

FINAL REPORT
OF THE
CITIZENS PANEL
ON
AGRICULTURE AND WATER QUALITY

JANUARY 1985

The Center for New Democratic Processes

CNDP is a non-profit organization, founded in 1974, with the goal of finding new and more effective ways to promote the public interest. Its main effort has been devoted to Citizens Panels, modeled on the jury system, as a way of improving the involvement of citizens in the formation of public policy. The advantage of this method is that it is one of the few ways in which a cross section of the public can become knowledgeable on an issue and thus make well-informed recommendations to policy makers. The project described in this report is the first time in the United States that such a Citizens Panel has been used on a statewide basis. This is not, however, the first time CNDP has worked on the issue of agriculture. In 1975-1977, CNDP did a study of U.S. government-held grain reserves with Bob Bergland and Paul Findley (then both members of the U.S. House of Representatives) as sponsors.

Steering Committee

The Agriculture/Water Quality Project was run under the auspices of an eleven member Steering Committee. The Steering Committee consisted of a representative from each of the following: the Association of MN Counties, the Center for Urban and Regional Affairs, the Izaak Walton League, the MN Association of Soil and Water Conservation Districts, the MN Department of Agriculture, the Department of Natural Resources, the Farm Bureau, the Farmers Union, the Pollution Control Agency, the MN Sportfishing Congress, and the Soil and Water Conservation Board.

It is important to note that when organizations chose to be on the Steering Committee, they made no commitment to the recommendations of the Citizens Panels. Their only commitment was to oversee the project to make sure it was run properly. As described in Section II, the Steering Committee made a number of significant decisions about how the project should be run. From January through March, 1985, the sponsors will be reviewing this report to decide on which of the recommendations they feel they can support.

The Citizens Panels

This report is the culmination of a year long project which examined the impacts of agriculture on water quality in Minnesota. There were five regional Citizens Panels of 12 persons each held during the summer and early fall of 1984 in Rochester, Windom, Fergus Falls, St. Cloud and the Metro Area. The 12 citizens from the Metro Area were selected entirely at random from the general public. Each of the other four Panels consisted of six persons selected at random from the general public and six selected at random from among those who attended a series of informational meetings held in January and February, 1984.

In November and December a statewide Citizens Panel, made up of three members from each of the five regional Panels, met in St. Cloud to make specific recommendations based upon the more general conclusions of the regional Panels. These recommendations are found in Section VI. The other sections were written by the staff of CNDP.

Members of the Statewide Panel

Gerald Brockberg	Pipestone, Chair	James Becker	Detroit Lakes
Chris Blonigen	Paynesville	Pat Butler	Verndale
Thomas Holm	New Ulm	Peggy Johnson	Apple Valley
Malcolm Lee	Pelican Rapids	Ethel Machacek	St. Paul
Norman Penner	Butterfield	Donald Sirucek	Staples
Gina Stang	Rochester	Paul Stellpflug	Rochester
Shelley Steva	Thief River Falls	John Theis	Cottage Grove
Gerald Tiedeman	Oronoco		

Members of the Regional Panels

Southeast Panel

Audrey Austin	Kilkenny	Dwight Ault	Austin
Sheri Bauter	Racine	Darla Beighley	Glenville
Philip Burnett	Rochester	Timothy Dykstal	Rochester
Hilda Felt	Rochester	Faith Knadel	Rochester
Gina Stang	Rochester	Paul Stellpflug	Rochester
Gerald Tiedeman	Oronoco	Robin Thorpe	Hayward

Southwest Panel

George Bishop	Fairmont	Gerald Brockberg	Pipestone
Dale Burnham	Walnut Grove	Marilyn Danks	Waterville
Paul Fasching	Mankato	Thomas Holm	New Ulm
Alfred Marquardt	Janesville	Susan Misgen	Mankato
Norman Penner	Butterfield	Myrna Rahm	Trimont
Jan Staus	Mankato	Donna Westman	St. James

West Central Panel

Carl Anderson	Chokio	Pat Butler	Verndale
Harold Gray	Fergus Falls	Guy Gorder	Moorhead
Laure Hoff	Ashby	Donald Kenyon	Henning
Malcolm Lee	Pelican Rapids	Betty Shelstad	Appleton
Shelley Steva	Thief River Falls	Jeanne Strom	Moorhead
Myrtle Volbrecht	Fergus Falls	Ronald Warnsholz	Twin Valley

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Central Panel

James Becker	Detroit Lakes	Chris Blonigen	Paynesville
William Caughey	Brainerd	Margaret Harju	Cokato
Wayne Johnson	Ogilvie	Dan Meyer	Willmar
Dan Nyquist	Howard Lake	Al Patton	Sartell
Donald Sirucek	Staples	Oscar Skibenes	Buffalo
Peter Stenger	Watkins	Charlotte Weber	Montrose

Metro Panel

Frank Clifton	Bloomington	Tanis Dauphinais	Anoka
Gloria Diehl	St. Paul	Deborah Douglas	Shakopee
Karen Flood	Eagen	Robert Gould	St. Paul
Peggy Johnson	Apple Valley	Ron Ledford	Spring Lake Park
Ethel Machacek	St. Paul	Terri Riemenschneider	St. Paul
Ralph Sundberg	Minneapolis	John Theis	Cottage Grove

Staff of the Center for New Democratic Processes

The six staff people who worked on this project brought to it a diversity of skills and a variety of points of view. The director of the project was Ned Crosby, who holds a Ph.D. in political science from the University of Minnesota. As founder and president of CNDP, he has worked since 1974 to perfect the Citizens Panel process as a means of including the public in the formation of public policy. Paul Schaefer, with a Ph.D. in anthropology from the University of Minnesota, was project associate. In the design and implementation of the project, there was little differentiation between the roles played by Schaefer and Crosby. Schaefer's previous interest and involvement have been in the area of sociocultural change.

Karen Husby, the administrative secretary, helped the project to run smoothly, typing its many materials, including this report, and managing a number of the details of the project such as overseeing most of the contacts with the press. She is an ordained Lutheran Pastor with a Master's degree in religion and a professional interest in peace and justice issues. Janet Kelly, a Sociology Ph.D. from Cornell, worked a total of four months doing background on the legislature as well as helping to set up several regional Panels. Kelly's academic and personal interests are in the areas of citizen participation and rural development. Carrie Emerson, a graduate student in agricultural economics at the University of Minnesota, worked one-quarter time as the project's research assistant. Mary Kearney, currently an attorney residing in Minneapolis, did most of the background work in 1983 which was necessary to get the project underway.

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ACKNOWLEDGEMENTS

There were a large number of people whose help was essential in the running of this project. The members of the Citizens Panels, both regional and statewide, worked diligently at their tasks. Several of the regional panelists had to drive over an hour to attend and some of the statewide panelists drove for up to four hours. The level of knowledge and the hard work shown by the panelists were the subject of frequent comments from those who observed the process. Members of the Steering Committee were no less diligent. Their help went well beyond attending the Steering Committee meetings: they gave frequent assistance during the running of the project and several of them spent a day or more in St. Cloud helping the statewide Panel (indeed three representatives were present for all six days).

In addition, representatives of other groups, notably the Agricultural Extension Service, the State Planning Agency, the Water Resources Board, and the Minnesota Dept. of Health, helped in a number of ways as the project progressed. Also we want to thank Sen. Gene Merriam, Rep. Elton Redalen, and Rep. William Schreiber for taking the time to drive to St. Cloud to address the statewide Panel.

In terms of gathering information, there were a large number of people (many from the above listed groups) who very kindly took the time to appear as witnesses before the Panels (see Appendix 1 for a list of names). Although they received no compensation for what they did, most of them put considerable work into preparing their presentations. In the process of our learning about the subject, there were people too numerous to list who helped us in a variety of ways. This group includes farmers, local officials, professors, interested citizens, and many others.

