and Presentation of Ground-Water Monitoring Data

The data in this report are presented in three different formats: maps, graphs and tables. Their format and content are explained below. Each format is displayed at four different resolution levels: national, regional, state and county. The charts and maps were intended to provide an "at-a-glance" visual summary of the information collected for the area in question. The tables provide detailed information concerning sampling dates, numbers of wells sampled, samples analyzed, concentration ranges, and the relationship between pesticide concentrations and current EPA drinking water standards.

1. Maps

The maps presented in this report display the number of wells sampled and the number of wells with pesticide detections. Map legends are consistent throughout the report to assist in any visual comparison of the maps. A regional-scale map illustrating the frequency of pesticide detections as a function of the total number of wells sampled is presented at the beginning of each EPA regional volume. The regional maps display information for each state in that EPA region. All of the regional maps are included in the National Summary. In addition, a state- scale map, in which the data are presented at the county level, is included with each state summary. State maps are also annotated with a list of pesticides detected in that state.

2. Graphs

Bar graphs, for each state within a region, illustrate the number of wells sampled, the number of wells with pesticide detections, and the number of wells with pesticide detections exceeding the MCL or lifetime HA. The graphs present this information ranked in descending order by the number of wells with pesticide detections. The version of this graph in the National Summary displays this information for each state. A similar graph in each EPA regional volume presents data only for the states in that region. The National Summary contains an additional graph, illustrating the above information by pesticide. Pesticides for which analyses were performed but were not detected in any wells are listed alphabetically at the end.

3. Tables

Two basic data tables are used throughout this report to summarize ground-water monitoring information: the "Pesticides" table and the "Wells" table. Figures 2 and 3 provide a detailed explanation of the information contained in each column for the two standard tables. The numbers that occur in the field descriptors correspond to the definitions listed below the example table.

The "Pesticides" table is illustrated in Figure 2. In this table, information is organized by pesticide. The monitoring locations, sampling frequencies, number of wells monitored, sampling results and concentration ranges are provided. In the National Summary, this table details the monitoring location to the state level and also includes the regulatory status for each pesticide. In the regional volumes, monitoring location is provided to the county level for each state and the table is expanded to include monitoring data for samples taken from each well.

FIGURE 2. Pesticides Table

PESTICIDE SAMPLING IN THE STATE OF ______

PESTICIDE 1	COUNTY 2	DATE 3 YR/MO	WELL RESULTS: TOTAL WELLS SAMPLED 4	WELL RESULTS: # OF POSITIVE WELLS 5 ≥ MCL	WELL RESULTS: # OF POSITIVE WELLS 5 < MCL	SAMPLE RESULTS: TOTAL # SAMPLES 6	SAMPLE RESULTS: NUMBER OF POSITIVE SAMPLES 7 ≥ MCL	SAMPLE RESULTS: NUMBER OF POSITIVE SAMPLES 7 < MCL	RANGE OF CONCENTRATION (ug/l) 8
Pesticide A	County A	1989/ 1,3							
		1990/6							
	County B	1987/ 1-5							
TOTAL DISCRETE WELLS OR SAMPLES			9	10	10	11	12	12	
Pesticide B	County A	1989							
		1990							
	County B	1987							
TOTAL DISCRETE WELLS/SAMPLES									
GRAND TOTAL DISCRETE WELLS/SAMPLES			13	14	14	15	16	16	

1 The tables are arranged in alphabetical order by the parent pesticide common name. Degradates of parent pesticides are listed directly following the parent. Any chemical that is currently or has ever been registered as a pesticide by the USEPA Office of Pesticide Programs is eligible to be included in these tables. Some chemicals included in these tables are more commonly associated with industrial processes; however, these chemicals were at some time also registered as pesticides.

2 County names are listed in alphabetical order for each pesticide that was monitored.

3 Well sampling dates are given by year and month(s). Months separated by a comma (1,3) means that samples were taken in these months only. Months separated by a dash (1-5) is the range of months in which sampling occurred, samples were taken in all months within the range.

4 The total number of wells that were sampled at least once during the time period stated in the previous column.

5 Wells with pesticide detections within the time period given in the date column (3). Wells with positive analytical results were classified based upon whether the results were above or below the MCL. If a pesticide did not have an established MCL, the lifetime HA level was used and noted at the end of the table. If neither of these values were established, the well was classified as less than the MCL. Wells were classified based upon their highest analytical result. Therefore, any well with at least one positive analysis equal to or greater than the MCL or HA during the time period listed in the date column (3) was classified as ≥ MCL. Any well with at least one positive analysis but all analyses less than the MCL or HA was classified as < MCL.

6 The total number of samples analyzed for that pesticide within the time period recorded in the date column.

7 Samples with pesticide detections were counted based upon whether the results were above or below the MCL or lifetime HA as stated in 5 above.

8 The range of positive results in ug/L (ppb) for the time period specified in the date column.

9 The total number of discrete wells that were sampled at least once and analyzed for the pesticide listed in column 1. *See Note

10 The total number of discrete wells in which the pesticide was detected based upon whether the results were above or below the MCL. Wells were classified as explained in 5 above, based upon the highest analytical result.

11 Total number of samples analyzed for a particular pesticide.

12 The total number of samples in which the pesticide was detected that are ≥ MCL or < MCL as explained in 5 above.

13 The grand total of discrete wells sampled in the state for any pesticide. * See Note

14 The grand total of discrete wells with at least one detection of any pesticide. Wells are classified above or below MCL or HA as explained in 5 above. *See Note

15 Grand total of samples taken in the state. *See Note

16 The grand total of samples with any pesticide detection for the state. Samples were classified as ≥ or < the MCL based upon their highest analytical result as explained in 5 above. *See Note

*Note: Some wells were sampled more than once, (i.e., during several successive years) and some wells were sampled for more than one pesticide. Therefore, the total number of discrete wells is not necessarily the arithmetic sum of the wells listed. Similarly some samples were analyzed for more than one pesticide, therefore, the total number of discrete samples for the state will not be, in all cases, the arithmetic sum for the column.

Figure 3 illustrates the "Wells" table. In this table, ground-water monitoring information is organized by well type, or use, and source of contamination. In the National Summary, the information is summarized by state. In the regional volumes, the information is summarized by county for each state in the region.

FIGURE 3. Wells Table

STATE OF ________
WELLS BY COUNTY

COUNTY	TYPES OF WELLS									SOURCE OF CONTAMINATION (NUMBER OF WELLS)		
	DRINKING WATER 1			MONITORING 2			OTHER 3					
	TOTAL SMPLD 4	≥ MCL 5	< MCL 5	TOTAL SMPLD 4	≥ MCL 5	< MCL 5	TOTAL SMPLD 4	≥ MCL 5	< MCL 5	NFU 6	PS 7	UNK 8
County A												
County B												
TOTAL 9												

1 Drinking Water wells include community (municipal), public non-community, and private wells. Public non-community wells are those that exclusively serve public buildings such as fire stations, schools, or libraries.

2 Monitoring wells, installed solely to monitor ground water for contaminants.

3 Other wells include: irrigation wells, stock watering wells, springs, and tile drains.

4 Total number of each type of well sampled in each county.

5 The number of wells per county in which a pesticide was detected. Wells were classified based upon whether the results were above or below an MCL for any of the pesticides detected. If a pesticide did not have an established MCL, the lifetime HA level was used. If neither of these values were applicable, the well was classified as less than the MCL and it was so noted at the end of the table. Wells were classified based upon their highest analytical result. Therefore, any well with at least one positive analysis greater than or equal to the MCL or HA was classified as ≥ MCL. Any well with at least one positive analysis but all analyses less than the MCL or HA was classified as < MCL.

Contaminated wells were placed in one of the following categories based on the opinion of the study director:

6 NFU = Known or Suspected Normal Field Use.

7 PS = Known or Suspected Point Source.

8 UNK = Unknown source of contamination. Wells were categorized as "unknown" if the study director did not know the source of contamination, or if there was no information available concerning the source of contamination.

9 Total number of wells in each category.

VI. DATA INTERPRETATION

Ground-water monitoring data in this report have been assembled from numerous sources, including state and federal agencies, chemical companies, consulting firms, and private institutions that are investigating the potential for ground-water contamination by pesticides. These data are extremely valuable, but must be interpreted carefully. In general, the PGWDB provides a relatively comprehensive overview of the ground-water monitoring efforts for pesticides in the United States, the pesticides that are being found in the nation's ground water, and the areas of the country that appear to be the most vulnerable to pesticide contamination.

Nationally, part of OPP's regulatory mission is to prevent contamination of ground-water resources resulting from the normal use of registered pesticides. OPP routinely reassesses the impact that registered pesticides have on the quality of ground-water resources. The PGWDB will be used to support ongoing regulatory activities, such as ground-water label advisories, monitoring studies required for pesticide re-registration and special review activities. In addition, combining the information in the PGWDB with other environmental fate data and usage data will assist OPP, at an early stage in the regulatory process, in refining criteria used to identify pesticides that tend to leach to ground water.

On a state or local level, the PGWDB can be used as a reference so that a state may access data from neighboring states. Evidence that pesticide residues occur in ground water can be used to target a state's resources for future monitoring and to re-assess pesticide management practices to prevent future degradation of ground-water quality. The information presented in this report will also be useful to state and regional agencies when implementing two pollution-prevention measures being developed by EPA; the *Restricted Use Rule* and the *State Management Plans* outlined in the *Pesticides and Ground Water Strategy*. Additional uses for the data in the PGWDB include identification of areas in need of further study, identification of the intensity of monitoring for particular pesticides, and graphic display of ground-water monitoring activities and localization of pesticide contamination.

VII. DATA LIMITATIONS

Despite their apparent value, these data do have limitations and must be used and interpreted carefully. Differences in study design, laboratory procedures/equipment, sampling practices, or well use can affect results. Some of the limitations governing the interpretation of the data in the PGWDB are discussed below:

1) The PGWDB is not a complete data set of all ground-water monitoring for pesticides in the United States. While we have attempted to include as many sources as possible, other data exist of which we are not aware or to which we do not yet have access.

2) **Monitoring for pesticides in ground water has not been performed in a uniform manner throughout the United States. Some states have extensive monitoring programs for pesticide residues, while others have more limited monitoring programs. In general, more extensive ground-water monitoring programs tend to be found in the states where pesticide use is heavy. This creates a picture that does not necessarily represent the overall impact of pesticides on ground-water quality nationwide.**

3) **Differences in ground-water monitoring study design can radically affect the results. Many monitoring efforts were initiated in response to suspected problems, and therefore yielded a disproportionately high number of positive samples. These results cannot be extrapolated to represent a larger region or state. Other efforts sampled a small number of wells or sampled under conditions in which contamination was unlikely. Still others were statistically designed studies, intended to be extrapolated to a specific population of wells. Each of these scenarios presents a vastly different view of the condition of the ground-water resource sampled.**

4) Analytical methods and limits of detection have changed over time, and also vary from laboratory to laboratory. Therefore, comparisons between the results of different studies and across several years must be performed carefully to avoid errors in interpretation.

5) Differences in construction, depth, location and intended use can greatly affect the likelihood that a particular well will become contaminated by pesticides. Some of these issues were addressed in the individual study summaries when such details were available. However, this information was not always provided and tends to be obscured when large amounts of data are summarized. The reader is cautioned to read the study summaries carefully and interpret the resulting data summaries conservatively.

VIII. THE FUTURE

The vulnerability of ground water to contamination by pesticides depends upon a variety of factors including depth, topography, soil, climate, pesticide use and pesticide application practices. In some cases, ground water is shallow or closely connected with surface water and the results of surface activities can be observed within months. More often, contamination is not observed for many years, allowing cause-and-effect relationships to become obscured. This report, for the most part, is a retrospective examination of the agricultural practices of the 1960s and 1970s, the results of which were observed through monitoring performed 20 years later. The condition of our ground-water resources for the next 20 years will be greatly affected by how we are handling our chemicals now. Our challenge today is clearly prospective.

EPA's Office of Pesticide Programs (OPP) is planning to publish a summary report of the data in the PGWDB on approximately a yearly basis. We are interested in presenting the data in a manner that is the most helpful to as many users as possible. The following are areas in which we would like to receive comments:

1. **Should future reports summarize only "new data" (those received since the last report) or all of the data? Should we continue to report very old monitoring data (10 to 20 years), given the fact that some of these studies had very high detection limits and monitored for pesticides that are no longer of regulatory interest?**

2. **What changes should be made to the maps, graphs and tables? Are they too detailed or not detailed enough? Are important pieces of information missing? Is there a clearer or more useful way to present these data?**

3. **How are those outside of OPP using the PGWDB?**

We appreciate all of those who took the time to comment on the draft version of this report. Many of the suggestions offered were included in this final version. However, some very good suggestions regarding changes to the tables could not be included in this report due to time constraints. These suggestions were taken seriously and will be considered for future reports.

For the PGWDB to retain its value, OPP must continue to gather and share as much pesticide monitoring information as possible. Any government agency or private institution that would like to have its work included in the PGWDB should provide a hard copy of a final or interim report and the sample and well data in electronic format. PGWDB data elements are listed on page OV-4 of this report. Electronic media should be accompanied by a description that includes, hardware compatibility (IBM, Apple etc.), operating system (DOS, UNIX, OS2), format identification (ASCII or software package name) and a data dictionary. Anyone wishing to provide comments or data may do so by contacting:

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Telephone: 703-305-5455
FAX: 703-305-6309

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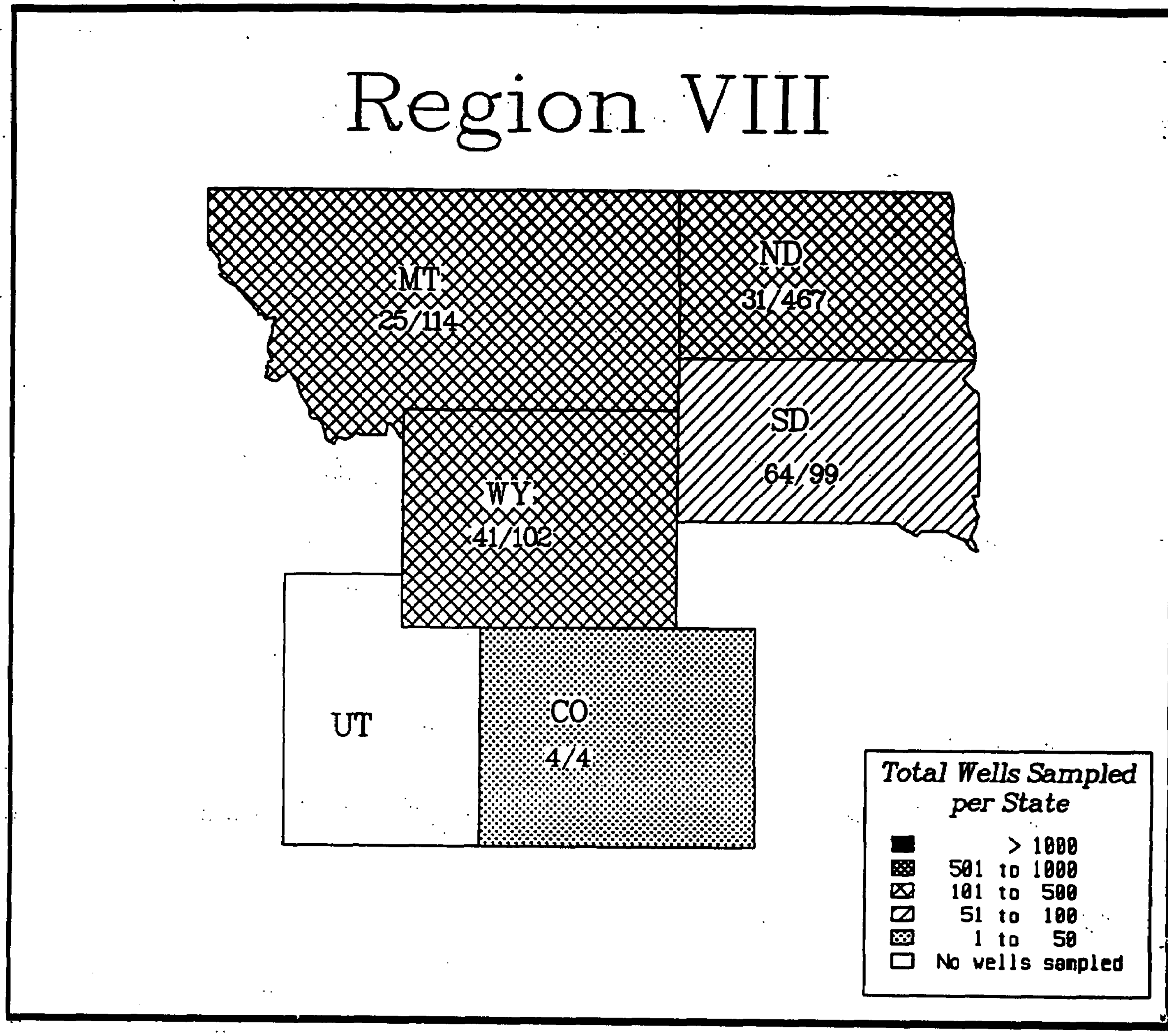
8. *U.S. Environmental Protection Agency, Office of Ground Water and Drinking Water* **Definitions for the Minimum Set of Data Elements for Ground-Water Quality.** Washington, D.C., 1991.

Well Sampling by State

(Total Number of Wells with Pesticide Detections / Total Number of Wells Sampled)



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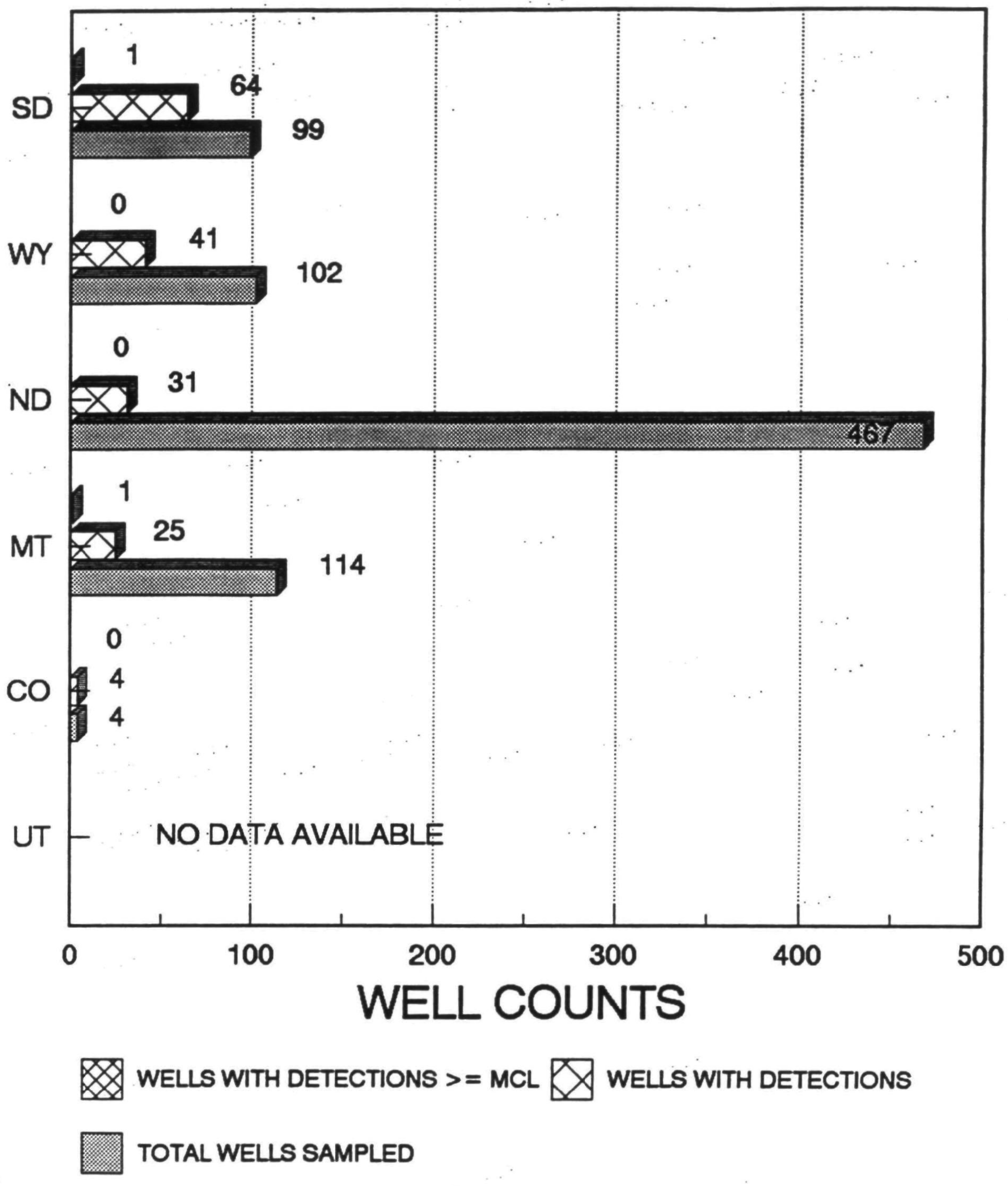
WELL STATUS BY STATE