Finally, thanks must be given to those whose financial generosity enabled us to undertake this project. It was a major grant from the Joyce Foundation of Chicago which made the project possible. In addition, there was a grant from the General Mills Foundation and from several private individuals. The sponsors of the project made in-kind contributions of staff time and equipment and some of the sponsors helped with the printing of this report. The University of Minnesota, through the Center for Urban and Regional Affairs, contributed the services of a research assistant for one-quarter time for a year. We are very indebted to all of these groups.

Although this project involved a considerable amount of work, it was exciting to do and we enjoyed the wide range of Minnesotans we met, many of whom we came to know quite well. To all of you who provided us with a year of lively and meaningful work, many thanks.

Ned Crosby
Minneapolis,
January 23, 1985

Section I

EXECUTIVE SUMMARY

The Issue

Conservationists have known for a long time that farming is a possible source of water pollution. As the use of agricultural chemicals and large machinery has increased since the end of World War II, so has concern with this problem. Nitrates can pollute ground water, phosphates can greatly accelerate the growth of weeds and algae in lakes, sediment can fill ditches, streams, and rivers, and pesticides can pose health hazards to fish and ultimately to humans.

This issue is of particular concern in Minnesota where the purity of our ground water and the beauty of our lakes is a source of pride, as well as the basis of a large tourist industry. But the complexity of the problem means that simple solutions are not possible. It is difficult to determine how much soil and/or agricultural chemicals are getting into the water from any given farm. Hence it is hard to develop standards and apply them to particular farms. Even if appropriate standards are developed, there is a risk that holding farmers to these standards will impose severe financial burdens on them. Unlike other industries, farmers cannot simply pass the cost of pollution control on to their customers. Given that agriculture is Minnesota's major industry, the regulation of farming activities has the potential for dealing a severe blow to our economy.

Section III of this report provides a detailed review of ways in which agriculture can and does impact water quality in Minnesota. Section V contains a discussion of areas of the problem which are in debate.

The Project

The project was started in January and completed in December of 1984. The process is described in detail in Section II of the report. The highlights were:

- Informational meetings held in seven cities in January and February.
- A state-wide survey, done in March, to learn what the general public felt about certain agricultural and environmental issues.
- Five regional Citizens Panels, consisting of twelve person each, selected at random from the survey and the informational meetings. These were held in Rochester, Windom, Fergus Falls, St. Cloud, and the Metro Area. They heard a total of 86 witnesses.
- A state-wide Citizens Panel consisting of three representatives from each of the regional Panels. The state-wide Panel met for six days in November and December to formulate the final recommendations of the project (see Section VI).

Recommendations

The project recommendations are discussed in detail in Section VI. The highlights are:

- Significance of issue. On a 10 point scale the regional Citizens Panels rated the significance of the issue to be 7.3. This means that, although there are other problems facing their communities of greater importance, clearly the issue is above average in terms of its significance.
- Need to act. The regional Citizens Panels found the need to take action to be high. On a 10 point scale the average rating was 8.9.
- How much should be spent and who should pay? The regional and state-wide Panels settled on a figure of \$12 million annually as the amount of additional funding needed. This would be approximately a 100% increase over what is currently being spent by federal, state and local governments. There was a strong feeling that this money should be raised at the state level so as to avoid additional tax burdens on counties and farmers.
- What should be done? The state-wide Panel sought to devise a plan so that all would share in the burdens and benefits of action:
 - The counties should be required by the state to take responsibility for dealing with the issue, but the state should provide \$12 million annually to enable them to do this.
 - The counties should be given wide authority to deal with the issue, but some state agency should coordinate the county plans.
 - Farmers should recognize the effects of agriculture on water quality and voluntarily do what they can to reduce these, but the majority of the state funds should go to farmers to help them do what is needed.
 - Education is needed to give both farmers and the general public a better understanding of the issue.
 - Improved research is needed in order to get good data on the nature of the problem and to indicate where and what kind of action is most needed.

Existing Programs

In Minnesota a somewhat bewildering array of programs and agencies have jurisdiction over, or some interest in, water quality. Section IV orders this array by providing an outline and brief description of the major federal, state and local units of government which address the problem of farming's impact on water quality in Minnesota.

Section II

THE PROCESS

1. INTRODUCTION

Since 1974, the Center for New Democratic Processes has been working on ways to modify the jury system so that it can be used on social/political/economic issues. The aim is to find a way to get a cross-section of the public involved in public policy debates. Altogether too often the views of average citizens are lost as special interests clamor to get their voices heard.

The jury system is a method for selecting a cross-section of the public, paying them so they can spend enough time to understand an issue, and then letting them render a verdict. Citizens Panels, as developed by CNDP, draw on some of these characteristics: people are selected at random and paid to attend a series of meetings where precautions are taken to prevent those who staff the process from biasing the results. On the other hand, Citizens Panels do not render a verdict which is binding on the public, the random selection process is modified in several ways from that used with juries, and information need not be organized by two advocates who present simply a pro and con point of view.

This report is not intended as an evaluative document which reviews the process from an analytical point of view. That will be the topic of a future report, once staff has had a chance to reflect on the experience, review the data, and gather comments from sponsors and others who were involved in the process. Instead, this report is intended as a description of the process for those who are interested in agriculture and water quality. This means that this section contains a fair amount of detail in order to show how the Panels were chosen, how they went about their task, and what information was available to them.

Before describing those details, however, we believe it would be useful for the reader to understand the goals or functions which the staff had in mind:

Gaining legitimacy. Since Citizens Panels are a novel idea, never used before in Minnesota (or the United States, to the best of staff knowledge), it was vital to get the approval and support of existing groups. The eleven sponsors listed at the beginning of the report served this function. They were selected between January and June, 1983. They agreed to three things: to appoint a representative to the Steering Committee which would oversee the project, to give in-kind contributions, and to give serious consideration to the final recommendations. Putting together the Steering Committee also helped staff ascertain the need for the project. If the issue of agricultural impacts on water quality was being dealt with effectively by existing methods, then sponsors would have been difficult to find. Of those groups asked to be sponsors, only one refused.

Gathering information. This was done in several ways: a questionnaire was sent to the 92 Soil and Water Conservation Districts in the state, seven informational meetings were held around the state where staff could learn about the views of those concerned about the issue, a statewide survey probed the attitudes of average citizens, the staff made numerous contacts with professionals in the area, and much time was devoted to locating existing data (see Section III, Description of the Problem).

Selecting balanced Panels. In the legal system a process called "voir dire" is used to eliminate those who have some interest or prejudice regarding the case. This approach is not possible with public policy issues, since most people have an interest in the outcome, as citizens and taxpayers. Therefore the approach used by CNDP is to balance the Panels according to the attitudes of the participants rather than attempting to remove any participant for cause. A questionnaire is developed and the general public is surveyed to discover their attitudes. The public is then divided into three equal segments according to whether they are pro, con, or balanced on the issue. When panelists are selected, they are drawn in equal numbers from the three categories in order to produce a group of panelists which represents a cross-section of the public on the relevant attitudes.

In this project it was felt that something needed to be done to CNDP's standard method in order to recognize those minorities with special concerns, in particular farmers and those who place a special value on water resources. In the random selection process they would be represented only in small numbers, even though their stake in the results would be considerably greater than that of most citizens. But to create a quota for farmers or, say, swimmers would raise the question of what other groups deserve a quota. Hence the decision was made to hold informational meetings which all interested groups would be urged to attend. All attending could put their name on a list to be drawn at random as a participant. As with the survey, a questionnaire was used to divide those at the informational meetings into three groups so that the panelists selected at random would represent a cross-section of those attending the meetings.

Minimizing staff bias. In a court of law, "staff bias" is kept at a minimum by having a counsel for the defense and for the prosecution, allowing witnesses to be questioned by both attorneys, and having the procedures overseen by a judge. With the issue of agriculture and water quality, there were not simply two sides to the issue and thus the idea of prosecution and defense were not appropriate. In order to control staff bias, CNDP staff set the agenda in a public way, invited interested parties to critique their presentation at a special trial run, and gave evaluation forms to the panelists at the end of each set of Panel meetings.

Making informed decisions. CNDP staff attempted to structure meetings so that panelists had both the time and the information necessary to answer the questions put to them. As the staff began to appreciate the complexity of the issue and the diverse geological

nature of Minnesota, it became clear that a single Panel, representing the whole state, would need at least 15 full days of meetings in order to make informed decisions. It was therefore decided to use five regional Panels which would meet for four days each in order to answer the basic questions about the general nature of the issue, its significance, and the need to take action. Then a statewide Panel, drawn from the regional Panels, would meet for six days to make specific recommendations. In other words, the structure of the process was intended to reflect the need for informed decisions. The two-tiered process also required an initial commitment of only four days from participants, rather than an initial commitment of something like 15 days which would have been necessary for a single statewide Panel.

Getting the recommendations used. Several steps were taken to accomplish this. As already noted, when sponsors agreed to the process, they also agreed to give serious attention to the recommendations of the Panels. Obviously, a commitment to carry out the recommendations would have been stronger, but given the prominent list of sponsors and the various boards and elected officials they serve, CNDP staff judged this to be a good accomplishment for a novel process. Also, efforts were made to obtain media coverage for the process. This resulted in over 70 newspaper articles, 15 T.V. commentaries, and 25 radio commentaries in 1984. Finally, CNDP staff will work during the beginning of 1985 to facilitate those steps which either the panelists or the sponsors may want to take regarding the recommendations. This process will be completed only several months after the release of this report.

Evaluating results. As noted above, this report is intended to describe the project and the data gathered rather than to evaluate the process. Other reports to be completed later in 1985 will deal with evaluation. At this point, however, a few statistics are in order. Of the 60 regional panelists, only one failed to attend the full four days (due to a health problem). The six day statewide meetings were attended by all 15 panelists. In the evaluation forms panelists were asked to rate the process on a five point scale ranging from "very satisfied" to "very dissatisfied". There were 62% of the panelists who chose "very satisfied", with all the rest choosing "satisfied" except for two regional panelists who were "neutral" and one who was "dissatisfied". On the question of staff bias, 65% of the panelists were "very satisfied" with staff performance. Evaluations by others such as witnesses and sponsors will be gathered in the next few months.

2. SWCD QUESTIONNAIRES

In gathering information about farming's effects on local water quality in Minnesota, CNDP mailed out a questionnaire to each of the state's 92 Soil and Water Conservation Districts. These were chosen because in many ways they are closest to the issue on a daily basis.

88 out of the state's 92 districts (96%) returned the questionnaire. 63 districts (68%) answered "yes" to the question "Have any disputes arisen in your district wherein a farming activity was

blamed for negatively affecting a water resource?" Concerns were expressed for both surface and ground water resources.

The following types of agricultural sources of water quality problems were listed by SWCD personnel or supervisors. Many of these were not the cause of specific disputes, but were listed as general concerns. Often, a district indicated having several of these problems.

<u>Problem</u>	<u>Number of Districts</u>
Animal Wastes	60
Erosion/Siltation	59
Agrichemicals	26
Nutrients	25
Drainage	16
Irrigation	8
Nitrates	4

Two non-agriculturally related problems were also listed, i.e., 23 districts cited concerns about residential waste, and four mentioned hazardous waste.

In answer to the question "If agricultural activities are significantly affecting water quality, what is the most effective way to approach a solution?" the districts suggested the following options, usually is several combinations:

<u>Solution</u>	<u>Number of Districts</u>
Cost-Sharing	65
Voluntary Participation	35
Education	30
Mandatory Controls	29
Increased Funding of Programs	10
Cross-Compliance	6
Incentives, e.g., Tax Relief	3

In sum, the questionnaire indicated that most districts did feel they had agriculturally-related water quality problems, and that the best approach to solving them was some sort of voluntary cost-sharing program wherein districts would work together with farmers. Education efforts were seen as essential and mandatory controls were usually seen as an "if necessary" option.

3. INFORMATIONAL MEETINGS, 1984

A. Contacts

Using media lists we began early in January to contact newspapers and radio and T.V. stations in each of the seven areas where we planned to hold meetings to advise the public of the project. At the same

time, we contacted a number of farmers, local officials, sportsmen and others potentially interested in the issue. We began our contacts with several names furnished by sponsors or others encountered in organizing the project. These few names soon led us to a large list of others. In all, we met face-to-face, in periods of time from several minutes to several hours, with over three hundred people.

The majority of those we spoke with were interested in, and some quite knowledgeable about, water quality issues. They contributed examples of local agricultural impacts on water quality, discussed possible solutions, and in most instances, referred us to others concerned with the matter. A number of people also showed an interest in (and at times a skepticism about) the processual part of the project. In the end, more than half of those we contacted attended the informational meetings, and many indicated a willingness to serve on the Citizens Panels.

In addition to personal contacts, attendance at the informational meetings and interest in the project were further enhanced by a number of radio and T.V. announcements and newspaper articles. Handbills were also placed in grain elevators, co-ops, cafes and hardware stores in many of the small towns along the route.

B. Attendance

Meeting attendance totaled 275, an average of 39 people per meeting. Members present at each location varied as follows: Mankato, 60; Rochester, 55; Windom, 14; Fergus Falls, 26; Thief River Falls, 30; Buffalo, 52; and Brainerd, 38. The Windom figure was low, we believe, because the meeting took place just two days after a disastrous winter storm hit the area.

The majority (84%) of those who came to the meetings were men. Of the 251 people who filled out questionnaires, half of them lived on farms, 45% of those responding were over age 50, and half of the total number were college graduates. Many of those in attendance indicated some association with a group interested in the issue, as shown in the following list:

<u>Sponsors</u>		<u>Non-Sponsors</u>	
SWCD	30	Educators	11
Izaak Walton League	10	MN Envir. Educ. Council	9
Sportfishing Congress	8	Legislators	5
Farmers Union	7	Lake Associations	4
Pollution Control Agency	7	Conservation Tillage	
Farm Bureau	5	Associations	3
Association of MN Counties	4	Irrigators Associations	3
Dept. of Nat. Resources	3	Miscellaneous	10

C. The Meetings

The meetings were held in the evening (starting at 7 or 7:30 P.M.) to allow for maximum participation. Locations used included Holiday Inns, college facilities, a county courthouse and an armory. People were greeted as they entered the door, and asked to sign a meeting log with name, address, telephone number and group represented.

Each meeting began with a brief introduction of the project by Ned Crosby. Ned explained the history of CNDP and the objectives of the Citizens Panel as it applied to agricultural impacts on water quality. Questions were taken from the audience. The most frequently asked question concerned the outcome of the project, i.e., what impacts would the Panels' recommendations have on policy and the issue in general. Another question frequently asked was whether CNDP was more interested in the process or in the substance of the issue. The answer given was that the two cannot be separated: although the main purpose of CNDP lies with process, it would be impossible to run the process properly and have people take it seriously unless the substance of the issue received at least as much attention as the process.

Following Ned's presentation, a questionnaire (described under part 4 of this section) was handed out. Ten to twenty minutes were spent filling out the questionnaire, after which people got up to talk with one another and have refreshments.

With the people seated again, the bulk of the meeting continued with Ned and Paul Schaefer moderating audience discussions of local water quality issues, possible solutions and related matters. Inevitably, a few unrelated matters also surfaced. Discussion and dialogue were always lively, but never heated despite the fact that several different, and sometimes opposing, points-of-view were represented. A rather thorough effort was made by the staff to ensure all participants an opportunity to be heard. In discussion between citizens and staff after the meetings, the staff was frequently complimented on "running a good meeting." Negative comments referred either to what someone else had said or the sense that "nothing new" had been voiced.