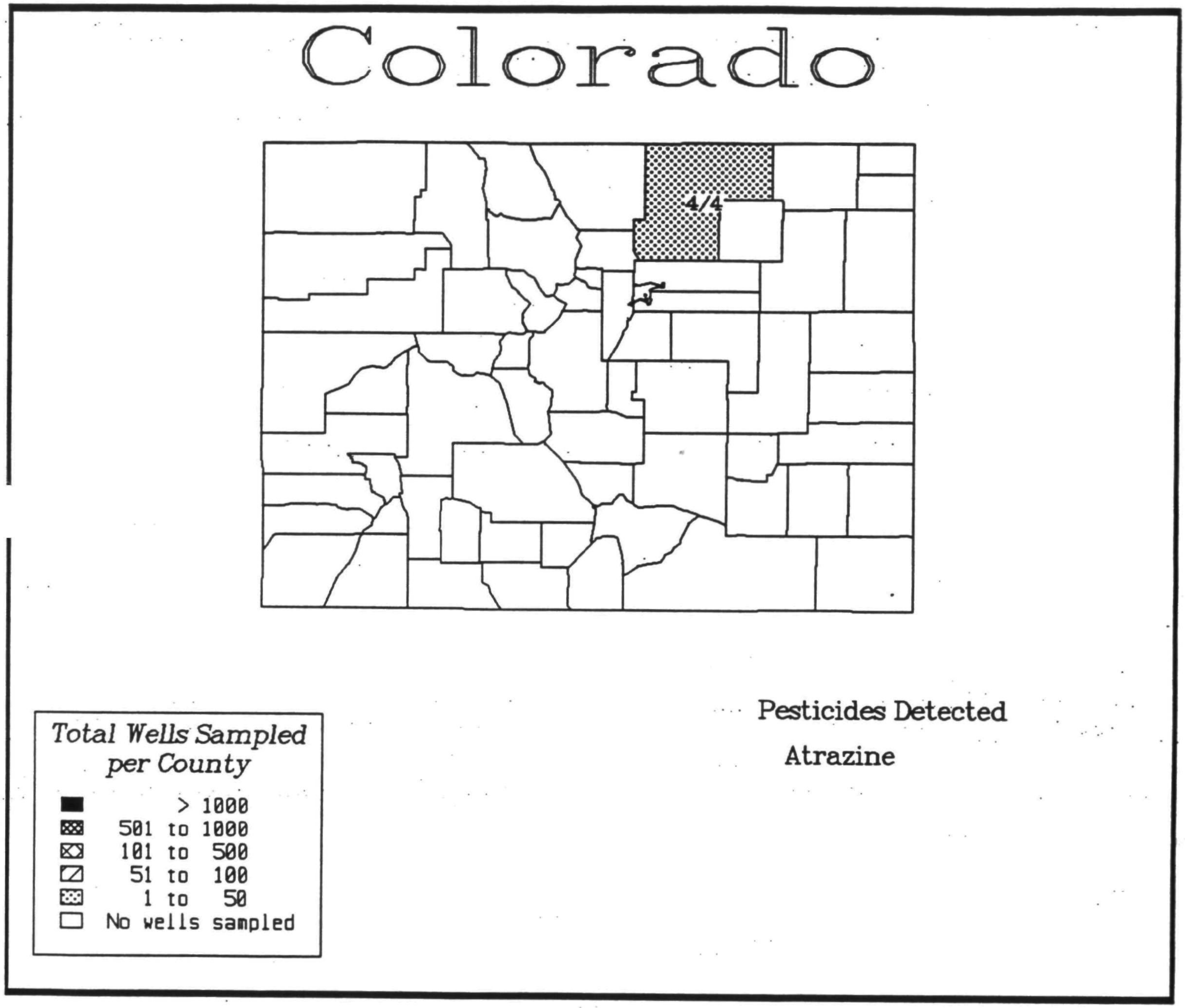
DESCENDING BY NUMBER OF WELLS WITH DETECTIONS



STATE SUMMARIES

Well Sampling by County

(Total Number of Wells with Pesticide Detections / Total Number of Wells Sampled)



OVERVIEW OF STATE LEGISLATIVE AND ENVIRONMENTAL POLICIES REGARDING PESTICIDES IN GROUND WATER

In 1987 Colorado established ground-water regulations to be enforced by the Water Quality Control Commission under the Colorado Department of Health. The purpose of the regulations was to establish statewide standards and a system for classifying ground water, and to adopt water quality standards for ground-water classifications to protect potential beneficial uses of ground water. Most people in Colorado are not dependent on ground water for domestic use; surface water is the main source for the more populated areas of the state.

As a result of the 1987 legislation, and subsequent amendments, several studies on pesticides in ground water were initiated by the Ground Water Unit of the Colorado Department of Health. A 32-well pilot program was conducted in the northeast corner of the state starting in 1989. This program was later expanded to include well sites in the south central part of the state. Data from these studies are going to be incorporated in a database on ground-water quality of the major aquifers. At the time that The Pesticides in Ground Water Database Report was being prepared, these data were not yet available. We look forward to including them in subsequent years.

REPORTED STUDIES OF PESTICIDES IN GROUND WATER

Savage, E.P., M.P. Wilson, J.J. Aaronson, T.J. Keefe, and J.T. Tessari, and D.H. Hamar, Colorado State University, Institute of Rural Environmental Health and Department of Pathology, Tel.: 303-491-6281. **Groundwater Transport of the Herbicide Atrazine, Weld County, Colorado.** Study conducted July to November 1985. (Reported 1987, 12 pp.)

Primary Objective

The purpose of this study was to monitor ground water at gradient points above, directly beneath, and below an atrazine-treated site in the South Platte River Valley of Weld County.

Design

The study site was selected because it is representative of the general conditions under which atrazine enters the agricultural environment of the South Platte River Valley. Characteristics of hydrogeology, agriculture and soils were considered in selecting the site. The site measures 1 by 3 miles with the long axis parallel to the underlying ground-water flow. The ground-water gradient slopes downward from south to north. Ground water beneath the study site is hydrologically isolated from underflow from the direction of the south end of the site. Within the study site are 240 acres that are annually planted to field corn. Pre-emergent broadleaf weed control on this acreage has been managed for more than 20 years by the use of atrazine. The soils to which atrazine was applied are primarily sandy loams: level, deep, well-drained, and moderately to rapidly permeable.

Four water wells were identified that allowed the collection of ground water at gradient points above (Well 1), beneath (Well 2), and below (Wells 3 and 4) the atrazine-treated fields. Water samples were collected from each of the four wells on nine occasions at two-week intervals beginning 31 July 1985 and ending 20 November 1985. Samples of ditch water used for center pivot irrigation were also collected to determine the atrazine contribution made by this source to the atrazine-treated fields. Ditch water samples were also collected at two-week intervals but only between 31 July and 23 October 1985; ditch water flow was inadequate for sampling after the latter date. Samples were analyzed by GC/NP. Identification of atrazine was confirmed by GC/MS. The detection limit of the GC analysis of atrazine was 0.80 ug/L.

Results and Conclusions

Based on analysis of samples from Well 1, there did not appear to be measurable atrazine contamination in study site ground water prior to its movement beneath the atrazine-treated fields. Trace positive levels of atrazine (below the detection limit of 0.80 ug/L) were detected in samples up to 9 October; atrazine was not detected after that date. Atrazine was also detected at trace levels in Well 3, located immediately below the study site. In this case, low atrazine levels were attributed to the peripheral location of Well 3; water pumped from Well 3 probably included water from east of the atrazine-treated fields. Thus, dilution of the ground water from beneath the treated fields would have occurred.

Both Well 2 (located beneath the study site) and Well 4 (located about one-half mile below the site) yielded ground-water samples with measurable atrazine concentrations for all sampling dates. Atrazine levels ranged from 1.1 to 1.8 ug/L in Well 2 and from 2.3 to 1.3 ug/L in Well 4. Levels of atrazine decreased over time in samples collected from Well 4. All detections were below the maximum contamination level (MCL) for atrazine of 3 ug/L. The linear correlation between atrazine concentration and time was statistically significant for the data from Well 4 ($0.001 < p < 0.002$); atrazine concentrations were estimated to decrease at a rate of .0094 ug/L per day. Atrazine levels in Well 4 samples were determined to be representative of points along the concentration gradient of a contaminant plume moving past the well. This gradient is the result of atrazine transport processes. Within the time limits of this study, the cessation of irrigation of the atrazine-treated fields did not produce a corresponding decrease in the level of atrazine in ground water.

Based on data for irrigation rates and the atrazine application rate, irrigation water would account for only 0.52 percent, at a maximum, of the total atrazine load to the treated fields. Thus, the levels of atrazine detected in ditch water would have a very small relative impact on ground water below the treated fields. Atrazine was detected in one ditch water sample at 1 ug/L, and in 5 samples at trace levels.

PESTICIDE SAMPLING IN THE STATE OF COLORADO

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCENTRATIONS (µg/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
Atrazine	WELD	1985/7	4	0	4	4	0	4	<0.80-2.3
		1985/8	4	0	4	8	0	8	<0.80-2.2
		1985/9	4	0	4	8	0	8	<0.80-1.7
		1985/10	4	0	4	8	0	7	<0.80-1.8
		1985/11	4	0	3	8	0	6	<0.80-1.4
TOTAL DISCRETE WELLS/SAMPLES			4	0	4	36	0	33	<0.80-2.3
GRAND TOTAL DISCRETE WELLS/SAMPLES			4	0	4	36	0	33	

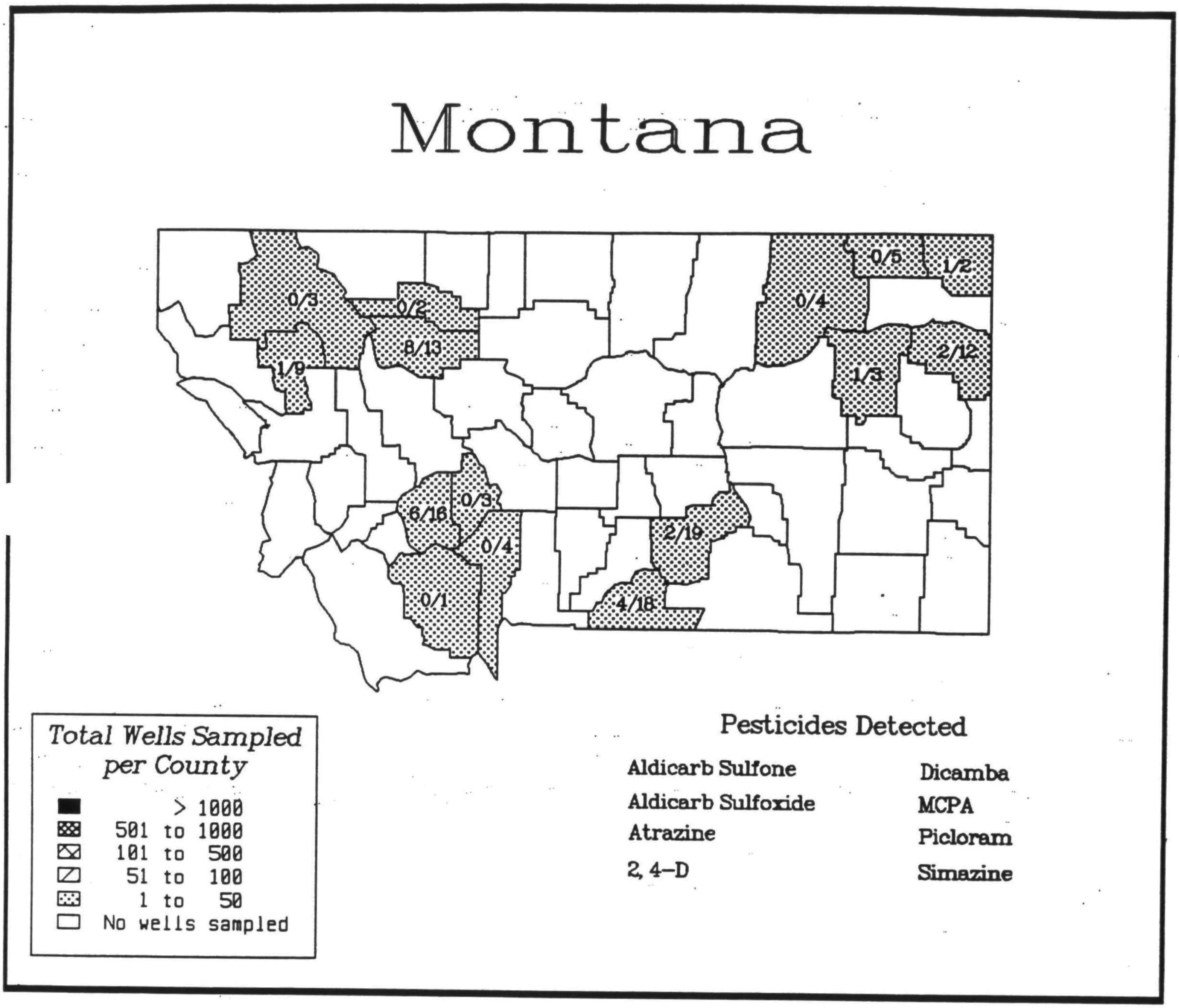
STATE OF COLORADO
WELLS BY COUNTY

COUNTY	TYPES OF WELLS									SOURCE OF CONTAMINATION (NUMBER OF WELLS)		
	DRINKING WATER			MONITORING			OTHER					
	TOTAL SMPLD	≥ MCL	< MCL	TOTAL SMPLD	≥ MCL	< MCL	TOTAL SMPLD	≥ MCL	< MCL	NFU*	PS*	UNK*
Weld	0	0	0	0	0	0	4	0	4	4	0	0
TOTAL	0	0	0	0	0	0	4	0	4	4	0	0

* NFU=Known or Suspected Normal Field Use
PS =Known or Suspected Point Source
UNK=Unknown

Well Sampling by County

(Total Number of Wells with Pesticide Detections / Total Number of Wells Sampled)



MONTANA

OVERVIEW OF STATE LEGISLATIVE AND ENVIRONMENTAL POLICIES REGARDING PESTICIDES IN GROUND WATER

Ground water is an important source of domestic and agricultural water in Montana. Montana has been monitoring its ground water for contaminants since 1984. At that time the Montana Department of Agriculture received a grant from the USEPA to study the occurrence of agricultural pesticides in ground water. This monitoring program was designed to gather baseline information on the occurrence and extent of such contamination throughout the state. The MDA chose to concentrate its efforts on areas that had a history of pesticide use.

REPORTED STUDIES OF PESTICIDES IN GROUND WATER

DeLuca, T., J. Larson, L. Torma, and G. Algard, **A Survey of Groundwater Contamination by Pesticides in Montana**. Montana Department of Agricuture, Environmental Management Division, Technical Report 89-1, August 1989. Additional contact Phil Johnson, Montana Department of Agriculture, Telephone (406) 444-2944.

Primary Objective
The objective of this study was to analyze water samples from domestic, livestock, and irrigation wells in several distinct agricultural production regions in Montana and determine whether Montana has a ground-water contamination problem worthy of further study or immediate action. Over a 5 year period, the monitoring program was expanded and adjusted to broaden the scope and database of this investigative monitoring study.

Design
The study was designed to gather baseline information concerning ground-water contamination by pesticides and to determine the need for further study. Areas and pesticides were selected based on the greatest potential for ground-water contamination, taking into consideration crops grown, production practices used, and pesticides applied. Site selection was divided into five major groups.

1. Seed potato production in Flathead, Lake and Gallatin Counties
2. Sugarbeet production along the Yellowstone River
3. Hay production in Southwestern Montana
4. Irrigated small grain production in the Triangle area
5. Chlorsulfuron use region in Northeastern Montana

The number of times a site was sampled during any one year or over the five year span was dependent on previous findings or changes in pesticide use patterns.

Pesticide analytes and detection limits in ug/L:

Organochlorine Insecticides		Carbamate Insecticides		Phenoxy Herbicides		Triazine Herbicides	
Aldrin	0.004	Aldicarb	1.0	2,4-D	0.3	Atrazine	0.1
Chlordane	0.03	Aldicarb	2.0	2,4-DB	0.5	Simazine	0.1
t-Nonachlor	0.008	sulfoxide	2.0	Dichloroprop	*		
Oxychlordane	0.008	Aldicarb sulfone	2.0	MCPA	0.2	Other	
DDT	0.02	Carbaryl	1.5	Mecoprop	*	Herbicides	
DDD	0.01	Carbofuran	2.0	Silvex	0.1		
DDE	0.007	3-Hydroxy-		2,4,5-T	0.1	Chlorsulfuron	*
Dieldrin	0.007	carbofuran	0.5			Cycloate	0.1
Endrin	0.01	Methomyl				Dicamba	0.2
Heptachlor	0.003					Picloram	1.0
Heptachlor	0.008	Organophosphate					
epoxide		Insecticides					
Hexachloro-	0.003		0.01				
benzene		Chlorpyrifos	0.01				
Lindane	0.004	Diazinon	0.02				
Methoxychlor	0.05	Ethyl Parathion	0.01				
Mirex	0.02	Methyl Parathion	0.01				
Toxaphene	0.5	Malathion	1.0				
		Terbufos					

*Not provided

Results and Conclusions

During the 5 year sampling period of this ground-water survey, 23 wells in different regions of Montana were observed to be contaminated by 7 different pesticides. Over 230 samples were analyzed, and approximately 25% were positive for the presence of pesticide residues. None of the residues detected in the program suggest any immediate drinking water health risk. Though no pesticides were detected in Beaverhead, Daniels, Flathead, Gallatin, Hill, Lake, and Valley Counties, the geographic area and the types of pesticide covered by this survey are far to limited for this result to be conclusive. Pesticide contamination in well water of Carbon, Jefferson, Richland, Sheridan, Teton, and Yellowstone Counties is conclusive in that it documents pesticide contamination of ground water in Montana and suggests the need to continue studying the extent of contamination.

This ground-water monitoring study allowed Montana to identify the presence of ground-water contamination by pesticides in several regions of the state. Both point source and non-point source ground-water contamination by pesticides were observed during the 5 year period. Though the study identified no immediate drinking water health threat (only one pesticide residue was in excess of the lifetime drinking water health advisory standards), the information does not preclude it's occurrence. Within the limited scope of this monitoring program, the occurrence of pesticide residues in ground water is primarily the result of a combination of soil type, precipitation (or irrigation), leaching potential of the pesticide, and depth to water table. Future monitoring programs will take a closer look at these factors when identifying sampling sites.