Meetings ended formally at 10 P.M. Animated discussion occurred long thereafter, however, and in several cases, moved out into the parking lots.

D. Information Gathered

A great deal of information about farming's impacts on water quality was gathered during the informational meeting phase. Much of what was learned about the issue, while in anecdotal form, was quite similar to professional presentations of the problem. A list of problems per se, such as sedimentation and its effects, as discussed at the informational meetings, bears a surprising resemblance to the "description of the problem" section of this document. A list of solutions, dealing with such things as education and incentives, is very much like what the regional and statewide Panels arrived at.

4. SURVEY

As noted above, the purpose of the survey was to provide an overview of Minnesotan's attitudes on certain agricultural and environmental issues. More importantly, it was the basis for selecting the entire Metro Panel and half of the other four regional Panels.

A. Developing the Questionnaire

Starting in December, 1983, Ned Crosby met several times with Robert Coursen, a consultant in the area of survey research and former director of the Minnesota Poll, to discuss the purpose of the questionnaire and develop a list of potential questions. Well over 100 questions were reviewed and several general strategies discussed. In the beginning of January two focus groups were convened. One was held in Plainview, Minnesota and included several farmers in the group. A questionnaire was presented and then a general discussion of the questions was encouraged. A week later, after a major revision of the questionnaire, it was presented to a focus group in the Metro Area.

A further refinement of the questions came when they were reviewed by a sub-committee of the Steering Committee. This was done because several of the sponsors of the project wanted to be sure that the questions were not slanted for or against any substantive point of view. Finally, the questionnaire was tested over the phone in two separate evenings of calling randomly selected telephone numbers in both urban and rural communities.

B. Conducting the Survey

The Minneapolis Star and Tribune generously agreed to supply a list of 11,000 randomly generated telephone numbers, constructed in such a way that the numbers were proportional to the population of each county in the state. Such a list of numbers is exactly what the Star and Tribune uses as the basis of the Minnesota Poll. This was a very important contribution, since otherwise it is quite difficult to select a sample at random and be sure that all parts of the state are fairly represented.

Jeanne Drew Surveys was then hired to conduct the survey. The advantage of hiring them was that they are a respected agency and they have often conducted surveys for the Minnesota Poll. This meant that they already had set procedures and forms for using the list of 11,000 telephone numbers. They called through a list for a particular county until they found a number which was in service (the computer generates many numbers which are not in service). Once contact was made, the person who answered was asked to list all adults who lived in the home. A random selection process was then used to select the person to be interviewed. This process is necessary to avoid biases created by the fact that women are more likely to answer the phone than men, while young adults are less likely to answer than older adults. Up to six call-backs were made in order to reach the person selected to be surveyed. The survey was conducted during the third week in March; interviews were completed for 623 people.

C. Results

Since the informational meetings were held in January and February, the 251 questionnaires filled out at those meetings were completed well ahead of the survey. As soon as the survey was completed, sets of questionnaires were given to Minnesota Opinion Research Inc. It was they who had all of the data entered into a computer and analyzed according to a number of parameters. A later report will analyze these findings in some detail. The interested reader can turn to the appendices for a brief summary of the questions and the answers received from both the survey and the informational meetings.

Many of the questions were answered in a similar way by both groups. They admired farmers more than any other occupational group, viewing them as very hard working. Both groups believed strongly that the public should help farmers pay for the problems created by agricultural impacts on water quality. There was also strong support shown for the environmental movement, with an agreement that stopping acid rain should be a top priority in the state.

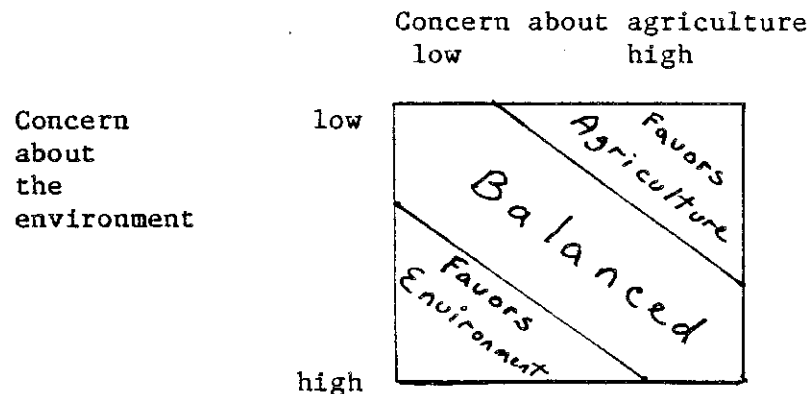
The main disagreement between the two groups lay over the priorities which the state should give to dealing with existing problems. Those in the survey felt that crime and business were somewhat more important than dealing with agriculture or the environment (question #1). Those in the informational meetings gave a much higher priority to dealing with agriculture and the environment than to dealing with crime and helping business. Also those from the informational meetings were much more prepared to sacrifice business interests for environmental quality than those from the survey (question #7).

The reason for not analyzing these results in greater detail in this report is that they are somewhat peripheral to the main use made of the data. As noted in the introduction, it was necessary to gather this data in order to insure a balance on the Panels. An analysis of the data showed that it was not possible to create a single continuum, with those who care about agriculture on one end and those who care about the environment at the other. Many people cared strongly about both. Hence it was necessary to create a table along the lines of that shown in Figure 1. The answers to four questions (see 1C, 2, 3, 9C in Appendix 3) were used to develop a scale indicating concern about agriculture, while the answers to five other questions (see 1F, 5, 6, 7, 9D in Appendix 3) were used to create a scale showing concern about the environment.

The chart in Figure 1 shows the ideal way in which both those from the survey and the informational meetings would be divided into three equal parts. In fact neither group could be broken down into such neat looking categories. The purpose of this chart must be kept in mind if it is not to be misinterpreted. The aim was to divide the groups into three equal sections so that those chosen for the Panels would fall into the same equal divisions. It would be incorrect to interpret the chart as showing that one-third of Minnesotans care more about the environment than agriculture. In fact, the results of the survey indicate that most residents of the state care quite a bit about both.

Thus the category "favors agriculture" contains those people in Minnesota who care more about agriculture than the environment as compared to other Minnesotans, while those in "favors environment" care more about the environment than agriculture as compared to others in the state.

Figure 1: Dividing those answering the questionnaire into three approximately equal categories.



5. REGIONAL PANELS

A. Preparation

When the project started, the plan called for a single statewide Panel to be held at the end of 1984. The time from April through early fall was to have been devoted to the gathering and analysis of information. As the staff traveled throughout the state, however, it became clear that there was a greater need to ground the project in several regions around the state than to devote time to the analysis of data.

This led the staff to suggest to the Steering Committee at the end of March that there be five regional Panels which would review the basic questions about agriculture and water quality in their area. The decisions of these Panels would form the basis upon which a statewide Panel would make specific recommendations. It took considerable time to decide whether the existing staff could carry out this additional work, what questions should be answered at which level, and how the whole process would fit together. In a Steering Committee meeting on April 25th, the final decision was made to go ahead with regional Citizens Panels according to the fairly detailed plan which had been developed by that time. The five sites which the Committee selected were Rochester, Windom, Fergus Falls, St. Cloud and the Metro Area. Immediately after this meeting, the staff turned to the task of setting the agenda for the Southeast Regional Citizens Panel to be held in Rochester in late June.

B. Agenda-Setting

Since those who set the agenda of a meeting have great control over the results, a public agenda-setting process was used. This started eight to ten weeks before the regional Panel in question. Letters were sent to all contacts which the staff had developed in the region. People were asked whether they had any witnesses to suggest (including themselves) and whether they wanted to be kept informed about the agenda-setting process.