PESTICIDE SAMPLING IN THE STATE OF MONTANA
2,4-D to DOE

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (ug/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/ MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
2,4-D	BEAVERHEAD	1984/7,9, 10	6	0	0	11	0	0	
		1989/10	2	0	0	2	0	0	
	BLAINE	1990/11	3	0	0	3	0	0	
	BROADWATER	1990/5	3	0	0	3	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	GALLATIN	1990/5	1	0	0	1	0	0	
	LAKE	1989/11	4	0	0	4	0	0	
		1990/5	3	0	0	3	0	0	
	MADISON	1984/7,9	1	0	0	2	0	0	
	MCCONE	1990/11	3	0	1	3	0	1	0.79
	PONDERA	1990/11	2	0	0	2	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7	2	0	0	2	0	0	
	TETON	1984/6	8	0	2	9	0	2	0.11-0.39
		1984/8	8	0	3	9	0	3	0.12-0.27
		1985/2,6	12	0	0	19	0	0	
		1986/11	6	0	0	6	0	0	
		1987/4,12	7	0	0	7	0	0	
		1988/4	5	0	0	5	0	0	
		1989/10	5	0	0	6	0	0	
		1990/5	4	0	0	4	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
2,4-D to DDE

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCENTRATIONS (ug/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/ MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(2,4-D)	VALLEY	1988/7	4	0	0	4	0	0	
	YELLOWSTONE	1986/3	5	0	1	6	0	1	1.7
		1986/5,9	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
TOTAL DISCRETE WELLS/SAMPLES			84	0	5	164	0	7	0.11-1.7
2,4-DB	BEAVERHEAD	1984/7,9,10	6	0	0	11	0	0	
		1989/10	2	0	0	2	0	0	
	BLAINE	1990/11	3	0	0	3	0	0	
	BROADWATER	1990/5	3	0	0	3	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	GALLATIN	1990/5	1	0	0	1	0	0	
	LAKE	1989/11	4	0	0	4	0	0	
		1990/5	3	0	0	3	0	0	
	MADISON	1984/7,9	1	0	0	2	0	0	
	MCCONE	1990/11	3	0	0	3	0	0	
	PONDERA	1990/11	2	0	0	2	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7	2	0	0	2	0	0	
	TETON	1984/6,8	8	0	0	16	0	0	
		1985/2,6	12	0	0	19	0	0	
		1986/11	6	0	0	6	0	0	
		1987/4,12	7	0	0	7	0	0	
		1988/4	5	0	0	5	0	0	
		1989/10	5	0	0	6	0	0	
		1990/5	4	0	0	4	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
2,4-D to DDE

PESTICIDE	COUNTY	DATE	WELL RESULTS: TOTAL WELLS SAMPLED	WELL RESULTS: # OF POSITIVE WELLS		SAMPLE RESULTS: TOTAL # SAMPLES	SAMPLE RESULTS: # OF POSITIVE SAMPLES		RANGE OF CONCENTRATIONS (ug/L)
		YEAR/MONTH		> MCL	< MCL		> MCL	< MCL	
(2,4-DB)	VALLEY	1988/7	4	0	0	4	0	0	
	YELLOWSTONE	1986/3,5,9	10	0	0	11	0	0	
		1988/4	3	0	0	3	0	0	
TOTAL DISCRETE WELLS/SAMPLES			84	0	0	164	0	0	
2,4,5-T	BEAVERHEAD	1984/7,9,10	6	0	0	11	0	0	
		1989/10	2	0	0	2	0	0	
	BLAINE	1990/11	3	0	0	3	0	0	
	BROADWATER	1990/5	3	0	0	3	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	GALLATIN	1990/5	1	0	0	1	0	0	
	LAKE	1989/11	4	0	0	4	0	0	
		1990/5	3	0	0	3	0	0	
	MADISON	1984/7,9	1	0	0	2	0	0	
	MCCONE	1990/11	3	0	0	3	0	0	
	PONDERA	1990/11	2	0	0	2	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7	2	0	0	2	0	0	
	TETON	1984/6,8	8	0	0	16	0	0	
		1985/2,6	12	0	0	19	0	0	
		1986/11	6	0	0	6	0	0	
		1987/4,12	7	0	0	7	0	0	
		1988/4	5	0	0	5	0	0	
		1989/10	5	0	0	6	0	0	
		1990/5	4	0	0	4	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
2,4-D to DDE

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF DETECTED CONCENTRATIONS
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		< MCL	> MCL		< MCL	> MCL	
(2,4,5-T)	VALLEY	1988/7	4	0	0	4	0	0	
	YELLOWSTONE	1986/3,5,9	10	0	0	11	0	0	
	[illegible]	1988/4	3	0	0	3	0	0	
TOTAL DISCRETE WELLS/SAMPLES			84	0	0	164	0	0	
2,4,5-TP (Silvex)	BEAVERHEAD	1984/7,9,10	6	0	0	11	0	0	
		1989/10	2	0	0	2	0	0	
	BLAINE	1990/11	3	0	0	3	0	0	
	BROADWATER	1990/5	3	0	0	3	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	GALLATIN	1990/5	1	0	0	1	0	0	
	LAKE	1989/11	4	0	0	4	0	0	
		1990/5	3	0	0	3	0	0	
	MADISON	1984/7,9	1	0	0	2	0	0	
	MCCONE	1990/11	3	0	0	3	0	0	
	PONDERA	1990/11	2	0	0	2	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7	2	0	0	2	0	0	
	TETON	1984/6,8	8	0	0	16	0	0	
		1985/2,6	12	0	0	19	0	0	
		1986/11	6	0	0	6	0	0	
		1987/4,12	7	0	0	7	0	0	
		1988/4	5	0	0	5	0	0	
		1989/10	5	0	0	6	0	0	
		1990/5	4	0	0	4	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
2,4-D to DDE

PESTICIDE	COUNTY	DATE YEAR/MONTH	WELL RESULTS TOTAL WELLS SAMPLED	# OF POSITIVE WELLS ≥ MCL	# OF POSITIVE WELLS < MCL	SAMPLE RESULTS TOTAL # SAMPLES	# OF POSITIVE SAMPLES ≥ MCL	# OF POSITIVE SAMPLES < MCL	RANGE OF CONCENTRATIONS (ug/l)
2,4,5-TP (Silvex)	VALLEY	1988/7	4	0	0	4	0	0	
	YELLOWSTONE	1986/3,5,9	10	0	0	11	0	0	
		1988/4	3	0	0	3	0	0	
TOTAL DISCRETE WELLS/SAMPLES			84	0	0	164	0	0	
Aldicarb	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,9,10	12	0	0	14	0	0	
		1987/8	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	FLATHEAD	1984/6,9	3	0	0	3	0	0	
	GALLATIN	1986/10	3	0	0	3	0	0	
		1990/5	1	0	0	1	0	0	
	LAKE	1984/6,9	4	0	0	6	0	0	
		1989/11	4	0	0	4	0	0	
		1990/5	2	0	0	2	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7,9	2	0	0	3	0	0	
	TETON	1987/4	6	0	0	6	0	0	
	VALLEY	1988/7	4	0	0	4	0	0	
	YELLOWSTONE	1986/9,10	16	0	0	19	0	0	
		1988/4	2	0	0	2	0	0	
TOTAL DISCRETE WELLS/SAMPLES			80	0	0	110	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
2,4-D to DDE

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (ug/L)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/ MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
Aldicarb sulfone	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2	1	0	0	1	0	0	
		1986/9	3	0	1	4	0	1	1.1
		1986/10	9	0	4	13	0	4	0.46-1.4
		1987/8	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	FLATHEAD	1984/6	3	0	0	3	0	0	
		1984/9	3	0	0	3	0	0	
	GALLATIN	1986/10	3	0	0	3	0	0	
		1990/5	1	0	0	1	0	0	
	LAKE	1984/6,9	4	0	0	6	0	0	
		1989/11	4	1	0	4	1	0	3.8
		1990/5	2	0	0	2	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7,9	2	0	0	3	0	0	
	TETON	1987/4	6	0	0	6	0	0	
	VALLEY	1988/7	4	0	0	4	0	0	
	YELLOWSTONE	1986/9	8	0	1	9	0	1	0.15
		1986/10	9	0	1	10	0	1	0.22
		1988/4	2	0	0	2	0	0	
TOTAL DISCRETE WELLS/SAMPLES			80	1	5	110	1	7	0.15-3.8

PESTICIDE SAMPLING IN THE STATE OF MONTANA
2,4-D to DDE

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCENTRATIONS (µg/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/ MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
Aldicarb sulfoxide	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2	1	0	0	1	0	0	
		1986/9	3	0	1	4	0	1	0.88
		1986/10	9	0	4	13	0	4	0.53-1.5
		1987/8	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	FLATHEAD	1984/6	3	0	0	3	0	0	
		1984/9	3	0	0	3	0	0	
	GALLATIN	1986/10	3	0	0	3	0	0	
		1990/5	1	0	0	1	0	0	
	LAKE	1984/6,9	4	0	0	6	0	0	
		1989/11	4	0	0	4	0	0	
		1990/5	2	0	0	2	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7,9	2	0	0	3	0	0	
	TETON	1987/4	6	0	0	6	0	0	
	VALLEY	1988/7	4	0	0	4	0	0	
	YELLOWSTONE	1986/9	8	0	1	9	0	1	0.28
		1986/10	9	0	1	10	0	1	0.35
		1988/4	2	0	0	2	0	0	
TOTAL DISCRETE WELLS/SAMPLES			80	0	5	110	0	7	0.28-1.5

PESTICIDE SAMPLING IN THE STATE OF MONTANA
2,4-D to DDE

PESTICIDE	COUNTY	DATE YEAR/MONTH	WELL RESULTS: TOTAL WELLS SAMPLED	WELL RESULTS: # OF POSITIVE WELLS ≥ MCL	WELL RESULTS: # OF POSITIVE WELLS < MCL	SAMPLE RESULTS: TOTAL # SAMPLES	SAMPLE RESULTS: # OF POSITIVE SAMPLES ≥ MCL	SAMPLE RESULTS: # OF POSITIVE SAMPLES < MCL	RANGE OF CONCENTRATIONS (ug/L)
Aldrin	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	
Atrazine	CARBON	1987/8	4	0	0	4	0	0	
		1989/11	5	0	0	5	0	0	
	HILL	1988/4	1	0	0	1	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	1	4	0	1	0.1
TOTAL DISCRETE WELLS/SAMPLES			22	0	1	26	0	1	0.1
Carbaryl	CARBON	1986/2,9,10	12	0	0	14	0	0	
		1987/8	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	GALLATIN	1986/10	3	0	0	3	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7,9	2	0	0	3	0	0	
	TETON	1987/4	6	0	0	6	0	0	
	VALLEY	1988/7	4	0	0	4	0	0	
	YELLOWSTONE	1986/9,10	16	0	0	19	0	0	
		1988/4	2	0	0	2	0	0	
TOTAL DISCRETE WELLS/SAMPLES			64	0	0	84	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
2,4-D to DDE

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (ug/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
Carbofuran	CARBON	1986/2,9,10	12	0	0	14	0	0	
		1987/8	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	GALLATIN	1986/10	3	0	0	3	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7,9	2	0	0	3	0	0	
	TETON	1987/4	6	0	0	6	0	0	
	VALLEY	1988/7	4	0	0	4	0	0	
	YELLOWSTONE	1986/9,10	16	0	0	19	0	0	
		1988/4	2	0	0	2	0	0	
TOTAL DISCRETE WELLS/SAMPLES			64	0	0	84	0	0	
3-Hydroxy-Carbofuran	CARBON	1986/2,9,10	12	0	0	14	0	0	
		1987/8	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	GALLATIN	1986/10	3	0	0	3	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7,9	2	0	0	3	0	0	
	TETON	1987/4	6	0	0	6	0	0	
	VALLEY	1988/7	4	0	0	4	0	0	
	YELLOWSTONE	1986/9,10	16	0	0	19	0	0	
		1988/4	2	0	0	2	0	0	
TOTAL DISCRETE WELLS/SAMPLES			64	0	0	84	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
2,4-D to DDE

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCENTRATIONS
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/ MONTH		≤ MCL	> MCL		≤ MCL	> MCL	
Chlorsulfuron	CHOTEAU	1988/7	3	0	0	3	0	0	
	VALLEY	1988/7	3	0	0	3	0	0	
TOTAL DISCRETE WELLS/SAMPLES			6	0	0	6	0	0	
Chlordane	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	
Nonachlor (chlordane impurity)	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	
Oxychlordane (chlordane degradate)	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	
Cycloate	HILL	1988/4	1	0	0	1	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
TOTAL DISCRETE WELLS/SAMPLES			13	0	0	17	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
2,4-D to DDE

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCENTRATIONS (ug/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/ MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
DDT	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	
DDD	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	
DDE	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
Dicamba to Toxaphene

PESTICIDE	COUNTY	DATE	WELL RESULTS: TOTAL WELLS SAMPLED	WELL RESULTS: # OF POSITIVE WELLS ≥ MCL	WELL RESULTS: # OF POSITIVE WELLS < MCL	SAMPLE RESULTS: TOTAL # SAMPLES	SAMPLE RESULTS: # OF POSITIVE SAMPLES ≥ MCL	SAMPLE RESULTS: # OF POSITIVE SAMPLES < MCL	RANGE OF CONCENTRATIONS (ug/l)
		YEAR/MONTH							
Dicamba	BEAVERHEAD	1984/7,9,10	6	0	0	11	0	0	
		1989/10	2	0	0	2	0	0	
	BLAINE	1990/11	3	0	0	3	0	0	
	BROADWATER	1990/5	3	0	0	3	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	GALLATIN	1990/5	1	0	0	1	0	0	
	LAKE	1989/11	4	0	0	4	0	0	
		1990/5	3	0	0	3	0	0	
	MADISON	1984/7,9	1	0	0	2	0	0	
	MCCONE	1990/11	3	0	0	3	0	0	
	PONDERA	1990/11	2	0	0	2	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7	2	0	1	2	0	1	0.26
	TETON	1984/6	8	0	2	9	0	2	0.56-0.74
		1984/8	8	0	0	9	0	0	
		1985/2	7	0	0	7	0	0	
		1985/6	12	0	4	18	0	6	0.51-3.0
		1986/11	6	0	0	6	0	0	
		1987/4,12	7	0	0	12	0	0	
		1988/4	5	0	0	5	0	0	
		1989/10	5	0	1	6	0	1	1.8
		1990/5	4	0	0	4	0	0	
	VALLEY	1988/7	4	0	0	4	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
Dicamba to Toxaphene

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (ug/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(Dicamba)	YELLOWSTONE	1986/3	5	0	0	6	0	0	
		1986/5	4	0	0	4	0	0	
		1986/9	1	0	0	1	0	0	
		1988/4	3	0	0	3	0	0	
TOTAL DISCRETE WELLS/SAMPLES			84	0	6	164	0	6	0.26-3.0
Dichlorprop	BEAVERHEAD	1984/7,9,10	6	0	0	11	0	0	
		1989/10	2	0	0	2	0	0	
	BLAINE	1990/11	3	0	0	3	0	0	
	BROADWATER	1990/5	3	0	0	3	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	GALLATIN	1990/5	1	0	0	1	0	0	
	LAKE	1989/11	4	0	0	4	0	0	
		1990/5	3	0	0	3	0	0	
	MADISON	1984/7,9	1	0	0	2	0	0	
	MCCONE	1990/11	3	0	0	3	0	0	
	PONDERA	1990/11	2	0	0	2	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7	2	0	0	2	0	0	
	TETON	1984/6,8	8	0	0	16	0	0	
		1985/2,6	12	0	0	19	0	0	
		1986/11	6	0	0	6	0	0	
		1987/4,12	7	0	0	7	0	0	
		1988/4	5	0	0	5	0	0	
		1989/10	5	0	0	6	0	0	
		1990/5	4	0	0	4	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
Dicamba to Toxaphene

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCENTRATIONS (ug/L)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		< MCL	> MCL		< MCL	> MCL	
(Dichlorprop)	VALLEY	1988/7	4	0	0	4	0	0	
	YELLOWSTONE	1986/3,5,9	10	0	0	11	0	0	
		1988/4	3	0	0	3	0	0	
TOTAL DISCRETE WELLS/SAMPLES			84	0	0	164	0	0	
Dieldrin	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	
Endrin	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	
Heptachlor	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
Dicamba to Toxaphene

PESTICIDE	COUNTY	DATE YEAR/MONTH	WELL RESULTS: TOTAL WELLS SAMPLED	WELL RESULTS: # OF POSITIVE WELLS > MCL	WELL RESULTS: # OF POSITIVE WELLS < MCL	SAMPLE RESULTS: TOTAL # SAMPLES	SAMPLE RESULTS: # OF POSITIVE SAMPLES > MCL	SAMPLE RESULTS: # OF POSITIVE SAMPLES < MCL	RANGE OF CONCENTRATIONS (ug/l)
Heptachlor epoxide	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	
Hexachlorobenzene	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	
Lindane	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	
MCPA	BEAVERHEAD	1984/7,9,10	6	0	0	11	0	0	
		1989/10	2	0	0	2	0	0	
	BLAINE	1990/11	3	0	0	3	0	0	
	BROADWATER	1990/5	3	0	0	3	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	GALLATIN	1990/5	1	0	0	1	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
Dicamba to Toxaphene

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (ug/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH	#	< MCL	> MCL	#	< MCL	> MCL	
(MCPA)	LAKE	1989/11	4	0	0	4	0	0	
		1990/5	3	0	0	3	0	0	
	MADISON	1984/7,9	1	0	0	2	0	0	
	MCCONE	1990/11	3	0	0	3	0	0	
	PONDERA	1990/11	2	0	0	2	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7	2	0	0	2	0	0	
	TETON	1984/6	8	0	2	9	0	2	0.36-0.39
		1984/8	8	0	0	9	0	0	
		1985/2	7	0	0	7	0	0	
		1985/6	12	0	1	18	0	1	5.5
		1986/11	6	0	0	6	0	0	
		1987/4,12	7	0	0	12	0	0	
		1988/4	5	0	0	5	0	0	
		1989/10	5	0	0	6	0	0	
		1990/5	4	0	0	4	0	0	
	VALLEY	1988/7	4	0	0	4	0	0	
	YELLOWSTONE	1986/3,5,9	10	0	0	11	0	0	
		1988/4	3	0	0	3	0	0	
TOTAL DISCRETE WELLS/SAMPLES			84	0	3	164	0	3	0.36-5.5
Mecoprop	BEAVERHEAD	1984/7,9,10	6	0	0	11	0	0	
		1989/10	2	0	0	2	0	0	
	BLAINE	1990/11	3	0	0	3	0	0	
	BROADWATER	1990/5	3	0	0	3	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	GALLATIN	1990/5	1	0	0	1	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
Dicamba to Toxaphene

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCENTRATIONS (µg/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(Mecoprop)	LAKE	1989/11	4	0	0	4	0	0	
		1990/5	3	0	0	3	0	0	
	MADISON	1984/7,9	1	0	0	2	0	0	
	MCCONE	1990/11	3	0	0	3	0	0	
	PONDERA	1990/11	2	0	0	2	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7	2	0	0	2	0	0	
	TETON	1984/6,8	8	0	0	16	0	0	
		1985/2,6	12	0	0	19	0	0	
		1986/11	6	0	0	6	0	0	
		1987/4,12	7	0	0	7	0	0	
		1988/4	5	0	0	5	0	0	
		1989/10	5	0	0	6	0	0	
		1990/5	4	0	0	4	0	0	
	VALLEY	1988/7	4	0	0	4	0	0	
	YELLOWSTONE	1986/3,5,9	10	0	0	11	0	0	
		1988/4	3	0	0	3	0	0	
TOTAL DISCRETE WELLS/SAMPLES			84	0	0	164	0	0	
Methoxychlor	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	
Mirex	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
Dicamba to Toxaphene

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (µg/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(Mirex)	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	
Pentachloro-phenol	LAKE	1989/11	1	0	0	1	0	0	
TOTAL DISCRETE WELLS/SAMPLES			1	0	0	1	0	0	
Picloram	BEAVERHEAD	1984/7,9,10	6	0	0	11	0	0	
		1989/10	2	0	0	2	0	0	
	BLAINE	1990/11	3	0	0	3	0	0	
	BROADWATER	1990/5	3	0	0	3	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
		1988/4	3	0	0	3	0	0	
		1989/11	5	0	0	5	0	0	
	DANIELS	1988/7	5	0	0	5	0	0	
	GALLATIN	1990/5	1	0	0	1	0	0	
	JEFFERSON	1988/6	4	0	2	4	0	2	14.0-26.0
		1988/7	9	0	4	9	0	4	8.9-28.0
		1988/8	6	0	2	6	0	2	1.3-21.0
		1988/9	6	0	4	6	0	4	11.0-22.0
	LAKE	1989/11	4	0	0	4	0	0	
		1990/5	3	0	0	3	0	0	
	MADISON	1984/7,9	1	0	0	2	0	0	
	MCCONE	1990/11	3	0	1	3	0	1	0.79
	PONDERA	1990/11	2	0	0	2	0	0	
	RICHLAND	1987/10	12	0	1	12	0	1	0.46
		1988/4	4	0	0	4	0	0	
	SHERIDAN	1988/7	2	0	0	2	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
Dicamba to Toxaphene

PESTICIDE	COUNTY	DATE YEAR/MONTH	WELL RESULTS: TOTAL WELLS SAMPLED	WELL RESULTS: # OF POSITIVE WELLS > MCL	WELL RESULTS: # OF POSITIVE WELLS < MCL	SAMPLE RESULTS: TOTAL # SAMPLES	SAMPLE RESULTS: # OF POSITIVE SAMPLES > MCL	SAMPLE RESULTS: # OF POSITIVE SAMPLES < MCL	RANGE OF CONCENTRATIONS (ug/l)
(Picloram)	TETON	1984/6	8	0	1	9	0	1	0.11
		1984/8	8	0	1	9	0	1	0.063
		1985/2	7	0	1	7	0	1	0.33
		1985/6	12	0	1	18	0	2	1.0-1.1
		1986/11	6	0	1	6	0	1	1.1
		1987/4	6	0	1	6	0	1	16.0
		1987/12	7	0	1	7	0	1	1.0
		1988/4	5	0	1	5	0	1	1.0
		1989/10	5	0	1	6	0	1	1.3
		1990/5	4	0	1	4	0	1	0.6
	VALLEY	1988/7	4	0	0	4	0	0	
	YELLOWSTONE	1986/3,5,9	10	0	0	11	0	0	
TOTAL DISCRETE WELLS/SAMPLES			100	0	10	189	0	25	0.063-28.0
Simazine	CARBON	1987/8	4	0	0	4	0	0	
		1989/11	5	0	0	5	0	0	
	HILL	1988/4	1	0	0	1	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	1	4	0	1	0.1
TOTAL DISCRETE WELLS/SAMPLES			22	0	1	26	0	1	0.1
Terbufos	HILL	1988/4	1	0	0	1	0	0	
	RICHLAND	1987/10	12	0	0	12	0	0	
		1988/4	4	0	0	4	0	0	
TOTAL DISCRETE WELLS/SAMPLES			13	0	0	17	0	0	

PESTICIDE SAMPLING IN THE STATE OF MONTANA
Dicamba to Toxaphene

PESTICIDE	COUNTY	DATE YEAR/MONTHS	WELL RESULTS: TOTAL WELLS SAMPLED	# OF POSITIVE WELLS ≥ MCL	# OF POSITIVE WELLS < MCL	SAMPLE RESULTS: TOTAL # SAMPLES	# OF POSITIVE SAMPLES ≥ MCL	# OF POSITIVE SAMPLES < MCL	RANGE OF CONCENTRATIONS (ug/l)
Toxaphene	BEAVERHEAD	1984/7	1	0	0	1	0	0	
	CARBON	1986/2,3	5	0	0	5	0	0	
	FLATHEAD	1984/6	1	0	0	1	0	0	
	TETON	1984/6,8	8	0	0	15	0	0	
	YELLOWSTONE	1986/3,5	8	0	0	8	0	0	
TOTAL DISCRETE WELLS/SAMPLES			22	0	0	29	0	0	
GRAND TOTAL DISCRETE WELLS/SAMPLES			124	1	24	264	1	61	

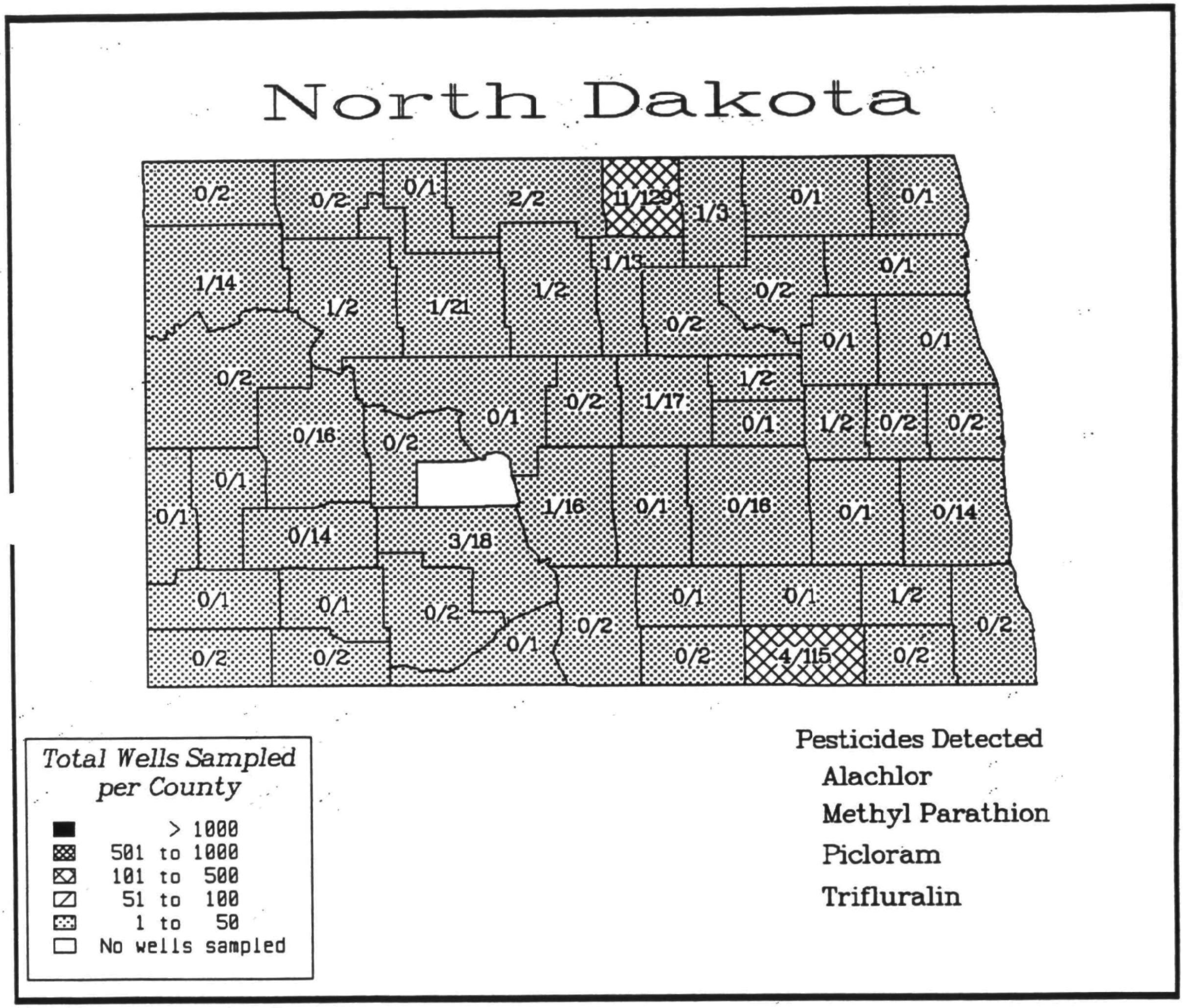
STATE OF MONTANA
WELLS BY COUNTY

COUNTY	TYPES OF WELLS									SOURCE OF CONTAMINATION (NUMBER OF WELLS)		
	DRINKING WATER			MONITORING			OTHER					
	TOTAL SMPLD	≥ MCL	< MCL	TOTAL SMPLD	≥ MCL	< MCL	TOTAL SMPLD	≥ MCL	< MCL	NFU*	PS*	UNK*
Beaverhead	6	0	0	0	0	0	1	0	0	0	0	0
Blaine	2	0	0	1	0	0	0	0	0	0	0	0
Broadwater	1	0	0	0	0	0	2	0	0	0	0	0
Carbon	16	0	4	0	0	0	2	0	0	4	0	0
Daniels	5	0	0	0	0	0	0	0	0	0	0	0
Flathead	2	0	0	0	0	0	1	0	0	0	0	0
Gallatin	4	0	0	0	0	0	0	0	0	0	0	0
Jefferson	15	0	6	0	0	0	1	0	0	0	6	0
Lake	6	1	0	2	0	0	1	0	0	1	0	0
Madison	1	0	0	0	0	0	0	0	0	0	0	0
McCone	2	0	0	1	0	1	0	0	0	1	0	0
Pondera	0	0	0	1	0	0	1	0	0	0	0	0
Richland	10	0	2	0	0	0	2	0	0	2	0	0
Sheridan	2	0	1	0	0	0	0	0	0	1	0	0
Teton	13	0	8	0	0	0	0	0	0	8	0	0
Valley	4	0	0	0	0	0	0	0	0	0	0	0
Yellowstone	14	0	1	0	0	0	5	0	1	2	0	0
TOTAL	103	1	22	5	0	1	16	0	1	19	6	0

* NFU=Known or Suspected Normal Field Use
PS =Known or Suspected Point Source
UNK=Unknown

Well Sampling by County

(Total Number of Wells with Pesticide Detections / Total Number of Wells Sampled)



OVERVIEW OF STATE LEGISLATIVE AND ENVIRONMENTAL POLICIES REGARDING PESTICIDES IN GROUND WATER

North Dakota is located in the upper Great Plains of the US. The majority of its population live and work in a rural environment. There are approximately 340 community drinking water systems scattered in various locations throughout the state, most serving less than 1,000 individuals. Ground water resources are the primary source of water used for these systems. Since agriculture and agricultural activities constitute the major economic base for the state, the levels of agricultural chemicals in the soil environment and the possible migration into ground-water resources have become issues of concern.

REPORTED STUDIES OF PESTICIDES IN GROUND WATER

Glatt, L. David, Environmental Engineer, North Dakota State Department of Health and Consolidated Laboratories, Tel.: 701-224-2354. **Pesticide and Herbicide Survey of Selected Municipal Drinking Water Systems in North Dakota.** Study conducted during Fall 1985. (Reported 2/86, 33 pp.)

Primary Objective
This study was initiated to determine the occurrence of agricultural compounds (aldicarb, fenvalerate, picloram, methyl parathion, and 2,4-D) in municipal drinking water systems in 52 counties of North Dakota.

Design
The sample collection from municipal drinking water systems was concentrated in those areas which appeared to exhibit the greatest potential for ground- or surface-water contamination. Criteria used in the selection of sample sites included municipalities which derive their water primarily from shallow ground water, or are located near regions of water-permeable soils, shallow ground-water tables, heavy irrigation, or heavy agricultural chemical application. At least one municipal drinking water supply system was chosen from 52 of the 53 counties in North Dakota. Samples were collected prior to water treatment processes from 85 municipal drinking water supply systems that receive water through ground-water resources, and seven which are supplied through surface water. The samples were analyzed for one or more of the following chemicals: 2,4-D by GC; aldicarb by LC; picloram, trifluralin, parathion, and fenvalerate by GC/ECD. The detection limits were as follows: (1) picloram, 0.8 ug/L; (2) 2,4-D, 0.02 ug/L; (3) fenvalerate, 4.0 ug/L; (4) aldicarb, 0.7 ug/L; (5) parathion, 0.02 ug/L; and (6) trifluralin, 0.07 ug/L.

Results and Conclusions

Ten (9 ground water and 1 surface water) of the systems surveyed indicated the presence or possible presence of at least one type of agricultural chemical. The compound detected in seven of the positive samples was the selective broadleaf herbicide picloram. All but one of these samples were from ground-water supplied systems. Suspected concentrations of ethyl parathion, methyl parathion, and trifluralin were detected at three separate sampling sites. The concentrations detected were near the detection limits for these compounds, therefore there is some question concerning the accuracy of these detections.

Glatt, L. David, Environmental Engineer, North Dakota State Department of Health and Consolidated Laboratories, Tel.: 701-224-2354. **"Groundwater Investigation to Determine the Occurrence of Picloram in Selected Well Sites of Rolette County, North Dakota."** Study conducted in July and August, 1985. (Reported 12/85, 35 pp.)

Primary Objective

The purpose of this monitoring study was to determine whether Tordon (picloram) was present in drinking water systems in the Shell Valley and Rolla Aquifers in Rolette County, ND, due to routine usage of picloram for the eradication of leafy spurge.

Design

Sample site selection concentrated on regions that exhibited the greatest potential for ground water concentration due to picloram application. Considerations in the selection of the sample sites included the proximity of shallow ground-water tables and permeable soils to areas treated with picloram within recent years. A total of 137 samples were collected from 126 drinking water wells. Approximately 85 samples were collected from wells supplied by the Shell Valley Aquifer, 15 from the Rolla Aquifer system and 26 samples from other locations outside of the major aquifer boundaries. Samples were analyzed approximately 7 days after collection for picloram by GC/MS. The majority of the samples were collected during the last week of July and first week of August 1985. Well depth, year of construction, diameter, static water level, and locations of picloram application activity were also reported. The detection limit was 0.02 ppb.

Results and Conclusions

Eleven of the samples exhibited evidence of at least a trace (<0.02ug/L) of picloram, with a high concentration of 0.85ug/L. Eight of the 11 positive samples were from private wells used by single family residences or livestock watering. The remaining three samples were collected from municipal drinking water wells. All of the positive wells were considered shallow (depth from 15-60 feet), with well casing diameters of 1.25 to 24 inches. A subsequent sample was collected from each positive sampling site to confirm the original sample results. None of the municipal wells and four of the private wells were positive at re-sampling.

Lym, Rodney G. and C. Messersmith, Associate Professor and Professor, respectively, North Dakota State University, Tel.: 701-237-7971. **"Survey for Picloram in North Dakota Groundwater."** Study conducted 1985-86. (Reported in Weed Technology, Vol. 2:217, 1988, p. 217).

Primary Objective

This study was conducted to determine the occurrence of picloram in drinking water systems in ten counties of North Dakota (Burleigh, Pierce, Stutsman, Ward, Wells, Morton, Stark, Williams, Cass, and Dunn) due to routine usage of picloram for the eradication of leafy spurge.

Design

Ten North Dakota Counties were chosen for sampling based on picloram usage during an active leafy spurge control program and on maintaining a representative cross-section of climate, soil, type, and geological formation. In 1985, 144 drinking water wells were sampled. Each well was sampled three times; in early June before spray season, in mid-July immediately after spray season, and in September to detect possible changes in herbicide concentrations with time. Wells were located in the following counties: Burleigh, Pierce, Stutsman, Ward, Wells, Morton, Stark, Williams, Cass, and Dunn. Wells containing picloram in 1985 were resampled in April and September 1986. An additional 44 wells were sampled only in 1986. These wells were located within 2 km of wells where picloram was detected in 1985. All the wells were located in a glacial drift formation. The samples were analyzed for picloram by HPLC. The detection limit was 0.05 ppb.

Results and Conclusions

Picloram contamination of North Dakota ground-water was widely scattered. Picloram was found in five wells in five counties in 1985, and all were within 1.5 km of an area treated for leafy spurge control. Picloram was present at concentrations from <0.1 to 12.8 in Burleigh, Ward, Wells, Morton, and Williams Counties. These counties are located in both eastern and western North Dakota. The five positive wells were resampled in 1986 and three were positive for picloram in Morton, Wells and Williams counties. Picloram was found in only one of the 44 additional wells sampled in 1986. It was detected at 0.97 ug.L in April and <0.1 in September in a domestic livestock well on the Morton county farmstead. A follow-up survey of well owners revealed that in all cases except one, a picloram-contaminated well either had been used to fill a sprayer and the owner recalled a spill or picloram had been applied to a nearby area where the water table was within 4m of the surface. The highest concentration found in this survey was 12.8 ug/L. This is well below the MCL of 500 ug/L. While water from contaminated wells may not be considered a health hazard, minute amounts of picloram could adversely affect sensitive crops grown under irrigation.

Prunty, Lyle and B. R. Montgomery, Department of Soil Science, North Dakota State University, Tel.: 701-237-7556 (Montgomery). **"Temporal Pesticide Leaching Through Irrigated Sandy Loam Soil."** Study conducted 1985-87. (Reported 10/87, 41 pp.)

Primary Objective

The purpose of this research was to provide baseline aquifer information concerning nitrates and pesticides under various irrigated and non-irrigated cropping systems.

Design

The West Oakes Test Area of the Garrison Diversion Unit (GDU) provides information on the environmental impacts of irrigation development on a surficial aquifer. The Test Area covers 3,100 hectares (7,600 acres) and is over 95% agricultural land. It is well-suited for ground-water quality studies, as it has sandy soils and a high water table and rapidly increasing irrigation acreage. Dominant crops within the Test Area are corn and small grains. Corn received the bulk of the herbicide application even though the crop occupied only 30% of the land area. Ninety-five percent of the corn acreage received at least one herbicide while only 50% of the non-corn acreage received at least one herbicide.

There were three sources of sample data established in this study: observation wells for obtaining samples from the lower portion of the aquifer; tile drain lines near the level of the water table; and lysimeters for monitoring directly the percolating water beneath the root zone. The wells are located on a 1/2-mile grid over the entire test area with a total of 98 wells available. The entire area is drained by subsurface tile drainage system accessed by manhole point, 16 of which were monitored in this study. Four large lysimeters were also sampled. The samples were analyzed for atrazine and simazine by HPLC, and for alachlor and metolachlor by GC. The detection limits were 1 g/L for all four chemicals.

Results and Conclusions

Six of the 229 samples taken from 1985-1987 were positive for alachlor: 3 samples were from a single well, 2 lysimeter samples, and 1 tile drain sample. Positive values ranged from 0.05 to 1.2 ppb. Contamination in the well with the 3 positive samples may have been from tank mixing and rinsing or a spill since it was rather isolated from agricultural applications. No alachlor was found in neighboring wells. Non of the other three herbicides (atrazine, simazine, metolachlor) were detected in any of the samples.

PESTICIDE SAMPLING IN THE STATE OF NORTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (µg/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/ MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
2,4-D	BARNES	1985/Fall	1	0	0	1	0	0	
	BENSON	1985/Fall	2	0	0	2	0	0	
	BILLINGS	1985/Fall	1	0	0	1	0	0	
	BOTTINEAU	1985/Fall	2	0	0	2	0	0	
	BURKE	1985/Fall	2	0	0	2	0	0	
	BURLEIGH	1985/Fall	1	0	0	1	0	0	
	CASS	1985/Fall	1	0	0	1	0	0	
	CAVALIER	1985/Fall	1	0	0	1	0	0	
	DICKEY	1985/Fall	2	0	0	2	0	0	
	DIVIDE	1985/Fall	2	0	0	2	0	0	
	DUNN	1985/Fall	2	0	0	2	0	0	
	EDDY	1985/Fall	2	0	0	2	0	0	
	EMMONS	1985/Fall	2	0	0	2	0	0	
	FOSTER	1985/Fall	1	0	0	1	0	0	
	GOLDEN VALLEY	1985/Fall	1	0	0	1	0	0	
	GRAND FORKS	1985/Fall	1	0	0	1	0	0	
	GRANT	1985/Fall	2	0	0	2	0	0	
	GRIGGS	1985/Fall	2	0	0	2	0	0	
	KIDDER	1985/Fall	1	0	0	1	0	0	
	LA MOURE	1985/Fall	2	0	0	2	0	0	
	LOGAN	1985/Fall	1	0	0	1	0	0	
	MCHENRY	1985/Fall	2	0	0	2	0	0	
	MCINTOSH	1985/Fall	2	0	0	2	0	0	
	MCKENZIE	1985/Fall	2	0	0	2	0	0	
	MCLEAN	1985/Fall	1	0	0	1	0	0	
	MERCER	1985/Fall	2	0	0	2	0	0	
	MORTON	1985/Fall	2	0	0	2	0	0	
	MOUNTRAIL	1985/Fall	2	0	0	2	0	0	
	NELSON	1985/Fall	1	0	0	1	0	0	
	PENDINA	1985/Fall	1	0	0	1	0	0	

PESTICIDE SAMPLING IN THE STATE OF NORTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCENTRATIONS (ug/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/ MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(2,4-D)	PIERCE	1985/Fall	1	0	0	1	0	0	
	RAMSEY	1985/Fall	2	0	0	2	0	0	
	RANSOM	1985/Fall	2	0	0	2	0	0	
	RENVILLE	1985/Fall	1	0	0	1	0	0	
	RICHLAND	1985/Fall	2	0	0	2	0	0	
	ROLETTE	1985/Fall	3	0	0	3	0	0	
	SARGENT	1985/Fall	2	0	0	2	0	0	
	SHERIDAN	1985/Fall	2	0	0	2	0	0	
	SIOUX	1985/Fall	1	0	0	1	0	0	
	STARK	1985/Fall	1	0	0	1	0	0	
	STEELE	1985/Fall	2	0	0	2	0	0	
	STUTSMAN	1985/Fall	2	0	0	2	0	0	
	TOWNER	1985/Fall	2	0	0	2	0	0	
	TRAILL	1985/Fall	2	0	0	2	0	0	
	WALSH	1985/Fall	1	0	0	1	0	0	
	WARD	1985/Fall	2	0	0	2	0	0	
	WELLS	1985/Fall	2	0	0	2	0	0	
	Unspecified County	1985/Fall	1	0	0	1	0	0	
TOTAL DISCRETE WELLS/SAMPLES			79	0	0	79	0	0	
Alachlor	DICKEY	1985/6-10	97	0	3	143	0	5	0.2-1.2
		1986/10-11	47	0	0	47	0	0	
		1987/4-7	23	0	1	39	0	1	0.053
TOTAL DISCRETE WELLS/SAMPLES			113	0	4	229	0	6	0.053-1.2
Aldicarb	CASS	1985/Fall	1	0	0	1	0	0	
	CAVALIER	1985/Fall	1	0	0	1	0	0	
	GRAND FORKS	1985/Fall	1	0	0	1	0	0	
	NELSON	1985/Fall	1	0	0	1	0	0	
	PEMBINA	1985/Fall	1	0	0	1	0	0	

PESTICIDE SAMPLING IN THE STATE OF NORTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (µg/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(Aldicarb)	RANSOM	1985/Fall	2	0	0	2	0	0	
	RICHLAND	1985/Fall	2	0	0	2	0	0	
	SARGENT	1985/Fall	2	0	0	2	0	0	
	STEELE	1985/Fall	2	0	0	2	0	0	
	TRAILL	1985/Fall	2	0	0	2	0	0	
	WALSH	1985/Fall	1	0	0	1	0	0	
	Unspecified County	1985/Fall	1	0	0	1	0	0	
TOTAL DISCRETE WELLS/SAMPLES			17	0	0	17	0	0	
Atrazine	DICKEY	1985-87	106	0	0	212	0	0	
TOTAL DISCRETE WELLS/SAMPLES			106	0	0	212	0	0	
Fenvalerate	BARNES	1985/Fall	1	0	0	1	0	0	
	BENSON	1985/Fall	2	0	0	2	0	0	
	BOTTINEAU	1985/Fall	2	0	0	2	0	0	
	BURLEIGH	1985/Fall	1	0	0	1	0	0	
	CASS	1985/Fall	1	0	0	1	0	0	
	CAVALIER	1985/Fall	1	0	0	1	0	0	
	DICKEY	1985/Fall	2	0	0	2	0	0	
	EDDY	1985/Fall	2	0	0	2	0	0	
	EMMONS	1985/Fall	2	0	0	2	0	0	
	FOSTER	1985/Fall	1	0	0	1	0	0	
	GRAND FORKS	1985/Fall	1	0	0	1	0	0	
	GRIGGS	1985/Fall	2	0	0	2	0	0	
	KIDDER	1985/Fall	1	0	0	1	0	0	
	LA MOURE	1985/Fall	2	0	0	2	0	0	
	LOGAN	1985/Fall	1	0	0	1	0	0	
	MCHENRY	1985/Fall	2	0	0	2	0	0	
	MCINTOSH	1985/Fall	2	0	0	2	0	0	
	MCLEAN	1985/Fall	1	0	0	1	0	0	
	NELSON	1985/Fall	1	0	0	1	0	0	