Often the initial contacts would lead to recommendations that further people be contacted. In this process the staff became aware of what might be called the "Minnesota water quality network," an informal linkage of professionals and concerned citizens throughout the state. Through this network, contacts were pursued with people knowledgeable about particular subjects. For example, after the Rochester informational meeting, it was clear that "karst topography" was a subject that needed to be brought before the southeast Panel. Witnesses and information on karst were sought accordingly. This process of contacting witnesses entailed many phone calls and sometimes a personal visit with the potential witness. Also potential witnesses were asked to submit a brief outline of their testimony.

Once an appropriate list of witnesses was gathered, this was worked into a proposed agenda and sent out to all sponsors and those citizens who wanted to be informed. Initially a process was set up whereby anyone who had objections to the agenda could first talk informally with the staff and then arbitrate if not satisfied with the results. Although several people did call with suggestions, no one asked to arbitrate. By the third regional Panel, therefore, the arbitration idea was dropped, especially since some people interpreted it as a barrier to raising questions about the agenda (rather than a check on the power of the staff, as intended). After the proposed changes were made, the final agenda was sent out to all interested parties, two weeks before the regional Panel began.

C. Panel Selection

As described in the discussion of the survey, all potential panelists were categorized either as "Favors Agriculture," "Balanced," or "Favors Environment". We then set up our Panels so as to provide a balance between these three categories. Each regional Panel consisted of six people drawn from the informational meetings and six drawn from the survey, except for the Metro Panel where all twelve were from the survey since no informational meetings had been held in the Metro Area.

Figure 2: Intended composition of the regional Panels, other than Metro, showing number selected in each category. For a description of categories, see "Survey" section.

	"Favors Agriculture"	"Balanced"	"Favors Environment"
From survey	2	2	2
From info meetings	2	2	2

In order to perform the random selection, all persons from the survey who lived in the region were numbered consecutively, as were those from the informational meeting(s) in the region. (The region was defined as everything within a 75 mile radius of where the regional meeting was to be held. This meant that all of the agricultural areas of the state were covered except for the extreme northwestern corner.) Then a starting point was selected at random for each list, and by a predetermined method everyone was ranked from the highest to the lowest priority. To demonstrate that this was a random selection, the drawing of the random starting point was done in public by the chair of the County Board for each regional meeting site.

Staff then divided the names into six lists to fit the categories shown in Figure 2, with people listed in order of priority. The aim was to select twelve panelists and six alternates for each regional Panel. The decision to select alternates was a wise one. In every Panel there were one or more cancellations during the last two weeks prior to the meeting, and in two cases alternates had to be called on the first day to fill in for someone who failed to show. What did not work as intended was that not enough alternates were selected. In two of the regional Panels (especially Fergus Falls) it was necessary to select panelists from another category in order to adjust for cancellations. The balance between informational meetings and the survey was maintained, however.

Those chosen from the lists were called and the Panel was explained to them in more detail than during their initial exposure to the process. They were told that they would be paid \$75 a day for their attendance and that they would be provided with lunch (mileage was not paid). If favorable to the phone inquiry, they were visited and given a further explanation, and then signed up as panelists, if they were willing. In general, people were very responsive to the prospect of serving as panelists. The majority of those who declined did so for scheduling reasons.

The contacting of panelists was done at the same time as contacting the witnesses. It was a very labor intensive process, involving a great deal of telephoning to make the initial contacts. Staff then made a point of attempting to visit all potential panelists on a face-to-face basis. Those witnesses whom the staff had not yet met were also visited. At any point in time during the summer, staff was making initial contacts for a Panel eight weeks hence, while in the midst of selecting witnesses and panelists for the Panel four weeks hence, and putting the final touches on the Panel which was about to start.

In retrospect, it is difficult for the staff to remember a time when they were not on the phone or travelling. Given the somewhat frantic pace it was necessary to maintain, a redesign of the process would probably allot more time between the Panel meetings, and involve more staff. Clearly a major reason for things proceeding as smoothly as they did was the great amount of cooperation given to the staff by so many people. It is the belief of the staff that this cooperation arose in large part because the project made sense and appeared worthwhile to almost everyone.

D. Running the Regional Panels

A copy of the agenda for the Fergus Falls Area Panel appears in the appendices. It is representative of the agendas for each of the Panels. One thing which an agenda cannot show is the effort made by the staff to make people comfortable. Participants were welcomed when they arrived and given a folder with a few background materials, a pad, and a pen. They were urged to help themselves to coffee and donuts (which were also provided to witnesses and visitors as well). During the breaks the staff would mingle with the panelists to make sure they were comfortable with the way things were going and to be sure that no panelist felt left out.

As described in the agenda, the first of the four Panel days was devoted to an introduction to the issue by the staff. The materials used on this day were checked for bias and appropriateness by presenting them to a group of sponsors, professionals and farmers on June 8th, before the first regional Panel was held. The test-day proved useful because substantial changes were made in the format as a result of the comments which were made.

Changes in the format were also made as the Panels progressed. Regionally applicable data changed from location to location. Staff also experimented with pedagogical techniques. At the Southwest Panel in Windom, for example, a videotape of professionals testifying about agricultural pesticides was shown to the Panel. The testimony was good, but the device was not. Panelists objected to the use of the television because it prevented them from asking questions directly of the witnesses.

If there was any consistent difficulty with the introductory materials and with the testimony that followed, it stemmed from a problem inherent in the project itself. The subject of non-point source pollution of water from agriculture proved to be wide ranging and hard to encapsulate. As a result, panelists sometimes found themselves responsible for a great deal of potentially confusing data.

The presentations given to the panelists by witnesses, on days 2 and 3 of the Panel, went beyond (and sometimes differed greatly from) the staff presentations on day 1. Ideally, witnesses were to further explicate, illuminate, regionalize and particularize the introductory data. Some did a very good job, some did not. Among the witnesses, there was no clear difference in competence between professionals and non-professionals. Some of the former gave very lucid down-to-the-groundwater presentations; others were as clear as sediment. Some of the farmers and other citizen witnesses gave very knowledgeable and eloquent testimony; others, somewhat unsure of themselves, were more difficult to understand.

The concept of taking testimony from a variety of people, with a deliberate mix of professional and non-professional, was a sound one. Professionals brought data and a certain perspective which the panelists needed to be exposed to; citizens provided data and perspective, but also a certain accessibility to the issue which served

to put the panelists at ease. Problems with testimony being inept or inappropriate were largely a function of staff time; i.e., if more time had been available, it could have profitably been applied to a more thorough preparation of the witnesses. Given the broad possible range of the topic, it might also have been more appropriate to devote an entire day, or two days, to one aspect of non-point source pollution with strong regional implications, such as the drainage of wetlands in the West Central region. In spite of these problems, however, panelists pronounced themselves satisfied with and instructed by the majority of the testimony.

The panelists spent most of day 4 deliberating over the information and making their recommendations. The day opened with a presentation by staff on any questions which had been raised regarding testimony heard on days 2 and 3. For example, in Rochester the staff spent over an hour trying to answer questions which the panelists had asked about pesticides at the end of day 2. At other meetings the staff presentation took only about a half hour. After this, the staff spent up to an hour going over the "charge" to the regional Panels. The charge had been given to the Panel on day 1, and witnesses were reminded to make their comments relevant to the charge, but staff felt it was important to go over the charge again to be sure that there were no misunderstandings. The charge consisted of six questions:

- a. How significant is the problem of agricultural impacts on water quality in your area?
- b. How important is it that something more be done in your area to deal with the issue?
- c. If something additional is needed, do you have any strong feelings about the type of action which should (or should not) be taken?
- d. How much additional money would you as taxpayers be willing to see spent on this?
- e. What factual claims need further clarification?
- f. Other comments.