PESTICIDE SAMPLING IN THE STATE OF NORTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (ug/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(Fenvalerate)	PEMBINA	1985/Fall	1	0	0	1	0	0	
	PIERCE	1985/Fall	1	0	0	1	0	0	
	RAMSEY	1985/Fall	2	0	0	2	0	0	
	RANSOM	1985/Fall	2	0	0	2	0	0	
	RENVILLE	1985/Fall	1	0	0	1	0	0	
	RICHLAND	1985/Fall	2	0	0	2	0	0	
	ROLETTE	1985/Fall	3	0	0	3	0	0	
	SARGENT	1985/Fall	2	0	0	2	0	0	
	SHERIDAN	1985/Fall	2	0	0	2	0	0	
	STEELE	1985/Fall	2	0	0	2	0	0	
	STUTSMAN	1985/Fall	2	0	0	2	0	0	
	TOWNER	1985/Fall	2	0	0	2	0	0	
	TRAILL	1985/Fall	2	0	0	2	0	0	
	WALSH	1985/Fall	1	0	0	1	0	0	
	WARD	1985/Fall	2	0	0	2	0	0	
	WELLS	1985/Fall	2	0	0	2	0	0	
	Unspecified County	1985/Fall	1	0	0	1	0	0	
TOTAL DISCRETE WELLS/SAMPLES			58	0	0	58	0	0	
Metolachlor	DICKEY	1985-87	113	0	0	229	0	0	
TOTAL DISCRETE WELLS/SAMPLES			113	0	0	229	0	0	
Parathion, ethyl	BARNES	1985/Fall	1	0	0	1	0	0	
	BENSON	1985/Fall	2	0	0	2	0	0	
	BURLEIGH	1985/Fall	1	0	0	1	0	0	
	CASS	1985/Fall	1	0	0	1	0	0	
	DICKEY	1985/Fall	2	0	0	2	0	0	
	EDDY	1985/Fall	2	0	1	2	0	1	0.02
	EMMONS	1985/Fall	2	0	0	2	0	0	
	FOSTER	1985/Fall	1	0	0	1	0	0	
	GRIGGS	1985/Fall	2	0	0	2	0	0	

PESTICIDE SAMPLING IN THE STATE OF NORTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (µg/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(Parathion, ethyl)	KIDDER	1985/Fall	1	0	0	1	0	0	
	LA MOURE	1985/Fall	1	0	0	1	0	0	
	LOGAN	1985/Fall	1	0	0	1	0	0	
	MCINTOSH	1985/Fall	2	0	0	2	0	0	
	NELSON	1985/Fall	1	0	0	1	0	0	
	PIERCE	1985/Fall	1	0	0	1	0	0	
	RAMSBY	1985/Fall	2	0	0	2	0	0	
	RANSOM	1985/Fall	2	0	0	2	0	0	
	RICHLAND	1985/Fall	2	0	0	2	0	0	
	ROLETTE	1985/Fall	3	0	0	3	0	0	
	SARGENT	1985/Fall	2	0	0	2	0	0	
	SHERIDAN	1985/Fall	2	0	0	2	0	0	
	STEELE	1985/Fall	2	0	0	2	0	0	
	STUTSMAN	1985/Fall	2	0	0	2	0	0	
	TOWNER	1985/Fall	2	0	0	2	0	0	
	WELLS	1985/Fall	2	0	0	2	0	0	
TOTAL DISCRETE WELLS/SAMPLES			42	0	1	42	0	1	0.02
Parathion, methyl	BARNES	1985/Fall	1	0	0	1	0	0	
	BENSON	1985/Fall	2	0	0	2	0	0	
	BURLEIGH	1985/Fall	1	0	0	1	0	0	
	CASS	1985/Fall	1	0	0	1	0	0	
	DICKEY	1985/Fall	2	0	0	2	0	0	
	EDDY	1985/Fall	2	0	0	2	0	0	
	EMMONS	1985/Fall	2	0	0	2	0	0	
	FOSTER	1985/Fall	1	0	0	1	0	0	
	GRIGGS	1985/Fall	2	0	1	2	0	1	0.04
	KIDDER	1985/Fall	1	0	0	1	0	0	
	LA MOURE	1985/Fall	1	0	0	1	0	0	
	LOGAN	1985/Fall	1	0	0	1	0	0	

PESTICIDE SAMPLING IN THE STATE OF NORTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (ug/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/ MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(Parathion, methyl)	MCINTOSH	1985/Fall	2	0	0	2	0	0	
	NELSON	1985/Fall	1	0	0	1	0	0	
	PIERCE	1985/Fall	1	0	0	1	0	0	
	RAMSBY	1985/Fall	2	0	0	2	0	0	
	RANSOM	1985/Fall	2	0	0	2	0	0	
	RICHLAND	1985/Fall	2	0	0	2	0	0	
	ROLETTE	1985/Fall	3	0	0	3	0	0	
	SARGENT	1985/Fall	2	0	0	2	0	0	
	SHERIDAN	1985/Fall	2	0	0	2	0	0	
	STEELE	1985/Fall	2	0	0	2	0	0	
	STUTSMAN	1985/Fall	2	0	0	2	0	0	
	TOWNER	1985/Fall	2	0	0	2	0	0	
	WELLS	1985/Fall	2	0	0	2	0	0	
TOTAL DISCRETE WELLS/SAMPLES			42	0	1	42	0	1	0.04
Picloram	ADAMS	1985/Fall	2	0	0	2	0	0	
	BARNES	1985/Fall	1	0	0	1	0	0	
	BENSON	1985/Fall	2	0	0	2	0	0	
	BILLINGS	1985/Fall	1	0	0	1	0	0	
	BOTTINEAU	1985/Fall	2	0	2	2	0	2	0.34-1.46
	BOWMAN	1985/Fall	2	0	0	2	0	0	
	BURKE	1985/Fall	2	0	0	2	0	0	
	BURLEIGH	1985/Fall	1	0	0	1	0	0	
		1985/6,7,9	15	0	1	45	0	1	<0.1
		1986/4,9	2	0	0	4	0	0	
	CASS	1985/Fall	1	0	0	1	0	0	
		1985/6,7,9	13	0	0	39	0	0	
	CAVALIER	1985/Fall	1	0	0	1	0	0	
	DICKEY	1985/Fall	2	0	0	2	0	0	
	DIVIDE	1985/Fall	2	0	0	2	0	0	
	DUNN	1985/Fall	2	0	0	2	0	0	

PESTICIDE SAMPLING IN THE STATE OF NORTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (µg/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/ MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(Picloram)		1985/6,7,9	14	0	0	42	0	0	
	EDDY	1985/Fall	2	0	0	2	0	0	
	EMMONS	1985/Fall	2	0	0	2	0	0	
	FOSTER	1985/Fall	1	0	0	1	0	0	
	GOLDEN VALLEY	1985/Fall	1	0	0	1	0	0	
	GRAND FORKS	1985/Fall	1	0	0	1	0	0	
	GRANT	1985/Fall	2	0	0	2	0	0	
	GRIGGS	1985/Fall	2	0	0	2	0	0	
	HETTINGER	1985/Fall	1	0	0	1	0	0	
	KIDDER	1985/Fall	1	0	0	1	0	0	
	LA MOURE	1985/Fall	2	0	0	2	0	0	
	LOGAN	1985/Fall	1	0	0	1	0	0	
	MCHENRY	1985/Fall	2	0	1	2	0	1	0.21
	MCINTOSH	1985/Fall	2	0	0	2	0	0	
	MCKENZIE	1985/Fall	2	0	0	2	0	0	
	MCLEAN	1985/Fall	1	0	0	1	0	0	
	MERCER	1985/Fall	2	0	0	2	0	0	
	MORTON	1985/Fall	2	0	0	2	0	0	
		1985/6,7,9	16	0	1	48	0	3	0.4-0.5
		1986/4,9	2	0	2	4	0	3	0.1-0.97
	MOUNTRAIL	1985/Fall	2	0	1	2	0	1	0.08
	NELSON	1985/Fall	1	0	0	1	0	0	
	PEMBINA	1985/Fall	1	0	0	1	0	0	
	PIERCE	1985/Fall	1	0	1	1	0	1	0.2
		1985/6,7,9	12	0	0	36	0	0	
	RAMSEY	1985/Fall	2	0	0	2	0	0	
	RANSOM	1985/Fall	2	0	1	2	0	1	0.2
	RENVILLE	1985/Fall	1	0	0	1	0	0	
	RICHLAND	1985/Fall	2	0	0	2	0	0	
	ROLETTE	1985/Fall	3	0	0	3	0	0	
		1985/7-8	126	0	11	137	0	15	<0.02-3.56

PESTICIDE SAMPLING IN THE STATE OF NORTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (µg/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(Picloram)	SARGENT	1985/Fall	2	0	0	2	0	0	
	SHERIDAN	1985/Fall	2	0	0	2	0	0	
	SIOUX	1985/Fall	1	0	0	1	0	0	
	SLOPE	1985/Fall	1	0	0	1	0	0	
	STARK	1985/Fall	1	0	0	1	0	0	
		1985/6,7,9	13	0	0	39	0	0	
	STEELE	1985/Fall	2	0	0	2	0	0	
	STUTSMAN	1985/Fall	2	0	0	2	0	0	
		1985/6,7,9	14	0	0	42	0	0	
	TOWNER	1985/Fall	2	0	0	2	0	0	
	TRAILL	1985/Fall	2	0	0	2	0	0	
	WALSH	1985/Fall	1	0	0	1	0	0	
	WARD	1985/Fall	2	0	0	2	0	0	
		1985/6,7,9	19	0	1	57	0	1	<0.1
		1986/4,9	1	0	0	2	0	0	
	WELLS	1985/Fall	2	0	0	2	0	0	
		1985/6,7,9	16	0	1	48	0	3	12.4-12.8
		1986/4,9	1	0	1	2	0	2	6.7-8
	WILLIAMS	1985/Fall	1	0	0	1	0	0	
		1985/6,7,9	14	0	1	42	0	3	2.2-2.4
		1986/4,9	2	0	1	4	0	2	<0.1-1
	Unspecified Counties	1896/4,9	41	0	0	82	0	0	
TOTAL DISCRETE WELLS/SAMPLES			400	0	23	1163	0	39	<0.02-12.8
Simazine	DICKEY	1985-87	106	0	0	212	0	0	
TOTAL DISCRETE WELLS/SAMPLES			106	0	0	212	0	0	

PESTICIDE SAMPLING IN THE STATE OF NORTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (µg/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/ MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
Trifluralin	TOWNER	1985/Fall	1	0	1	1	0	1	<0.031
TOTAL DISCRETE WELLS/SAMPLES			1	0	1	1	0	1	<0.031
GRAND TOTAL DISCRETE WELLS/SAMPLES			515	0	30	1392	0	48	

[A]Additional wells sampled near positive wells from the 1985/6,7,9 sampling. Wells are located in one of the following counties: Burleigh, Morton, Ward, Wells, Williams.

STATE OF NORTH DAKOTA
WELLS BY COUNTY

COUNTY	TYPES OF WELLS									SOURCE OF CONTAMINATION (NUMBER OF WELLS)		
	DRINKING WATER			MONITORING			OTHER					
	TOTAL SMPLD	≥ MCL	< MCL	TOTAL SMPLD	≥ MCL	< MCL	TOTAL SMPLD	≥ MCL	< MCL	NFU*	PS*	UNK*
Adams	2	0	0	0	0	0	0	0	0	0	0	0
Barnes	1	0	0	0	0	0	0	0	0	0	0	0
Benson	2	0	0	0	0	0	0	0	0	0	0	0
Billings	1	0	0	0	0	0	0	0	0	0	0	0
Bottineau	2	0	2	0	0	0	0	0	0	2	0	0
Bowman	2	0	0	0	0	0	0	0	0	0	0	0
Burke	2	0	0	0	0	0	0	0	0	0	0	0
Burleigh	17	0	1	0	0	0	0	0	0	0	1	0
Cass	14	0	0	0	0	0	0	0	0	0	0	0
Cavalier	1	0	0	0	0	0	0	0	0	0	0	0
Dickey	2	0	0	113	0	4	0	0	0	4	0	0
Divide	2	0	0	0	0	0	0	0	0	0	0	0
Dunn	16	0	0	0	0	0	0	0	0	0	0	0
Eddy	2	0	1	0	0	0	0	0	0	1	0	0
Emmons	2	0	0	0	0	0	0	0	0	0	0	0
Foster	1	0	0	0	0	0	0	0	0	0	0	0
Golden Valley	1	0	0	0	0	0	0	0	0	0	0	0
Grand Forks	1	0	0	0	0	0	0	0	0	0	0	0
Grant	2	0	0	0	0	0	0	0	0	0	0	0
Griggs	2	0	1	0	0	0	0	0	0	1	0	0
Hettinger	1	0	0	0	0	0	0	0	0	0	0	0
Kidder	1	0	0	0	0	0	0	0	0	0	0	0
La Moure	2	0	0	0	0	0	0	0	0	0	0	0
Logan	1	0	0	0	0	0	0	0	0	0	0	0
McHenry	2	0	1	0	0	0	0	0	0	1	0	0
McIntosh	2	0	0	0	0	0	0	0	0	0	0	0
McKenzie	2	0	0	0	0	0	0	0	0	0	0	0
McLean	1	0	0	0	0	0	0	0	0	0	0	0
Mercer	2	0	0	0	0	0	0	0	0	0	0	0
Morton	19	0	2	0	0	0	0	0	0	2	0	0
Mountrail	2	0	1	0	0	0	0	0	0	1	0	0
Nelson	1	0	0	0	0	0	0	0	0	0	0	0

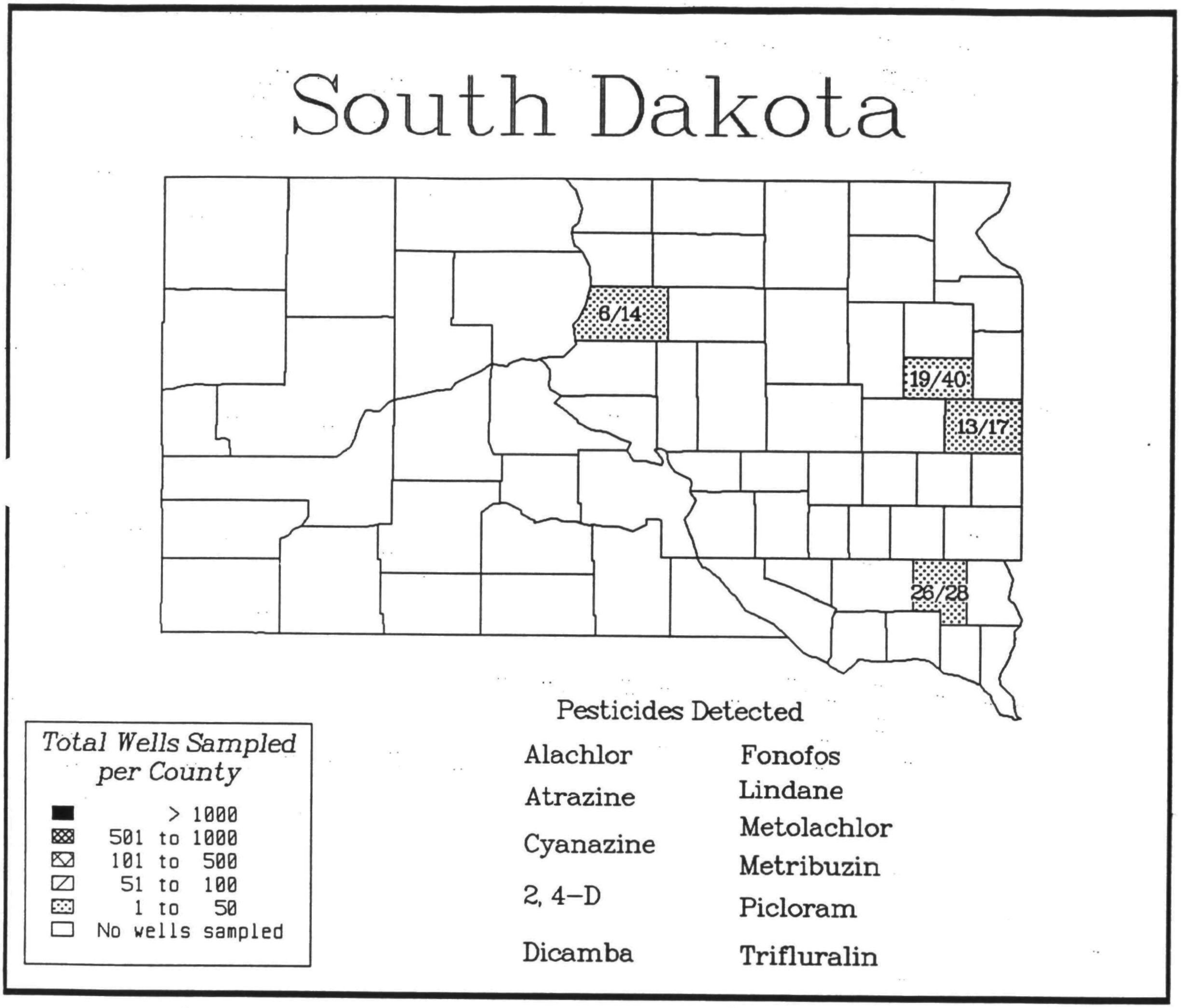
STATE OF NORTH DAKOTA
WELLS BY COUNTY

COUNTY	TYPES OF WELLS									SOURCE OF CONTAMINATION (NUMBER OF WELLS)		
	DRINKING WATER			MONITORING			OTHER					
	TOTAL SMPLD	≥ MCL	< MCL	TOTAL SMPLD	≥ MCL	< MCL	TOTAL SMPLD	≥ MCL	< MCL	NFU*	PS*	UNK*
Pembina	1	0	0	0	0	0	0	0	0	0	0	0
Pierce	13	0	1	0	0	0	0	0	0	1	0	0
Ramsey	2	0	0	0	0	0	0	0	0	0	0	0
Ransom	2	0	1	0	0	0	0	0	0	1	0	0
Renville	1	0	0	0	0	0	0	0	0	0	0	0
Richland	2	0	0	0	0	0	0	0	0	0	0	0
Rolette	129	0	11	0	0	0	0	0	0	5	6	0
Sargent	2	0	0	0	0	0	0	0	0	0	0	0
Sheridan	2	0	0	0	0	0	0	0	0	0	0	0
Sioux	1	0	0	0	0	0	0	0	0	0	0	0
Slope	1	0	0	0	0	0	0	0	0	0	0	0
Stark	14	0	0	0	0	0	0	0	0	0	0	0
Steele	2	0	0	0	0	0	0	0	0	0	0	0
Stutsman	16	0	0	0	0	0	0	0	0	0	0	0
Towner	3	0	1	0	0	0	0	0	0	0	1	0
Traill	2	0	0	0	0	0	0	0	0	0	0	0
Walsh	1	0	0	0	0	0	0	0	0	0	0	0
Ward	21	0	1	0	0	0	0	0	0	0	1	0
Wells	18	0	1	0	0	0	0	0	0	0	1	0
Williams	16	0	1	0	0	0	0	0	0	0	0	1
Unspecified	42	0	0	0	0	0	0	0	0	0	0	0
TOTAL	402	0	26	113	0	4	0	0	0	19	10	1

* NFU=Known or Suspected Normal Field Use
PS =Known or Suspected Point Source
UNK=Unknown

Well Sampling by County

(Total Number of Wells with Pesticide Detections / Total Number of Wells Sampled)



OVERVIEW OF STATE LEGISLATIVE AND ENVIRONMENTAL POLICIES REGARDING PESTICIDES IN GROUND WATER

An estimated 93% of South Dakota's land area is farmed and 75% of its population relies on ground water as a source of drinking water. A great concern of the people of South Dakota is the potential effects of modern pesticides an fertilizers on their drinking water supplies. The South Dakota Department of Natural resources designated Water Quality Study areas in east-central South Dakota which originally studied surface water and later expanded to examine ground water quality. Monitoring of surface and ground waters have been carried out since the early seventies as part of South Dakota's Statewide Water Quality Management Plan. In the early eighties two of these sites were combined and qualified for research money under USDA's Rural Clean Water Program (RCWP). The final Oakwood Lakes-Poinsett RCWP area covers portions of four counties.

In 1988 the South Dakota Legislature directed the Department of Water and Natural Resources to undertake a sampling program to assess the presence and extent of pesticides and nitrogen-based fertilizers in ground water. This pilot program was expanded in 1989 to cover additional aquifers. The South Dakota Groundwater Law, enacted in 1989, stipulates that, in conjunction with the South Dakota Department of Agriculture, State universities, and other interested parties, the secretary of the Department of Water and Natural Resources will annually review new studies and data that relate the use of pesticides and fertilizers to the quality of South Dakota's waters. Based on the information obtained, the State will formulate and revise state management plans for the use of pesticides and fertilizers which will prevent ground-water contamination.

REPORTED STUDIES OF PESTICIDES IN GROUND WATER

Shade Di[illegible]

Region 8

The State of South Dakota has additional data that is not presented in this report. Contact Jeanne Goodman, South Dakota Department of Environment and Natural Resources, Tel: 605-773-3296.