Just before the panelists started their deliberations, an important step was taken to reduce staff bias. The panelists were asked to select a chair, who would act like the foreman of a jury during the deliberations. While it would have been possible to select the chair on day 1, it was decided that the panelists did not know each other well enough and therefore it was best to wait until day 4. After the selection of the chair, the staff offered the panelists the choice of having a staff member present during the deliberations to take notes or of doing that task themselves. All the Panels decided to have one staff person present for this purpose.

The deliberations took up the rest of the day; no Panel was able to finish their task before 4:00 PM and clearly several Panels could have used considerably more time. A thorough discussion of the deliberations is not possible here, but a few points are worth noting. Most panelists found this task difficult and some found it very frustrating. Only a few of the panelists had previous experience with public policy making and even they were used to being guided by lobbyists, the media, and other such groups. When faced with the task

of trying to answer difficult questions based upon incomplete information, all found the task formidable. By this time, however, virtually all of the panelists took the task seriously and they were determined to come up with good results. A sense of humor and the many friendships which had developed helped ease the burden.

Upon completion of their recommendations, panelists were asked to select four of their members (three regulars and an alternate) to represent them at the statewide Panel. This was done by secret ballot. Following this, they filled out an evaluation sheet. In several of the regions, the media (press, radio, T.V.) appeared to film or record a segment of the final deliberations and to interview several of the panelists and staff. The staff made a considerable effort to have the recommendations typed up as the Panel went through the deliberations. In Rochester the recommendations were ready in rough draft for the media; at the other meetings a press release was available within an hour of when the Panel completed its task. Names of the witnesses and the Panel recommendations are included in the appendices. The names of the regional panelists are listed at the beginning of this report.

6. STATEWIDE PANEL

The project was designed so that the regional Panels would lay the foundations of the final report and the statewide Panel would make the specific recommendations. It was the members of the regional Panels who made the decisions about the significance of the issue, the need to take action, and the amount of additional funding which they as taxpayers would be willing to contribute. They also recommended specific solutions, but with the understanding that these would become part of the final recommendations only if the statewide Panel chose to adopt them.

A. Agenda Setting

Preparation for the statewide Panel began with a Steering Committee meeting in October. At the meeting, sponsors put forth their proposals about what should be done at the Panel, and instructed the staff to prepare a format for the proceedings. Staff and sponsors agreed to limit presentations to the Panel to the four agents best able to implement any Panel recommendations. These included the counties, (as represented by the AMC), the SWCB, the DNR, and the MPCA. It was agreed that other interested agencies should participate by commenting on the outline and proposals presented.

During much of October and early November the staff devoted itself to preparing a summary of relevant information for the panelists' use. This information was sent to the panelists prior to their arrival at St. Cloud (and is included in this report, in a slightly revised form, as Sections III, IV, and V).

B. Running the Statewide Panel

The first three days of the statewide Panel proceeded according to the agenda prepared by staff (see appendices).

Panelists and staff arrived at the meeting place (the Sunwood Inn) on the evening of Sunday, November 25th. A social hour was held to provide an opportunity for the panelists to become acquainted, thereby easing the transition into working together the next day.

The first morning of the Panel was devoted to a review of farming-water quality problems and programs which had surfaced at the regional Panels. These were compiled in the report mailed to the panelists. In going over the material, panelists were asked whether they felt it was necessary to make major changes in existing approaches to agriculture/water quality problems, or whether adjustments in the current system would suffice. In general, the Panel opted for the latter.

The panelists spent most of the rest of the morning reviewing the recommendations of the regional Panels. Part of their task was to review the three basic findings of the regional Panels (significance of issue, need for action, amount to spend) and devise language to summarize the regional decisions in the final report. The other task was to select the specific recommendations from the regional Panels which should be considered for inclusion in the final report (about 1/3 of the specific regional recommendations were selected.)

The afternoon of the first day, the entire second day, and the morning of the third day were given to presentations made by the MPCA, AMC, SWCB, and DNR. An agency representative gave an hour-long overview of the issue, citing problem areas and ways in which these were being (or ought to be) addressed. Suggestions were made as to possible recommendations the Panel might choose to pursue. The second hour allowed for commentary by sponsors and other interested professionals (see appendices for a list of those who spoke). The commentary served two specific purposes, i.e., critical response to what was proposed by the presenter, and an opportunity for the Panel to hear about programs and proposals not mentioned by those making presentations. In the final hour, panelists asked questions of both the presenter and the commentators. For the first session, Panel questions were taken as asked. However, in subsequent sessions, upon the recommendation of the Panel, the moderator went around the table giving each panelist an opportunity to raise a question, which almost all did in each instance.

On the evening of the first and second days, and at lunch on the third day, panelists convened in committees to review the proposals made by each presenter. The review resulted in a list of items which the committee members saw as possible for inclusion in the Panel's final recommendations. Staff served a secretarial function at these meetings, which lasted about an hour and a half in the evening session.

Panelists lunched with presentors and commentators and also joined them for a social hour before dinner. These occasions also provided opportunities for questions and points to be pursued more informally.

On the afternoon of the third day, panelists selected a chair and prepared an outline for their final recommendations. The outline was to serve as the agenda for discussion and work over the final three day period. Basically, it consisted of a compilation of specific recommendations which had originated in the regional Panels, and the recommendations which had come out of the committees formed around the presentations the panelists had just heard. In preparing the agenda, panelists also made requests that certain of the presentors and commentators return to serve as advisors in the final deliberations.

The final three days of meetings were on December 10, 11, and 12. On December 9, the panelists and staff enjoyed another evening social hour. Work began the next day in accordance with an outline prepared by the staff and approved by the Panel. The proceedings were run by the Panel chair, with staff serving in an advisory and secretarial capacity. Time was spent reviewing, discussing and providing language for each of the recommendations tentatively arrived at in the first three days. Votes were taken frequently on specific proposals. Language, proposed by Panel members or staff, was put on a chalkboard and finally agreed on, and not infrequently, a panelist would suggest returning to a previous item to suggest more changes. Questions of fact arose, and were answered where possible by advisors or staff.

Also on December 10th, the panelists had a chance to talk with three prominent members of the State Legislature. Sen. Gene Merriam (Chair, Senate Committee on Agriculture and Natural Resources), Rep. Elton Redalen (well-known author of soil loss legislation), and Rep. William Schreiber (Chair, House Committee on Taxes) joined the panelists at noon for lunch. In the afternoon meeting, each legislator took about 10-15 minutes to give his views about the state position on agriculture and water quality. This was followed by about a 45 minute question and answer session with the panelists. During this discussion, the legislators urged the panelists to bring their recommendations to the legislature in some form.

Advisors were also asked to contribute opinions about certain recommendations, so it is fair to say that both they and the staff played a key role in the Panel's final product. The major directions laid out in the report, however, and the specific proposals accompanying them, were a product of the Panel. The distinction between content and form characterizes the difference between the type of contribution made by the panelists and that made by staff and advisors. The panelists provided all of the content and some of the form, the staff and advisors aided in the form (language and outline or structure) of the recommendations.

Notable about the final three days was the degree of commitment shown by the panelists. Work continued an hour late on Monday evening. A special subcommittee worked until 8 P.M. on Tuesday evening, when the entire Panel reconvened to hear its report. Coffee breaks and lunchtime found panelists continuing work on language changes and major proposals. In brief, the panelists took responsibility for the recommendations, and especially in the case of the chairman, for the process itself.

The recommendations were in final form early in the afternoon of the final day. A long discussion ensued about what should be done with them, aside from their incorporation into a report. The Panel requested that the staff look into the possibility of the recommendations being made into a legislative proposal and appointed a five-member committee to work with the staff on the matter. An hour was spent on written and oral evaluation, after which a press conference was convened. The chair, two panelists, and the project director answered questions from the press; other panelists were interviewed singly.