<u>Primary Objective</u>
This report was intended to provide an overview of the status of pesticides in ground- water monitoring efforts and potential health risks associated with pesticide occurrence in South Dakota through 1986. Three studies in which pesticides had been detected in ground water were included in the report:

(1) the Oakwood Lakes-Poinsett RCWP, which includes a 10-year Comprehensive Monitoring and Evaluation Project administered by the Agricultural Stabilization and Conservation Service (ASCS), the Soil Conservation Service (SCS), and the South Dakota Department of Water and Natural Resources (DWNR);
(2) a 1985 sampling of selected shallow Public Water Supplies (PWSs); and
(3) ground-water investigations by the South Dakota Geological Survey (SDGS).
The bulk of the report discussed the characteristics and toxicity of 21 pesticides that had detected in ground-water, were considered a potential health risk, and were used in South Dakota.

Design and Results
Details of the monitoring studies mentioned were not provided in this summary report. Study design and results of the Oakwood Lakes-Poinsett RCWP are provided below.
Ten PWSs were sampled in 1985. Pesticides were detected in samples from 3 of the 10 supplies. In one of these cases (unspecified), the source of the contamination was determined to be poor handling and disposal practices.

As a result of ground water investigations by the South Dakota Geological Survey pesticides were detected in monitoring wells in Alcester and Union Counties.
The following table was presented in the report to summarize pesticide detections in South Dakota before 1986:

County	Well Type	Pesticide	Conc.*	LOD*
Alcester, Union	SDGS Observation	Alachlor Atrazine	3.1 1.7	0.05 0.5
Bruce, Brookings	Main PWS	Alachlor Atrazine	3.2-6.7 5.8-7.1	0.05 0.5
Egan, Moody	Standby PWS	Picloram	8.3	0.1
Brookings	RCWP	alachlor 2,4-D	0.16-3.09 0.29-0.8	0.05 0.1

* Concentration and Limit of Detection are in ug/L

Bender, A.R., Project Leader and Contact, Water Resources Institute, South Dakota State University, Oakwood Lakes-Poinsett Rural Clean Water Program. Tel.: 605-688-4910. **1987 Annual Progress Report - Project 20 and CM&E Technical Report (Water Quality Land Use Data Analysis).** Study conducted January 1984 through July 1987. (Reported 1987, 181 pp.) Analysis and evaluation of field site ground-water monitoring by C.G. Kimball (Principal Investigator), and W.A. Best (Research Assistant).

Primary Objective

The goal of the Oakwood Lakes-Poinsett Rural Clean Water Program (RCWP) Comprehensive Monitoring & Evaluation Plan (CM&E) is to improve and protect the surface- and ground-water quality of the project area by the application of selected Best Management Practices (BMPs). The overall goals of the RCWP project to:

(1) reduce the amount of total nitrogen and pesticides entering the ground and surface water by assisting with fertilizer and pesticide management on 70,000 and 65,000 critical acres, respectively;
(2) reduce the amount of water- and sediment-borne pollutants entering waterways and lakes by applying or maintaining conservation tillage on 65,000 critical acres;
(3) reduce the amount of animal waste entering waterways, lakes, and ground water by applying waste management systems on 10 livestock operations.

The specific objective of the CM&E project is to monitor the effect and to evaluate the impact on ground- and surface-water quality of selected BMPs that have been implemented by the RCWP. BMPs that have been initiated include conservation tillage, fertilizer management, and pesticide management.

Design

Fifty-seven monitoring wells in Hamlin (40) and Brookings (17) Counties were selected for continued monitoring of ground-water quality, including analysis for 22 pesticides: alachlor, atrazine, butylate, chloramben, carbofuran, cyanazine, 2,4-D, dicamba, endrin, EPTC, fonofos, lindane, methoxychlor, metolachlor, metribuzin, parathion, phorate, picloram, propachlor, terbufos, toxaphene, and trifluralin. The wells sampled for pesticides are part of a network of 114 monitoring wells installed by the CM&E Project to evaluate land use, ground water, soil profile, runoff, and climatic changes. Wells were located on seven fields; six of the sites were farmed fields and one uncultivated. The three BMPs listed above have been implemented on five of the six farmed fields; one is a control site.

A total of 508 samples were collected and analyzed for pesticides from January 1984 to July 1987; 140 samples were collected in 1987. Quarterly sampling of 33 wells was conducted in 1984. In 1985, monthly sampling of approximately 20 wells was initiated. Samples were analyzed using GC/ECD. Positive detections were confirmed by GC/NP. Detection limits were not specified for each pesticide, but ranged from 0.01 to 0.10 ug/L.

Results and Conclusions

Between 1984 and 1987, 46 samples had detectable levels of pesticides. The site specific results of the monitoring are presented below:

Pesticide	County & Site	Year	Wells No.	Wells Pos.	Samples No.	Samples Pos.	Avg. Conc. (ug/l)
Alachlor	Brookings BL	1985,86	12	2	80	4	0.30
	Brookings OP	1985-87	5	3	69	4	1.03
	Hamlin LK	1986	10	2	82	2	0.10
	Hamlin RS	1985,86	14	2	98	13	0.59
	Hamlin JW	1986	4	2	61	2	0.10
	Hamlin PH	1985,86	9	2	83	4	0.11
Atrazine	Brookings BL	1985	12	1	80	1	5.40
2,4-D	Brookings BL	1986	12	2	80	2	0.44
	Brookings OP	1986	5	1	69	1	0.41
	Hamlin LK	1986	10	2	82	2	0.77
	Hamlin RS	1984,86	14	4	98	4	2.05
	Hamlin JW	1986	4	2	61	2	0.77
	Hamlin PH	1986	9	1	83	1	0.84
Lindane	Brookings BL	1987	12	2	80	2	0.05
Metribuzin	Brookings BL	1985	12	1	80	1	0.02
	Hamlin RS	1986	14	1	98	1	0.025
Trifluralin	Hamlin PH	1985	9	1	83	1	0.02

The lindane found at the Brookings BL site was due to cattle treated with the pesticide rubbing against monitoring wells. This pesticide was never actually in the ground water. The majority of the pesticide detections are of low enough concentrations that the detection limits of the equipment are being approached. Additional, 72% of the detections are single events with no detections in the following monthly sample.

At each monitoring site land use histories were collected and updated annually. Pesticides that have been used on the monitoring sites include:

alachlor	bentazon	carbofuran	2,4-D	dicamba
MCPA	metribuzin	propachlor	trifluralin	

Pesticide detections were represented by those with and without a history of on-site use. Fifty percent of the pesticide detections have no use history (used within 2 years of detection) on the site in which they were detected.

In the samples with pesticide detects alachlor was found 65.2% of the time, regardless of a history of on-site use. The percent of detection of alachlor increases with respect to other pesticide when on-site use is a criteria. Alachlor and 2,4-D are the most often used herbicides on the project monitoring sites. Timing of pesticide detections was not uniform, although detections appear to be seasonal. Sixty-nine percent (69%) of pesticide detections, regardless of on-site use, occurred during the growing season (May-October). Forty percent (40%) of detections occurred during June and July. There was an anomalous bulge in detects in January 1986. This may have been caused by an unusual winter thaw and infiltration through frost cracks. Desorption of organic chemicals from materials can be triggered by temperature of pH changes and the cold water which may have infiltrated would have caused a decided temperature change.

When only those samples with a history of on-site use were considered, an increase in the percentage detections was observed in the post-application months of August and October. From the land-use data available, it appeared that the average time for alachlor to appear in ground-water samples following application was 7.7 months (17 samples). For 2,4-D the average was 9.1 months (4 samples). In some cases the intervals between applications and detections exceeded the time at which pesticide detections would be expected, based on calculations using half life, partition coefficient and maximum solubility. Although investigators did not find a direct correlation between annual precipitation and pesticide detections, it did appear that storms of sufficient cumulative precipitation to cause infiltration did directly influence the number of pesticide detections.

Based on the data collected it appears that under the climatic conditions found in Eastern South Dakota, percolation of pesticides to the ground water is limited and sporadic. It also appears that shallow sand and gravel aquifers, which would intuitively to be most vulnerable, received a minor percentage of the pesticides reaching ground water. The high rate of detection in glacial till was attributed to pesticide flow through secondary porosity channels (macropores).

Bhatt, Kailash P., Project Leader and Contact, Hydrologist, Department of Water and Natural Resources, Division of Environmental Regulations, Ground-Water Quality Program. Tel: 605-773-3296. **1989 Pesticide and Nitrogen Sampling Program** and **1990 Pesticide and Nitrogen Sampling Program.** Studies conducted in 1988-1990. (Reported January 1990, 77 pages, and February 1991, 63 pages, respectively).

Primary Objective

In 1988 the South Dakota Department of Water and Natural Resources (DWNR) initiated a sampling program to assess the presence and extent of pesticides and nitrogen-based fertilizers in ground water. Sampling began in May 1988 in the Parker-Centerville aquifer in Turner County, and the program was expanded in 1989 to include the Bowdle aquifer in Potter County. In 1990 sampling in irrigated and dry land areas was added to the program. Data collected from land- and chemical-use surveys being conducted in conjunction with the monitoring program will be used to help define the relationship between farming practices and ground-water contamination, and to aid farmers in developing Best Management Practices (BMPs) to reduce agricultural chemical impacts on ground water.

Design

The Parker-Centerville aquifer was selected because of the intensive agriculture, extensive irrigation, the potential for ground-water contamination with pesticides and fertilizers, and its susceptibility for rapid infiltration to the ground water. The aquifer is vulnerable to pesticide contamination from the land surface because of the presence of a shallow water table and highly permeable horizons. The Bowdle aquifer was selected due to the shallow ground-water occurrence and highly permeable soil, and the potential for ground-water contamination as a result of land use. Monitoring sites were selected so as to reduce the potential effect from point-source contamination such as chemical spill areas, septic tanks, and sites restricted to livestock.

The original sampling network consisted of 24 monitoring wells at 10 sites in the Parker-Centerville aquifer (Turner County). In 1989 10 wells at 7 sites in the Bowdle aquifer (Potter County) were added, and in 1990 six wells (2 sites) were added in Turner County and 5 wells (2 sites) were added in Potter County. Sampling for pesticides was conducted monthly from May through October each year. Twenty-two Turner County wells were sampled in 1988. In 1989, 12 Turner County wells and 14 Potter County wells were sampled, and in 1990, 18 and 14 wells were sampled in Turner and Potter Counties, respectively. Two wells in Turner County and 1 well in Potter county were never sampled due to insufficient water levels.

Samples were analyzed for 18 pesticides commonly used in the two areas:

alachlor	atrazine	butylate	carbofuran	chloramben
cyanazine	2,4-D	dicamba	EPTC	fonofos
MCPA	metolachlor	metribuzin	pendimethalin	phorate
picloram	terbufos	trifluralin		

Analytical methodologies were chosen that were capable of detecting numerous pesticides in an effort to collect as much data in the most efficient manner.

Results and Conclusions

In 1988 there were 6 Turner County (Parker-Centerville aquifer) wells with detections of alachlor, dicamba or 2,4-D. One well was contaminated with all three pesticides. In 1989 eight Turner County wells and four Potter County (Bowdle Aquifer) were contaminated with atrazine, cyanazine, 2,4-D, dicamba, or fonofos. Fonofos was the most frequently detected pesticide.In 1990 six Turner County wells and two Potter County wells hade detections of alachlor, metolachlor, metribuzin, picloram or trifluralin. Alachlor and metolachlor were the most frequently detected pesticides.

All concentrations reported were low. Seventy-five percent of the pesticides detections in the 1988 Pilot Program were from deeper portions of the Parker Centerville aquifer and 25% were from within 10 feet of the water table. In the 1989 study, 79% of the pesticide detections were in samples from within 10 feet of the water table. Pesticide detections in the Bowdle aquifer accounted for 29% of the total pesticide detections. Three of the four detections were in samples from within 10 feet of the water table. Except for one Turner County well, all wells with detections of pesticides in 1990 also had detections of pesticides in 1989 and one had a sample containing a pesticide in 1988.

Even though some wells in this study showed detectable levels of pesticides in successive years, the same pesticides were not detected in the same well in successive sampling periods. This suggests possible dilution or natural degradation in the aquifer system. The results from three years of sampling indicated that surface activities were the primary source of pesticide presence in ground water.

PESTICIDE SAMPLING IN THE STATE OF SOUTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCENTRATIONS (µg/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
2,4-D	BROOKINGS	1984-1987	17	0	3	149	0	3	0.41-0.44[A]
	HAMLIN	1984-1987	40	0	9	359	0	9	0.77-2.05[A]
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	4	126	0	4	0.02-1.46
		1989/5-10	12	0	1	66	0	1	0.19
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	17	789	0	17	0.02-1.46
Alachlor	BROOKINGS	1984-87	17	0	5	149	0	8	0.3-1.03[A]
	HAMLIN	1984-87	40	0	8	359	0	21	0.1-0.59[A]
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	1	80	0	1	0.90
	TURNER	1988/5-10	22	0	3	126	0	3	0.09-1.26
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	2	98	0	2	0.06-0.22
TOTAL DISCRETE WELLS/SAMPLES			99	0	19	789	0	35	0.06-1.26
Atrazine	BROOKINGS	1984-1987	17	1	0	149	1	0	5.40
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0		
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	1	66	0	1	0.25
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	1	1	789	1	1	0.25-5.40
Butylate	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	

PESTICIDE SAMPLING IN THE STATE OF SOUTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS		SAMPLE RESULTS			RANGE OF CONCENTRATIONS (ug/l)	
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(Butylate)	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	0	789	0	0	
Carbofuran	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	0	789	0	0	
Chloramben	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	0	789	0	0	
Cyanazine	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	1	60	0	1	0.11
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	

PESTICIDE SAMPLING IN THE STATE OF SOUTH DAKOTA

PESTICIDE	COUNTY	DATE YEAR/ MONTH	WELL RESULTS: TOTAL WELLS SAMPLED	# OF POSITIVE WELLS ≥ MCL	# OF POSITIVE WELLS < MCL	SAMPLE RESULTS: TOTAL # SAMPLES	# OF POSITIVE SAMPLES ≥ MCL	# OF POSITIVE SAMPLES < MCL	RANGE OF CONCENTRATIONS (µg/l)
(Cyanazine)	(TURNER)	1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	1	789	0	1	0.11
Dicamba	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	1	126	0	1	0.042
		1989/5-10	12	0	1	66	0	1	0.11
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	2	789	0	2	0.042-0.11
Endrin	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	0	789	0	0	
▸EPTC	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	0	789	0	0	

PESTICIDE SAMPLING IN THE STATE OF SOUTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (ug/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/ MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
Fonofos	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	3	60	0	3	0.01-0.05
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	6	66	0	8	0.007-0.06
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	9	789	0	11	0.007-0.06
Lindane	BROOKINGS	1984-1987	17	0	2	149	0	2	0.05[A]
	HAMLIN	1984-1987	40	0	0	359	0	0	
TOTAL DISCRETE WELLS/SAMPLES			57	0	2	508	0	2	0.05
MCPA	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	0	789	0	0	
Methoxychlor	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	0	789	0	0	

PESTICIDE SAMPLING IN THE STATE OF SOUTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (µg/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/ MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
Metolachlor	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	1	80	0	1	0.10
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	3	98	0	3	0.09-0.12
TOTAL DISCRETE WELLS/SAMPLES			99	0	4	789	0	4	0.09-0.12
Metribuzin	BROOKINGS	1984-1987	17	0	1	149	0	1	0.02
	HAMLIN	1984-1987	40	0	1	359	0	1	0.025
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	4	98	0	2	0.002-0.02
TOTAL DISCRETE WELLS/SAMPLES			99	0	3	789	0	4	0.002-0.025
▸Parathion, ethyl	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	0	789	0	0	
▸Pendimethalin	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	

PESTICIDE SAMPLING IN THE STATE OF SOUTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCENTRATIONS (µg/L)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/ MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(Pendimethalin)	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	0	789	0	0	
*Phorate	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	0	789	0	0	
Picloram	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	1	98	0	1	0.15
TOTAL DISCRETE WELLS/SAMPLES			99	0	1	789	0	1	0.15
Propachlor	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	

PESTICIDE SAMPLING IN THE STATE OF SOUTH DAKOTA

PESTICIDE	COUNTY	DATE	WELL RESULTS: TOTAL WELLS SAMPLED	WELL RESULTS: # OF POSITIVE WELLS		SAMPLE RESULTS: TOTAL # SAMPLES	SAMPLE RESULTS: # OF POSITIVE SAMPLES		RANGE OF CONCENTRATIONS (µg/l)
		YEAR/ MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(Propachlor)	(TURNER)	1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	0	789	0	0	
Terbufos	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	0	359	0	0	
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	0	98	0	0	
TOTAL DISCRETE WELLS/SAMPLES			99	0	0	789	0	0	
Trifluralin	BROOKINGS	1984-1987	17	0	0	149	0	0	
	HAMLIN	1984-1987	40	0	1	359	0	1	0.02
	POTTER	1989/5-10	10	0	0	60	0	0	
		1990/5-10	14	0	0	80	0	0	
	TURNER	1988/5-10	22	0	0	126	0	0	
		1989/5-10	12	0	0	66	0	0	
		1990/5-10	18	0	1	98	0	1	0.03
TOTAL DISCRETE WELLS/SAMPLES			99	0	2	789	0	2	0.02-0.03
GRAND TOTAL DISCRETE WELLS/SAMPLES			99	1	63	789	1	80	

[A] Results from wells with detections were averaged for each site and pesticide. The values listed are the range of these averages. Bendar, Oakwood Lakes-Poinsett RCWP

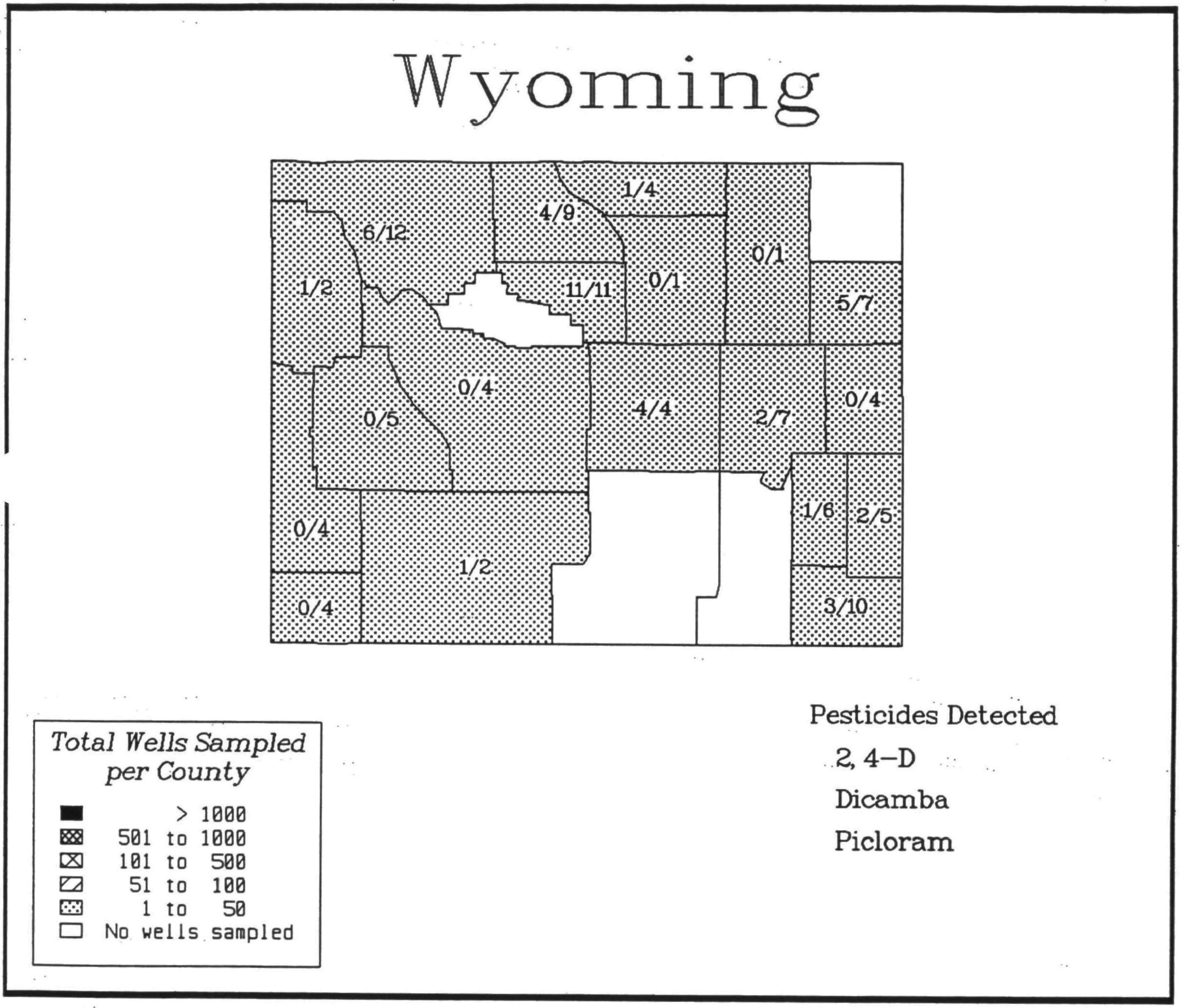
STATE OF SOUTH DAKOTA
WELLS BY COUNTY

COUNTY	TYPES OF WELLS									SOURCE OF CONTAMINATION (NUMBER OF WELLS)		
	DRINKING WATER			MONITORING			OTHER					
	TOTAL SMPLD	≥ MCL	< MCL	TOTAL SMPLD	≥ MCL	< MCL	TOTAL SMPLD	≥ MCL	< MCL	NFU*	PS*	UNK*
Brookings	0	0	0	17	1	12	0	0	0	13	0	0
Hamlin	0	0	0	40	0	19	0	0	0	19	0	0
Potter	0	0	0	14	0	6	0	0	0	6	0	0
Turner	0	0	0	28	0	26	0	0	0	26	0	0
TOTAL	0	0	0	99	1	63	0	0	0	64	0	0

* NFU=Known or Suspected Normal Field Use
PS =Known or Suspected Point Source
UNK=Unknown

Well Sampling by County

(Total Number of Wells with Pesticide Detections / Total Number of Wells Sampled)



OVERVIEW OF STATE LEGISLATIVE AND ENVIRONMENTAL POLICIES REGARDING PESTICIDES IN GROUND WATER

Currently, there is no legislative mandate for ground water monitoring in the state of Wyoming. However, some ground water monitoring is being performed under a Cooperative Monitoring Agreement between the Wyoming Department of Agriculture, the Wyoming Weed and Pest Control Districts and the United States Geological Survey. Under this agreement three herbicides: 2,4-D, dicamba and picloram are monitored from preselected well sites. These herbicides represent approximately 50% of all pesticide application in the state. Site selection is determined by the Wyoming Department of Agriculture and the Weed and Pest Control Districts, and may vary on a yearly basis.

REPORTED STUDIES OF PESTICIDES IN GROUND WATER

Druse, S. A.; et. al. Water Resources Data Wyoming Water Year 1987. US Geological Survey, Water Resources Division, Cheyenne, WY. Tel:(307)772-2153.

Primary Objective
The emphasis of the USGS's monitoring program is surface water. However, the Water Resources Division of the USGS includes a small number of ground water monitoring stations within its water resources monitoring program for the state. Monitoring data is gathered in cooperation with state, municipal, county and federal agencies to identify and track Wyoming's water resources.

Design
Most of the 89 wells in the observation-well network are located in southeastern Wyoming where there is extensive ground-water withdrawal. The methods for collection and analysis of water samples are described in the "U.S. Geological Survey Techniques of Water-Resources Investigations" manuals.

Results and Conclusions
Ground-water monitoring for pesticides was conducted only for special studies in specific areas and thus is not representative of ground water throughout the state.

Five counties were monitored during this time period: Big Horn, Fremont, Natrona, Park and Washakie. It must be noted that analysis was not performed for all pesticides in every county. Big Horn county was the most frequently monitored and was monitored for a more extensive list of pesticides than any other county. Of the 13 pesticides screened during the sampling year, only three were detected. They were: 2,4,-D in Natrona and Washakie counties; dicamba in Big Horn, Park and Washakie counties; and picloram in Big Horn, Natrona, Park and Washakie counties.

Hittle, George F. (1990) **Herbicide Monitoring Program; 1990 Water Quality Analysis,** Wyoming Department of Agriculture/ USDI, Geological Survey. Point of Contact: State of Wyoming Department of Agriculture, Cheyenne, Wyoming 82002-0100.

Primary Objective
The herbicide monitoring program was implemented in 1977 on the upper North Platte River in Carbon County. Application of herbicides has increased over the years, therefore the monitoring program has been expanded to other areas of the state.

The current program monitors thirty-six surface water sites plus twenty-five ground-water quality sites per year. The purpose of the program was to determine the effects of herbicide application on water quality in order to insure that State and Federal water quality standards were not being exceeded, and determine whether herbicide concentrations were adversely affecting drinking water supplies.

Design
Site selection for ground-water samples was performed by the United States Geological Survey (USGS) and the Wyoming Department of Agriculture. Twenty-five new ground-water sites are selected each year. Samples were analyzed by the USGS for pesticides using equipment and methods described in "Techniques of Water Resource Investigation". The detection limits reported for the analytical methods are 0.01 ug/l. A non-zero value is any concentration equal to or greater than the detection limit. Values less than the detection limit are reported as <0.01 ug/l. The samples were analyzed for the herbicides picloram, dicamba, and 2,4-D.

Results and Conclusions
Ground-water samples were collected and analyzed from sites during the years 1987-1990. Twenty-six of the 75 wells sampled during this time period were found to contain at least one herbicide. All three herbicides were detected over the time period. Dicamba and 2,4-D concentrations were below 1 ug/liter, but picloram ranged up to 30 ug/liter and was the most frequently found herbicide.

PESTICIDE SAMPLING IN THE STATE OF WYOMING

PESTICIDE	COUNTY	DATE YEAR/MONTH	WELL RESULTS: TOTAL WELLS SAMPLED	WELL RESULTS: # OF POSITIVE WELLS ≥ MCL	WELL RESULTS: # OF POSITIVE WELLS < MCL	SAMPLE RESULTS: TOTAL # SAMPLES	SAMPLE RESULTS: # OF POSITIVE SAMPLES ≥ MCL	SAMPLE RESULTS: # OF POSITIVE SAMPLES < MCL	RANGE OF CONCEN-TRATIONS (µG/L)
2,4-D	BIG HORN	1987/9	8	0	0	8	0	0	
		1988/9	1	0	0	1	0	0	
	CAMPBELL	1988/9	1	0	0	1	0	0	
	CONVERSE	1988/8,9	7	0	1	7	0	1	0.01
		1989/8	1	0	0	1	0	0	
	FREMONT	1987/8	4	0	0	4	0	0	
	GOSHEN	1988/9	1	0	0	1	0	0	
		1990/8,9	4	0	2	4	0	2	0.02-0.04
	JOHNSON	1988/9	1	0	0	1	0	0	
	LARAMIE	1990/8,9	10	0	2	11	0	2	0.05-0.13
	LINCOLN	1989/8	4	0	0	4	0	0	
	NATRONA	1987/9	2	0	1	2	0	1	0.14
		1990/9	2	0	1	2	0	1	0.01
	NIOBRARA	1988/9	4	0	0	4	0	0	
	PARK	1987/8	8	0	0	8	0	0	
		1988/9	3	0	2	3	0	2	0.02
		1989/8	1	0	0	1	0	0	
	PLATTE	1990/8,9	6	0	1	6	0	1	0.03
	SHERIDAN	1988/8,9	6	0	0	6	0	0	
	SUBLETTE	1989/8,9	5	0	0	5	0	0	
	SWEETWATER	1989/8	2	0	0	2	0	0	
	TETON	1989/8	2	0	0	2	0	0	
	UINTA	1989/8	4	0	0	4	0	0	
	WASHAKIE	1987/8	5	0	1	5	0	1	0.13
		1988/8	5	0	0	5	0	0	
		1989/8	1	0	0	1	0	0	
	WESTON	1987/8,11	2	0	0	2	0	0	
		1988/2-12	6	0	2	30	0	3	0.06-0.13

PESTICIDE SAMPLING IN THE STATE OF WYOMING

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCENTRATIONS (ug/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(2,4-D)	(WESTON)	1989/1-12	4	0	2	20	0	3	0.04-0.09
		1990/1-10	4	0	1	17	0	1	0.01
TOTAL DISCRETE WELLS/SAMPLES			105	0	11	163	0	18	0.01-0.14
2,4,5-T	BIG HORN	1987/9	8	0	0	8	0	0	
	FREMONT	1987/8	4	0	0	4	0	0	
	NATRONA	1987/9	2	0	0	2	0	0	
	PARK	1987/8	8	0	0	8	0	0	
	WASHAKIE	1987/8	5	0	0	5	0	0	
TOTAL DISCRETE WELLS/SAMPLES			27	0	0	27	0	0	
2,4,5-TP (Silvex)	BIG HORN	1987/9	8	0	0	8	0	0	
	FREMONT	1987/8	4	0	0	4	0	0	
	NATRONA	1987/8	2	0	0	2	0	0	
	PARK	1987/8	8	0	0	8	0	0	
	WASHAKIE	1987/8	5	0	0	5	0	0	
TOTAL DISCRETE WELLS/SAMPLES			27	0	0	27	0	0	
Carbophenothion	BIG HORN	1987/9	6	0	0	6	0	0	
TOTAL DISCRETE WELLS/SAMPLES			6	0	0	6	0	0	
Carbophenothion, methyl	BIG HORN	1987/9	6	0	0	6	0	0	
TOTAL DISCRETE WELLS/SAMPLES			6	0	0	6	0	0	
Diazinon	BIG HORN	1987/9	6	0	0	6	0	0	
TOTAL DISCRETE WELLS/SAMPLES			6	0	0	6	0	0	
Dicamba	BIG HORN	1987/9	8	0	1	8	0	1	0.03
		1988/9	1	0	1	1	0	1	0.01

PESTICIDE SAMPLING IN THE STATE OF WYOMING

PESTICIDE	COUNTY	DATE YEAR/MONTH	WELL RESULTS: TOTAL WELLS SAMPLED	WELL RESULTS: # OF POSITIVE WELLS ≥ MCL	WELL RESULTS: # OF POSITIVE WELLS < MCL	SAMPLE RESULTS: TOTAL # SAMPLES	SAMPLE RESULTS: # OF POSITIVE SAMPLES ≥ MCL	SAMPLE RESULTS: # OF POSITIVE SAMPLES < MCL	RANGE OF CONCEN-TRATIONS (µg/l)
(Dicamba)	CAMPBELL	1988/9	1	0	0	1	0	0	
	CONVERSE	1988/8,9	7	0	1	7	0	1	0.09
		1989/8	1	0	1	1	0	1	0.02
	FREMONT	1987/8	4	0	0	4	0	0	
	GOSHEN	1988/9	1	0	0	1	0	0	
		1990/8,9	4	0	0	4	0	0	
	JOHNSON	1988/9	1	0	0	1	0	0	
	LARAMIE	1990/8,9	10	0	0	11	0	0	
	LINCOLN	1989/8	4	0	0	4	0	0	
	NATRONA	1987/9	2	0	0	2	0	0	
		1990/9	2	0	0	2	0	0	
	NIOBRARA	1988/9	4	0	0	4	0	0	
	PARK	1987/8	8	0	1	8	0	1	0.13
		1988/9	3	0	0	3	0	0	
		1989/8	1	0	1	1	0	1	0.25
	PLATTE	19908/9	6	0	0	6	0	0	
	SHERIDAN	1988	6	0	2	6	0	2	0.01
	SUBLETTE	1989/8,9	5	0	0	5	0	0	
	SWEETWATER	1989/8	2	0	0	2	0	0	
	TETON	1989/8	2	0	0	2	0	0	
	UINTA	1989/8	4	0	0	4	0	0	
	WASHAKIE	1987/8	5	0	1	5	0	1	0.03
		1988/8	5	0	3	5	0	3	0.01-0.02
		1989/8	1	0	0	1	0	0	
	WESTON	1987/8,11	2	0	0	2	0	0	
		1988/2-12	6	0	1	27	0	2	0.06-0.13
		1989/1-12	4	0	0	20	0	0	
		1990/1-10	4	0	2	17	0	2	0.01
TOTAL DISCRETE WELLS/SAMPLES			105	0	16	163	0	16	0.01-0.25

PESTICIDE SAMPLING IN THE STATE OF WYOMING

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (µg/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
Dichlorprop	BIG HORN	1987/9	8	0	0	8	0	0	
	FREMONT	1987/8	4	0	0	4	0	0	
	NATRONA	1987/9	2	0	0	2	0	0	
	PARK	1987/8	8	0	0	8	0	0	
	WASHAKIE	1987/8	5	0	0	5	0	0	
TOTAL DISCRETE WELLS/SAMPLES			27	0	0	27	0	0	
Ethion	BIG HORN	1987/9	6	0	0	6	0	0	
TOTAL DISCRETE WELLS/SAMPLES			6	0	0	6	0	0	
Malathion	BIG HORN	1987/9	6	0	0	6	0	0	
TOTAL DISCRETE WELLS/SAMPLES			6	0	0	6	0	0	
Parathion, ethyl	BIG HORN	1987/ 9	6	0	0	6	0	0	
TOTAL DISCRETE WELLS/SAMPLES			6	0	0	6	0	0	
Parathion, methyl	BIG HORN	1987/ 9	6	0	0	6	0	0	
TOTAL DISCRETE WELLS/SAMPLES			6	0	0	6	0	0	
Picloram	BIG HORN	1987/9	8	0	2	8	0	2	0.01
		1988/9	1	0	1	1	0	1	0.01
	CAMPBELL	1988/9	1	0	0	1	0	0	
	CONVERSE	1988/8,9	7	0	1	7	0	1	0.16
		1989/8	1	0	1	1	0	1	0.05
	FREMONT	1987/8	4	0	0	4	0	0	
	GOSHEN	1988/9	1	0	0	1	0	0	
		1990/8,9	4	0	0	4	0	0	
	JOHNSON	1988/9	1	0	0	1	0	0	
	LARAMIE	1990/8	10	0	2	11	0	2	0.02-0.14

PESTICIDE SAMPLING IN THE STATE OF WYOMING

PESTICIDE	COUNTY	DATE	WELL RESULTS			SAMPLE RESULTS			RANGE OF CONCEN-TRATIONS (µg/l)
			TOTAL WELLS SAMPLED	# OF POSITIVE WELLS		TOTAL # SAMPLES	# OF POSITIVE SAMPLES		
		YEAR/MONTH		≥ MCL	< MCL		≥ MCL	< MCL	
(Picloram)	LINCOLN	1989/8	4	0	0	4	0	0	
	NATRONA	1987/9	2	0	2	2	0	2	0.01-0.04
		1990/9	2	0	0	2	0	0	
	NIOBRARA	1988/9	4	0	0	4	0	0	
	PARK	1987/8	8	0	2	8	0	2	0.01-0.02
		1988/9	3	0	0	3	0	0	
		1989/8	1	0	0	1	0	0	
	PLATTE	1990/8,9	6	0	0	6	0	0	
	SHERIDAN	19888/9	6	0	0	6	0	0	
	SUBLETTE	1989/8,9	5	0	0	5	0	0	
	SWEETWATER	1989/8	2	0	1	2	0	1	0.01
	TETON	1989/8	2	0	1	2	0	1	0.01
	UINTA	1989/8	4	0	0	4	0	0	
	WASHAKIE	1987/8	5	0	5	5	0	5	0.01-0.16
		1988/8	5	0	2	5	0	2	0.01-0.11
		1989/8	1	0	0	1	0	0	
	WESTON	1987/8,11	1	0	1	2	0	1	18.0
		1988/2-12	6	0	4	27	0	21	0.01-30.0
		1989/1-12	4	0	4	20	0	20	0.04-15.0
		1990/1-10	4	0	4	17	0	16	0.02-11.0
TOTAL DISCRETE WELLS/SAMPLES			105	0	24	163	0	80	0.01-30.0
GRAND TOTAL DISCRETE WELLS/SAMPLES			105	0	42	340	0	91	

STATE OF WYOMING
WELLS BY COUNTY

COUNTY	TYPES OF WELLS									SOURCE OF CONTAMINATION (NUMBER OF WELLS)		
	DRINKING WATER			MONITORING			OTHER					
	TOTAL SMPLD	≥ MCL	< MCL	TOTAL SMPLD	≥ MCL	< MCL	TOTAL SMPLD	≥ MCL	< MCL	NFU*	PS*	UNK*
Big Horn	1	0	1	8	0	3	0	0	0	1	0	3
Campbell	1	0	0	0	0	0	0	0	0	0	0	0
Converse	8	0	2	0	0	0	0	0	0	2	0	0
Fremont	0	0	0	4	0	0	0	0	0	0	0	0
Goshen	5	0	2	0	0	0	0	0	0	2	0	0
Johnson	1	0	0	0	0	0	0	0	0	0	0	0
Laramie	10	0	3	0	0	0	0	0	0	3	0	0
Lincoln	4	0	0	0	0	0	0	0	0	0	0	0
Natrona	2	0	1	2	0	3	0	0	0	1	0	3
Niobrara	4	0	0	0	0	0	0	0	0	0	0	0
Park	4	0	3	8	0	3	0	0	0	3	0	3
Platte	6	0	1	0	0	0	0	0	0	1	0	0
Sheridan	6	0	2	0	0	0	0	0	0	2	0	0
Sublette	5	0	0	0	0	0	0	0	0	0	0	0
Sweetwater	2	0	1	0	0	0	0	0	0	1	0	0
Teton	2	0	1	0	0	0	0	0	0	1	0	0
Uinta	4	0	0	0	0	0	0	0	0	0	0	0
Washakie	6	0	4	5	0	7	0	0	0	4	0	7
Weston	7	0	5	0	0	0	0	0	0	5	0	0
TOTAL	78	0	26	27	0	16	0	0	0	26	0	16

* NFU=Known or Suspected Normal Field Use
PS =Known or Suspected Point Source
UNK=Unknown

APPENDIX I - PESTICIDE CROSS-REFERENCE TABLE

PESTICIDE CROSS-REFERENCE TABLE

CHEMICAL NAME	REFERENCE	MCL (µg/l)	LHA (µg/l)	PESTICIDE CATEGORY	REGULATORY STATUS
1-Naphthol				Insecticide	C
1,2,4-Trichlorobenzene		9	9	Herbicide	U,C
1,2-D	1,2-Dichloropropene				
1,2-Dichloroethane		5		Fumigant	S
1,2-Dichloropropane		5		Fumigant	C
1,3-D	Dichloropropene				
1,3-Dichloropropene	Dichloropropene				
2-Chloroallyl-diethyldithiocarbamate	CDEC				
2(2,4-Dichlorophenoxy) propionic acid	Dichlorprop				
2(2,4-DP)Diethylamine salt	Dichloroprop				
2,4-D		70		Herbicide	S,SR[Pre]
2,4-DB				Herbicide	S,SR[Pre]
2,4-Dichlorobenzoic acid				Possible degradate or impurity	
2,4-Dichlorophenoxyacetic acid	2,4-D				
2,4-Dinitrophenol				Acaricide insecticide	U,C
2,4-DP	Dichlorprop				
2,4,5-T		70		Herbicide	C,SR[C]
2,4,5-Trichlorophenoxy-acetic acid	2,4,5-T				
2,4,5-TP		50		Herbicide	C,SR[C]
2,4,6-Trichlorophenol	Trichlorophenol				
2,6-diethylaniline	Alachlor			Degradate	
3-Hydroxycarbofuran	Carbofuran			Degradate	
3-Ketocarbofuran & 3-Ketocarbofuran (phenol)	Carbofuran			Degradate	
3,5-Dichlorobenzoic acid	Pronamide			Degradate	
4-Nitrophenol	Parathion, methyl		60	Degradate Fungicide	S
4(2,4-Dichlorophenoxy) butyric acid	2,4-DB				
4(2,4-DB), Butoxyethanol ester	2,4-DB				

PESTICIDE CROSS-REFERENCE TABLE

CHEMICAL NAME	REFERENCE	MCL (µg/l)	LHA (µg/l)	PESTICIDE CATEGORY	REGULATORY STATUS
4(2,4-DB), Dimethylamine salt	2,4-DB				
5-Hydroxy dicamba	Dicamba			Degradate	
Acenaphthene				Insecticide Fungicide	S
Acephate				Insecticide	S
Acifluorfen				Herbicide	S
Acrolein				Fungicide Herbicide Antimicrobial	S,R
Acrylonitrile				Fumigant	C,R,SR^C
Alachlor		2		Herbicide	S,R,SR^P
Aldicarb		3	1	Insecticide Acaricide Fungicide Nematicide	S,R,SR^P
Aldicarb Sulfone	Aldicarb	2	1	Degradate	
Aldicarb Sulfoxide	Aldicarb	4	1	Degradate	
Aldicarb, Total	Aldicarb	3		Parent + degradates	SR^P
Aldrin				Insecticide	C,SR^C
Ametryn		60	60	Herbicide	S
Aminocarb				Insecticide	U,C
Amitraz				Insecticide Acaricide	S,R,SR^C
Amitrole				Herbicide	S,R^P
Anilazine				Fungicide	S
Arsenic		50			
Arsenates, Arsenites	Arsenic			Insecticide Fungicide Herbicide	C SR^C
Arsenic acid Arsenicals	Arsenic			Defoliant Insecticide	S,R SR^P
Atraton	experimental discontinued triazine			Herbicide	C
Atrazine		3		Herbicide	S,R
Atrazine, dealkylated	Atrazine			Degradate	
Azinphos-ethyl				Insecticide	C
Azinphos-methyl				Insecticide	S,R
Banvel	Dicamba				