C. Panelist's Participation

The question of why panelists chose to take part in the process is a complex one, and will probably never be fully answered. For some, the chance to do something out of their ordinary routine was a motive. For most, the fact that they were paid \$75 a day plus expenses made it more possible for them to participate. A number of farmers wanted to serve on the Panels to insure that agriculture got a fair hearing in the proceedings, and others came primarily out of civic duty.

Once the Panels were in progress, most members appeared to become engaged by the process itself. Some enjoyed the "schooling" feature of the Panels, with the opportunity to learn about a new and vital issue. Some also relished acting in the dual roles of both juror and attorney, asking questions of the witnesses, "cross-examining" them, and then sitting in assessment of the answers. For others, the presence of agency representatives and other professionals, and the media, fostered a sense of importance. While several of the panelists had considerable experience with public process, e.g., a former county board member, a former legislator, a member of the League of Women Voters, most had not. Thus the simple fact of sitting down with other adults for a specified period of time in order to assess and make recommendations about an important issue was stimulating in and of itself.

Equally significant were the social functions which the process served, i.e., Panel members thoroughly enjoyed meeting, eating, and talking with one another, the witnesses, and the staff. In all, the high level of serious and good-natured participation by all but three or four of the 60 panelists belied prevailing notions about the politically and publicly apathetic "average citizen." Judging from these proceedings, it may in fact be said that Americans (to the degree this group is representative) are quite willing and able to participate in public processes, with the provision of an appropriate vehicle.

Further indication of the panelists' response to the process can be gained from formal evaluations which they filled out in the middle and at the end of each Panel. In this evaluation, 62% of the panelists pronounced themselves "very satisfied" about their participation in the Panel. In their written and tape-recorded comments, the only consistent criticism which panelists voiced was a feeling of being rushed and of having insufficient time for their deliberations. A summary of the evaluation form, a tabulation of evaluation results, and a list of panelists' comments are attached in the appendices.

Section III

A DESCRIPTION OF THE PROBLEM

1. OVERVIEW

What are the impacts that farming activities can have on water quality in Minnesota? The following is a brief review of 1) the potential effects that agriculture can have on water quality and 2) some studies from the state's five major agricultural river basins that look at actual effects on either ground or surface waters, or both.

A. What Gets Into the Water and What Can It Do?

a. Ground Water—Almost 2/3 of Minnesota's population gets its drinking water from ground water. Ground water is contained under the ground in water-holding geological formations called aquifers. Aquifers can consist of rocks, sands, or gravels. There can be several distinct and geologically separate aquifers occurring at different depths in one location. Aquifers can be contaminated by agriculture through the following substances:

Nitrates: A form of nitrogen which can be derived from plant residues, manure, rainfall, chemical fertilizers and domestic wastewater. Nitrates are of particular concern if water containing them is used in the preparation of infant formula. In concentrations of 10 ppm or more, nitrates can cause "blue baby syndrome" (methemoglobinemia), a potentially fatal inability of the blood to transport oxygen. Nitrates in excessive amounts can also cause a variety of illnesses in farm animals. Some researchers are beginning to raise questions about further health problems associated with nitrates, but the research is as of yet inconclusive. (See discussion below under "Issues in Debate".)

Bacteria: Bacteria found in water fall into three categories. Coliform bacteria are found in the guts of warm-blooded animals and in the soil surface. The most common water quality tests performed are those for nitrates and "total coliform" bacteria. Further tests will indicate whether the bacteria are fecal in origin. Tests for fecal streptococci determine whether the bacteria are of human or animal origin. Consumption of bacteria-contaminated water can lead to a variety of illnesses in both humans and livestock. Such illness includes diarrhea, gastroenteritis, and dysentery.

Chlorides: Chlorides, or salts, should not exceed 250 ppm in drinking water. Chlorides are found in road de-icing salts, manure, septic tanks and fertilizers.

Sulfates: Sulfate occurs in rainfall, sediment, decaying organic matter, chemical fertilizers and wastewater discharges. The amount of sulfate in drinking water should not exceed 250 ppm.

Pesticides: This group includes herbicides (weed killers), insecticides (bug killers), rodenticides (rodent poisons) and fungicides (fungus poisons). In certain doses, these can of course kill or seriously disable human beings and animals. Small amounts of herbicides are currently being found in some of Minnesota's ground water. The amounts detected so far remain well below established levels of safe consumption, but questions remains about possible long term health consequences and synergistic (mixing) effects of these chemicals.

b. Surface Water: Slightly more than 1/3 of Minnesota's population obtains its drinking water from surface waters. These include lakes, ponds, rivers, streams and wetlands. (The drinking water, of course, is taken almost entirely from rivers.) With regard to the apparent difference between ground and surface waters, the distinction can be misleading. Southeastern Minnesota, for example, is characterized by a distinct geology known as "karst" where the bedrock underlying the soil has been eroded by interaction with ground water to form an elaborate system of cracks, caves, and sinkholes. In total, the effects of these is that of an enormous sieve allowing surface water to move rapidly underground and ground water to appear unexpectedly above ground. While this is a special and extreme instance, it is worth remembering that in all kinds of topography, there is movement between ground and surface waters, and care must be taken accordingly.

As with ground water, surface water is affected by nitrates, bacteria, and pesticides. The most notable effects, however, are due primarily to sediment and phosphates.

Sediment: Sediment is soil that has been moved by wind and water erosion into ditches, lakes and streams. As dirt fills in waterways, it displaces water and causes flooding. It also obstructs passages for watercraft and has negative effects for feeding, breathing and breeding of fish and wildlife, especially game fish and waterfowl. Sediment can also transport organic matter, nutrients, and chemicals into surface waters.

Phosphates: A form of phosphorus, phosphates are derived from rain, the weathering of rocks, soil erosion, manure and fertilizers. As a nutrient, phosphates are an essential plant food. Unfortunately, the function they fulfill so well on land has less desirable consequences in the water, where excessive growth of aquatic plants, particularly algae, clogs waterways, reduces fish habitat, and produces scum and smell. This process, known as eutrophication, occurs naturally with the movement of nutrients into surface waters, but human activities apparently accelerate the change enormously.

Nitrates: Nitrates, which fertilize plants in the soil, also aid plant growth in the water, thus contributing to accelerated lake aging, or eutrophication. Generally, however, the amount of phosphate in a lake is the more critical factor in determining how rapidly a lake ages.

Bacteria: Excessive amounts of bacteria in surface water can pose a hazard to swimmers and to animals drinking the water. There is also the possibility of the transfer of disease between animals and humans using the same body of water.

Pesticides: Following their application, pesticides can move into surface water as part of agricultural runoff. The effect can be fatal or severely debilitating for fish, for wildlife, or for livestock using the water. Pesticides can also move into water through wind drift or careless handling and application.

B. How Do Agricultural Materials Move Into the Water?
How Can Such Movement Be Prevented?

a. Ground water: Nitrates, chlorides and pesticides get into ground water by leaching or percolating down through the soil. Movement varies with the substance, weather conditions, soil type and the geology of particular locations. Much discussion and some controversy exists concerning the relationship between high levels of nitrates in ground water and high levels of chemical fertilizer application (see Issues in Debate, below). Nitrates, bacteria and pesticides can enter directly into ground water through sinkholes, abandoned or poorly constructed and maintained wells, and surface water flowing underground.