PESTICIDE CROSS-REFERENCE TABLE

CHEMICAL NAME	REFERENCE	MCL (µg/l)	LHA (µg/l)	PESTICIDE CATEGORY	REGULATORY STATUS
Barban				Herbicide	C
Baygon	Propoxur				
Bendiocarb				Insecticide	S,R
Benefin	Benfluralin			Insecticide Herbicide	S
Benfluralin	Benefin				
Benomyl				Fungicide	S,SR[C]
Bensulide				Herbicide	S
Bentazon		20	20	Herbicide	S
Bentazon, sodium salt	Bentazon			Degradate	
BHC (α,β,δ)				Insecticide	C,SR[C]
BHC (Γ)	Lindane				
Bromacil			90	Herbicide	S
Bromide	Sodium bromide				
Bromoxynil				Herbicide	S
Bufencarb				Insecticide	C
Butachlor				Herbicide	C
Butylate			350	Herbicide	S
Captafol				Fungicide	C
Captan				Fungicide	S,SR[C]
Carbaryl			700	Insecticide	S
Carbendazim				Fungicide	C
Carbofuran		40	40	Insecticide Acaracide Fungicide Nematicide	S,R,SR[C]
Carbofuran phenol	Carbofuran			Degradate	
Carbofuran, total	Carbofuran			Parent + degradates	SR[C]
Carbon disulfide				Fumigant Fungicide	U
Carbon tetrachloride		5		Fire retardant in fumigant formulations	SR[C]
Carbophenothion				Insecticide Acaricide	C
Carbophenothion, methyl				Insecticide Acaricide	U

PESTICIDE CROSS-REFERENCE TABLE

CHEMICAL NAME	REFERENCE	MCL (ug/l)	LHA (ug/l)	PESTICIDE CATEGORY	REGULATORY STATUS
Carboxin			700	Fungicide	S
CDEC				Herbicide	C
Chloramben			100	Herbicide	U,C
Chlordane		2		Insecticide Termiticide	C,SR[C]
Chlordecone				Insecticide	C,SR[C]
Chlordimeform				Insecticide Acaricide Ovacide	C,SR[C]
Chlorfenac				Herbicide	U,C
Chlorfenson				Acaricide	U,C
Chloroallyl alcohol				Insecticide	C
Chlorobenzilate				Insecticide Acaricide	C,SR[C]
p-Chloro-m-cresol				Fungicide Antimicrobial	S
p-Chloro-o-cresol					
Chloroform		100		Fumigant	C,SR[P]
Chloroneb				Fungicide	S
Chloropicrin				Fumigant Warning agent	S,R
Chlorothalonil				Fungicide	S
Chloroxuron					C
Chlorpropham				Herbicide	S
Chlorpyrifos		20		Insecticide	S
Chlorpyrifos, methyl				Insecticide	S
Chlorsulfuron				Herbicide	S
Chlorthal dimethyl	DCPA				
Copper					
Copper salts	Copper			Insecticide Herbicide Antimicrobial Fungicide	some S some U
Copper oxides	Copper			Insecticide Herbicide Fungicide	S
Coumaphos				Insecticide	S
Crufomate				Insecticide	
Cyanazine			1	Herbicide	S,R,SR[C]

PESTICIDE CROSS-REFERENCE TABLE

CHEMICAL NAME	REFERENCE	MCL (µg/l)	LHA (µg/l)	PESTICIDE CATEGORY	REGULATORY STATUS
Cyanide		200	200		
Cyanide, calcium or potassium	Cyanide			Rodenticide	U
Cyanaide, sodium	Cyanide			Rodenticide	S,R
Cycloate				Herbicide	S
Cypermethrin				Insecticide	S,R
Cyprazine				Herbicide	C
Dacthal	DCPA				
Dacthal diacid	DCPA acid metabolites				
Dalapon		200	200	Herbicide	U,C
DBCP		0.2		Fumigant	C,R,SR[C]
DCBA	2,4-Dichlorobenzoic acid				
DCP	1,2-Dichloropropane				
DCPA			4000	Herbicide	S
DCPA acid metabolites	DCPA			Degradate	
D-D Mix	1,2-Dichloropropane and Dichloropropene				
DDT				Insecticide	C
DDD	DDT			Degradate	SR[C]
DDE	DDT			Degradate	
DDVP	Dichlorvos				
DEF	Tribufos			Insecticide Acaricide	C,R
Demeton				Insecticide Acaricide	C
Demeton-methyl				Insecticide Acaricide	C
Demeton-S				Degradate	
Demeton-S sulfone	Demeton-S			Degradate	
Des-ethyl atrazine	Atrazine			Degradate	
Des-isopropyl atrazine	Atrazine			Herbicide	C,R
Diallate				Herbicide	C,R,SR[C]
Diazinon			0.6	Insecticide Fungicide Nematicide	S,SR[C]
Dibromochloropropane	DBCP				

PESTICIDE CROSS-REFERENCE TABLE

CHEMICAL NAME	REFERENCE	MCL (µg/l)	LHA (µg/l)	PESTICIDE CATEGORY	REGULATORY STATUS
Dibutyl phthalate				Insect repellant	U,C
Dicamba			200	Herbicide	S
Dichlobenil				Herbicide	S
o-Dichlorobenzene		600	600	Antimicrobial	U
p-Dichlorobenzene		75	75	Insecticide Fungicide Rodenticide Antimicrobial	S
Dichloropropane[A]					
Dichloropropene				Nematicide Fumigant	S,R,SR[P]
Dichlorprop				Herbicide	S,SR[Pre]
Dichlorprop, butoxyethanol ester	Dichlorprop				
Dichlorvos				Insecticide	S,SR[P]
Dicofol				Insecticide Acaricide	S,SR[C]
Dicrotophos				Insecticide	S,R
Dieldrin				Insecticide	C,SR[C]
Diethylhexyl phthalate	Dioctyl phthalate				
Dimethoate				Insecticide Acaricide	S,SR[C]
Dinoseb		7	7	Herbicide	C,SR[C]
Dinitrocresol	DNOC				
Dioctyl phthalate				Acaricide	C
Dioxacarb					C
Dioxathion				Insecticide	C,R
Diphenamid			200	Herbicide	C
Diquat		20	20	Herbicide	S
Diquat dibromide and various salts	Diquat				
Disulfoton			0.3	Insecticide Acaricide	S,R
Disulfoton sulfone	Disulfoton			Degradate	
Disulfoton sulfoxide	Disulfoton			Degradate	
Diuron			10	Herbicide	S
DMPA				Fly larvicide	C

PESTICIDE CROSS-REFERENCE TABLE

CHEMICAL NAME	REFERENCE	MCL (µg/l)	LHA (µg/l)	PESTICIDE CATEGORY	REGULATORY STATUS
DNOC				Insecticide Herbicide Fungicide Antimicrobial	U,C
DNOC, sodium salt	DNOC				
EDB	Ethylene dibromide				
EBDC compounds	Maneb, Mancozeb, Zineb				SR[C]
Endosulfan				Fungicide Antimicrobial	S
Endosulfan I	Endosulfan			Isomer	
Endosulfan II	Endosulfan			Isomer	
Endosulfan sulfate	Endosulfan			Degradate	
Endothall		100	100	Herbicide	S
Endrin		2	2	Insecticide	U,C,R,SR[C]
Endrin aldehyde	Endrin			Degradate	
EPN				Insecticide Acaricide	C,R
EPTC				Herbicide	S
Ethalfluralin				Herbicide	S,SR[C]
Ethion				Insecticide Acaricide	S,R
Ethoprop				Insecticide Fungicide Nematicide	S,R
Ethyl alcohol				Disinfectant	S
Ethylan				Insecticide	U,C,SR[C]
Ethylene bisdithiocarbamate compounds	Maneb, Mancozeb, Zineb				
Ethylene dibromide		0.05		Insecticide	C,R,SR[C]
Ethylene dichloride	1,2-Dichloroethane				
Ethylene thiourea	ETU				
Ethyl parathion	Parathion, ethyl				
Etridiazole				Fungicide	S
ETU	Maneb			Degradate	
Fenac	Chlorfenac				
Fenamiphos			2	Insecticide Fungicide Nematicide	S,R

PESTICIDE CROSS-REFERENCE TABLE

CHEMICAL NAME	REFERENCE	MCL (µg/l)	HA (µg/l)	PESTICIDE CATEGORY	REGULATORY STATUS
Fenamiphos sulfone	Fenamiphos			Degradate	
Fenamiphos sulfoxide	Fenamiphos			Degradate	
Fenarimol				Fungicide	S
Fenbutatin-oxide				Insecticide Acaricide	S
Fensulfothion				Insecticide Fungicide Nematicide	C,R
Fenthion				Insecticide	C
Fenuron				Herbicide	C
Fenvalerate				Insecticide	S,R
Fluazifop-butyl				Herbicide	S
Fluchloralin				Herbicide	S
Flumetralin				Herbicide	S
Fluometuron			90	Herbicide	S
Fluridone				Aquatic herbicide	S
Fonofos			10	Insecticide	S,R
Formaldehyde			1000	Fungicide Antimicrobial	U
Glyphosate		700	700	Herbicide	S
Glyphosate isopropylamine salt	Glyphosate				
Guthion	Azinphos-methyl				
HCH (α,β,δ)	BHC (α,β,δ)				
HCH (Γ)	Lindane				
Heptachlor		0.4		Insecticide	C,SR[C]
Heptachlor epoxide	Heptachlor	0.2		Degradate	
Hexachlorobenzene		1		Seed protectant	
Hexazinone			200	Herbicide	S
Hydroxyalachlor	Alachlor			Degradate	
Iprodione				Fungicide	S
Isobornyl thiocyanoacetate				Insecticide	C
Isofenphos				Insecticide Herbicide	S,R
Isopropalin				Herbicide	C

PESTICIDE CROSS-REFERENCE TABLE

CHEMICAL NAME	REFERENCE	MCL (µg/l)	LHA (µg/l)	PESTICIDE CATEGORY	REGULATORY STATUS
Kepone	Chlordecone				
Lindane		0.2	0.2	Insecticide	S,R,SR[C]
Linuron				Herbicide	S,SR[P]
Malathion			200	Insecticide	S
Malaoxon	Malathion			Degradate	
Mancozeb				Fungicide	S
Maneb				Fungicide	S
MCPA			10	Herbicide	some C, some S
MCPA acids, salts, esters	MCPA				
MCPB				Insecticide	S
MCPB salts, esters	MCPB				
MCPP salts, esters	Mecoprop				
MCPPA	Mecoprop				
Mecoprop				Herbicide	S
Mercury		2	2		SR[C]
Merphos				Fungicide Herbicide	U,C
Metalaxyl				Fungicide	S
Methamidophos				Insecticide Acaricide	S,R
Methazole				Herbicide	S
Methidathion				Insecticide Acaricide	S,R
Methiocarb				Insecticide Acaricide Molluscicide Rodenticide Bird repellant	S,R
Methomyl			200	Insecticide	S,R
Methoxychlor		40	40	Insecticide Acaricide	S
Methyl bromide				Insecticide Antimicrobial	S,R
Methyl carbophenothion	Carbophenothion, methyl				
Methyl isothiocyanate				Insecticide Fungicide Herbicide	S,R
Methyl paraoxon	Parathion, methyl			Degradate	

PESTICIDE CROSS-REFERENCE TABLE

CHEMICAL NAME	REFERENCE	MCL (µg/l)	LHA (µg/l)	PESTICIDE CATEGORY	REGULATORY STATUS
Methyl parathion	Parathion, methyl				
Methyl trithion	Carbophenothion, methyl				
Methylene chloride				Insecticide	U
Metolachlor			100	Herbicide	S
Metribuzin			200	Insecticide	S
Metribuzin DA	Metribuzin			Degradate	
Metribuzin DADK	Metribuzin			Degradate	
Metribuzin DK	Metribuzin			Degradate	
Mevinphos				Insecticide Acaricide	S,R
Mexacarbate				Insecticide	U,C
Mirex				Insecticide	C,SR[C]
Molinate				Herbicide	S
Molinate sulfoxide	Molinate			Degradate	
Monocrotophos				Insecticide Acaricide	C,R
Monuron				Herbicide	C,SR[C]
Naled				Insecticide Acaricide	S
Naphthalene			20	Insecticide	S
Napropamide				Insecticide	S
Neptalam				Herbicide	S
Neburon				Herbicide	C
Nemagon	DBCP				
Nitrofen				Herbicide	C
p-Nitrophenol	4-Nitrophenol				
Nonachlor	Chlordane			Impurity in formulation	
Norflurazon				Herbicide	S
Octyl bicycloheptene-dicarboximide				Insecticide Fungicide Antimicrobial	S
Ortho-dichlorobenzene	o-Dichlorobenzene				
Oryzalin				Herbicide	S
Ovex	Chlorfenson				

PESTICIDE CROSS-REFERENCE TABLE

CHEMICAL NAME	REFERENCE	MCL (µg/l)	LHA (µg/l)	PESTICIDE CATEGORY	REGULATORY STATUS
Oxamyl		200		Insecticide Acaricide Fungicide Nematicide	S,R
Oxychlordane	Chlordane			Animal metabolite	
Oxydemeton-methyl				Insecticide Acaricide	S,R,SR[P]
Oxydisulfoton				Insecticide Acaricide	C
Oxyfluorfen				Herbicide	S,SR[C]
Para-chlorometacresol	p-Chloro-m-cresol				
para-Dichlorobenzene see p-Dichlorobenzene, listed at dichlorobenzene	p-Chloro-o-cresol				
Paraquat			30	Herbicide	S,R
Paraquat dichloride	Paraquat				
Parathion	Parathion, ethyl				
Parathion, ethyl				Insecticide	S,R,SR[C]
Parathion, methyl		2		Insecticide	S,R
PCNB				Fungicide	S,SR[C]
PCP	Pentachlorophenol				
Pebulate				Insecticide Herbicide	S
Pendimethalin				Herbicide	S
Pentachlorophenol		1		Insecticide Fungicide Antimicrobial	S,R,SR[P]
Permethrin				Insecticide	S,R
Perthane	Ethylan				
Phorate				Insecticide	S,R
Phorate sulfone	Phorate			Degradate	
Phorate sulfoxide	Phorate			Degradate	
Phoratoxon	Phorate			Degradate	
Phoratoxon sulfone	Phorate			Degradate	
Phoratoxon sulfoxide	Phorate			Degradate	
Phosalone				Insecticide Acaricide	U,R
Phosmet				Insecticide	S

PESTICIDE CROSS-REFERENCE TABLE

CHEMICAL NAME	REFERENCE	MCL (µg/l)	LHA (µg/l)	PESTICIDE CATEGORY	REGULATORY STATUS
Phosmet oxygen analog	Phosmet			Degradate	
Phosphamidon				Insecticide	C,R
Picloram		500	500	Herbicide	S,R
Pirimicarb				Aphidicide	C
Pirimicarb sulfone	Pirimicarb			Degradate	
Profenofos				Insecticide	S,R
Profluralin				Herbicide	C
Promecarb				Insecticide	NR (in US)
Prometon			100	Herbicide Antimicrobial	S
Prometryn				Herbicide	S
Pronamide			50	Herbicide	S,R,SR[C]
Propachlor			90	Herbicide	S
Propanil				Herbicide	S
Propargite				Insecticide Acaricide	S
Propazine			10	Herbicide	C
Propham			100	Herbicide	C
Propoxur			3	Insecticide	S,SR[P]
Propyzamide	Pronamide				
Prothiofos	Prothiophos				
Prothiophos				Insecticide	NR
Pyrethrins				Insecticide Fungicide Antimicrobial	U
Pyriclor				Herbicide	C
Ronnel				Insecticide	U,C,SR[C]
Rotenolone	Rotenone			Degradate	
Rotenone				Insecticide Acaricide Piscicide	S
Secbumeton				Herbicide	C
Sethoxydim				Herbicide	S
Siduron				Herbicide	S
Silvex	2,4,5-TP				
Simazine		1	4	Herbicide	S

PESTICIDE CROSS-REFERENCE TABLE

CHEMICAL NAME	REFERENCE	MCL (mg/l)	LHA (µg/l)	PESTICIDE CATEGORY	REGULATORY STATUS
Simetone				Herbicide	NR
Simetryn				Herbicide	NR
Sodium bromide	Bromide			Insecticide Fungicide Herbicide Antimicrobial	S
Sodium cyanide	Cyanide				
Sulprofos				Insecticide	S,R
Swep				Herbicide	C
TCA and salts	Trichloroacetic acid				
TCE	Trichloroethene				
Tebuthiuron			500	Herbicide	S
Telone	Dichloropropene				
Terbacil			90	Herbicide	S
Terbufos			0.9	Insecticide Fungicide Nematicide	S,R
Terbufos sulfone	Terbufos			Degradate	
Terbuthylazine				Herbicide Algaecide	S
Terbutryn				Herbicide	C
Terrazole	Etridiazole				
Tetrachloroethylene		5		Fumigant	C
Tetrachlorvinphos				Insecticide	S
Tetradifon					U,C
Thanite	Isoboryl thiocyanoacetate				
Thiobencarb				Herbicide	S
Thiobencarb sulfoxide				Degradate	
Thiophanate				Fungicide	C
Thiophanate-methyl				Insecticide Fungicide	S,SR[C]
Tordon	Picloram				
Toxaphene		3		Insecticide	U,R,SR[C]
Tralomethrin				Insecticide	S,R
Trans-nonachlor	chlordane			Impurity in formulation	
Triadimefon				Fungicide	S

PESTICIDE CROSS-REFERENCE TABLE

CHEMICAL NAME	REFERENCE	MCL (µg/l)	LHA (µg/l)	PESTICIDE CATEGORY	REGULATORY STATUS
Tribufos				Herbicide	S
Trichlorfon				Insecticide	S
Trichloroacetic acid				Herbicide	U
Trichlorobenzene	1,2,4-Trichlorobenzene				
Trichloroethene					
Trichloroethylene	Trichloroethene	5		Fumigant	C
Trichloronat(e)				Insecticide	C
Trichlorophenol				Fungicide Herbicide Antimicrobial	U,C
Trichlorophon	Trichlorfon				
Triclopyr				Insecticide Herbicide	S
Tricyclazole				Fungicide	NR
Trifluralin			5	Herbicide	S,SR,^{C}
Trithion	Carbophenothion				
Tunic	Methazole				
Uracil/Urea				Antimicrobial	U
Vernolate				Herbicide	S
Vorlex	1,2-Dichloropropene, Dichloropropene, Methyl isothiocyanate				
Xylene		10000	10000	Insecticide Fungicide Herbicide Antimicrobial	U
Zineb				Insecticide Fungicide	C
Ziram				Insecticide Fungicide	U

SR^{Pre} Presently in Pre-Special Review

SR^{P} Special Review in progress

SR^{C} Special Review completed

S Supported: The producer(s) of the pesticide has made commitments to conduct the studies and pay the fees required for reregistration, and is meeting those commitments in a timely manner.

PESTICIDE CROSS-REFERENCE TABLE

U Unsupported: The producer(s) of the pesticide has not made or honored a commitment to seek reregistration, conduct the necessary studies, or pay the requisite fees for reregistration of the product.

C Canceled: The active ingredient is no longer contained in any registered pesticide products.

R Restricted Use: The pesticide has been classified as a Restricted Use Pesticide under 40 CFR Part 1, Subpart 1. It is therefore restricted to use by a certified applicator, or by or under the direct supervision of a certified applicator.

A In Hawaii both dichloropropane and 1,2-dichloropropane appear in the data.

NR Not Registered for use in the United States

APPENDIX II - NATIONAL SURVEY OF PESTICIDES IN DRINKING WATER WELLS

NATIONAL SURVEY OF PESTICIDES IN DRINKING WATER WELLS

At this time the Pesticides in Ground Water Database does not contain data from the National Survey of Pesticides in Drinking Water Wells (NPS). These data have been recently analyzed and published.[3] OPP is currently working on importing the results of the pesticide analyses, so that they will be available when the PGWDB becomes part of the Pesticide Information Network. The following is a short description of the NPS and a summary of findings from the NPS.

The NPS is a joint project of EPA's Office of Drinking Water and Office of Pesticide Programs. This survey is the first national study of pesticides, pesticide degradates and nitrate in drinking water wells. The Survey has two principal objectives: 1) to determine the frequency and concentration of pesticides and nitrate in drinking water wells nationally; and 2) to improve EPA's understanding of how the presence of pesticides and nitrate in drinking water wells is associated with patterns of pesticide use and the vulnerability of ground water to contamination. The focus of the Survey was on the quality of drinking water in wells, rather than on the quality of ground water, surface water or drinking water at the tap. The Survey was designed to yield valuable information on both the frequency and levels of pesticides, pesticide degradates and nitrate in rural domestic (private) and community (public) drinking water wells on a nationwide basis. The Survey was not designed to provide an assessment of pesticide contamination in drinking water wells at the local, county or State level.

More than 1300 wells were sampled, some in each State, for 127 analytes. Nitrate was the most commonly detected analyte in these wells. Based upon the NPS results EPA estimates that nitrate is present at or above the analytical minimum reporting limit of 0.15ug/L in about 52.1% or community wells, and 57% of rural wells nationwide.

The survey detected pesticides and pesticide degradates much less frequently than nitrate. Twelve of the 126 pesticides and degradates were found in the sampled wells. EPA estimates that 10.4% of community wells and 4.2% of rural domestic wells in the United States contain pesticides or pesticide degradates at or above the analytical minimum reporting limit. The two most commonly found pesticides were DCPA acid metabolites (degradate of dimethyl tetrachloroterphthalate) and atrazine. The following is a list of the pesticides found in each type of well in alphabetical order.

<u>Community:</u> atrazine, DCPA acid metabolites, dibromochloropropane, dinoseb, hexachlorobenzene, prometon, simazine.

<u>Rural Domestic:</u> alachlor, atrazine, bentazon, DCPA acid metabolites, dibromochloropropane, ethylene dibromide, ethylene thiourea, gamma-BHC (lindane), prometon, simazine.