Ground water protection requires several things. Foremost is an intimate knowledge of the agricultural terrain, including soil type and crop nutrient needs, and its relationship to ground water supplies. Similarly, landowners need to understand the connections between farming practices and potential ground water pollution. With regard to nitrates in the form of chemical fertilizer and manure, farmers must avoid overapplication, i.e., no more should be used than a crop needs, and applications should be made when the crop needs them. As for pesticides, proper timing, application and understanding of chemical interactions with the environment are essential. Unfortunately, not enough is currently known about how certain pesticides behave in percolation and in the ground water.

b. Surface Waters: Agricultural materials are transported into lakes and streams in two major ways, runoff and erosion. Runoff is the movement of water across the surface of a feedlot or field. As it moves, it picks up water-soluble matter, such as nitrates, and also carries soil and organic matter along mechanically. Rainfall and snowmelt are the base for runoff occurrence.

Erosion is caused by both wind and water. It is currently occurring in Minnesota at the rate of 6.4 tons per acre, 153.7 million tons per year. As soil moves into water, it carries phosphates, which readily adsorb to soil, and anything else that happens to be in or on the soil. Much erosion is not visible, in that soil is removed from a field in thin layers, or sheets. The effects of sheet erosion,

however, are as pernicious as those occurring from highly visible gullies down the slope of a field.

It is important to remember that runoff and erosion are both natural processes. Like lake eutrophication, however, they can be accelerated considerably by human activity, including farming.

With runoff and erosion prevention, the basic goal is to keep soil, manure, chemicals and plant matter in the field or the feedlot and out of the water. A vast variety of techniques and tools, referred to collectively as "best management practices," exist for doing this. No one practice is a cure-all, nor does one set of practices that is useful in one place transfer readily to another type of terrain and set of farming circumstances. If there is a key word here, it is "management," i.e., a requirement that landowners and those helping them have a good understanding of a particular piece of land and its environment. The range of things a farmer may want to consider range from ground water to interest rates and the status of international trade.

C. Agricultural Impacts on Water Quality: Potential Costs

a. On-farm: Aside from the obvious costs of erosion per-se, impaired water quality costs for farmers can include medical and veterinary expenses, cost of a new water well, cost of replacement livestock, ditch cleaning, and reduced yields from flooding or poor water retention.

b. Off-farm: These cost are much higher than on-farm costs. One estimate places national on-farm costs of erosion and related problems at \$40 million a year, and off-farm at 3.1 billion. Off-farm include medical expenses, water-purification costs, dredging, decline in lakeshore property values and loss of tourist income.

c. Overall, this issue involves considerable economic stakes for Minnesota. Most of the counties in the southwestern part of the state are so heavily agricultural that tourism is of little significance. In the northeast there is considerable tourism, but little agriculture. But in the 38 non-urban counties which stretch in a band from the northwest to the southeast (where agriculture makes up from 20-89% of land use) the yearly income from farming is \$2.8 billion, and the income from tourism \$600 million. It would be as foolish for us in Minnesota to allow agriculture to permanently harm our tourist industry as it would be to put inappropriate restrictions on agriculture and thereby harm the major industry in our state.

2. SOUTHEASTERN REGION

A. Area Background (1)

Southeast Minnesota is an area of gently rolling glacial moraines and drift plains with increasing grade moving west to east. The major rivers (from north to south) in this Lower-Upper Mississippi River Basin are the Cannon, Zumbro, and Root Rivers. The average annual precipitation is 29" with high waters in the spring and summer.

A unique characteristic of SE Minnesota that cannot be overlooked when discussing water quality is its karst topography. A karst area is unique because of the effects of the highly permeable sedimentary rocks (i.e., limestone, dolomite) which underlie the soil surface. This karst topography leads to such effects as sinkholes, allogenic (disappearing) streams, caves, and large springs. The sinkholes (depressed areas where the limestone has caved in) are particularly important because under certain conditions they represent direct connections between surface water runoff and the surficial aquifer. Under normal conditions the surface water has to infiltrate down through the soil until it reaches the surficial aquifer. In SE Minnesota the average density of sinkholes is 30 per square mile.

Based on 40 acre surveyor's plots, the SE area is rated high on the percentage of water resources per 40 acre plot. The water resources are mainly in the form of permanent streams (11.7% of the 40 acre plots), intermittent streams, and to a lesser degree lake shore (1.4% of the 40 acre plots).

Sediment pollution, nitrogen, phosphorus, and fecal coliform levels in the SE area are greater than the state averages: the lake clarity is low to moderate. The delivery capacities (flood runoff, roughness, and amount of water) is medium high in the SE.

The dominant land use in the SE is agriculture, 58% east - 80% west. Corn and soybeans are the major crops in the area. The east to southwest trend of agricultural intensity is exemplified by a comparison between Winona and Mower counties.

	<u>Row Crops</u>	<u>Small Grains</u>	<u>Hay</u>
Winona County	42%	22%	37%
Mower County	87%	9%	5%

In addition to crops, the SE area supports a large number of beef cattle, dairy cows, hogs and chickens. Livestock is particularly prevalent in the south central section of the SE area, especially in Fillmore County.

B. Southeast Area Studies

a. Groundwater Quality in Southeast Minn. WRRRC Bulletin 109 (2)

Objective: To test the magnitude and distribution of 18 parameters (variables) with respect to water well construction, land use, precipitation, health effects, and changes in ground water.

Study Area: The parameter samples were taken from a 29 square mile area in Fillmore County. The density of sinkholes in this area was great, 10-99 per square mile and soil depth ranged from .2 to 15 m. Four of the carbonate aquifers in this area are the Galena, St. Peter, Shakopee-Oneota, and Jordan, in order of increasing depth. The surficial carbonate aquifer in the Galena formation is the most critical because it can be directly affected by the surface water runoff.

Methods: Test wells were chosen to obtain a diversity between well constructions and the four aquifers. The 21 wells selected were sampled tri-monthly from February 1977 to May 1978 and rotated to catch seasonal changes. Each well underwent 13 routine and 6 runoff samplings. Parameters that were tested were bacterial counts, nitrate-nitrogen, turbidity, conductivity, sulfate, chloride, phosphate, total organic carbon, and nitrate-nitrogen/chloride ratio.

Findings: To determine the effect of changes in the magnitude of surface runoff on these four aquifers, the variability between wells and dates of sampling was determined. A significant variation (seasonal) was found mainly in the Galena formation. Most of the variation was represented by changes in the total coliform bacteria and fecal coliform bacteria, (53% of routine samples and 47% of runoff samples had significant seasonal variation.) The St. Peter was the only other aquifer with significant seasonal variation in 11% of routine samples.

In the Galena aquifer 38% of the routine and 80% of the runoff samples showed fecal contamination, most of which was of animal origin. Nitrate-nitrogen levels were greater than the safety level of 10 parts per million (ppm) for 41% of the routine and 67% of the runoff samples in the Galena aquifer. Chloride levels were greater than the safety level of 20 ppm for 35% of routine and 54% runoff samples in the Galena aquifers. Phosphate levels were greater than safety levels of 1.28 ppm for 14% of routine and 24% of runoff samples in the Galena aquifer. The safety levels stated above were specific to this report.

Conclusions: The amount of seasonal variability in the data and their connection to surface runoff in the Galena aquifer was significant. Clearly, the "surficial" or topmost aquifer was contaminated by surface water, as indicated by the high levels of nitrate-nitrogen and high bacteria counts. Whether or not deeper aquifers were affected depended upon well construction and possible inter-aquifer connections. In this study the authors did not specifically state that agriculture was the cause of the high nitrate-nitrogen and bacteria levels, but they did recommend the renewal of efforts to minimize the impact of agriculture on ground water quality in SE Minnesota.

b. Hydrogeology, Water Quality, and Land Management in the Big Spring Basin, Clayton County, Iowa (3)

Objective: To define the Big Spring Basin (BSB) ground water system, the movement of ground water, the quality of ground water, and the effect of land use on the quality of ground water. Northeastern Iowa, where Clayton County is located, is very similar to SE Minnesota because of its karst topography.

Study Area: The BSB study covers a 100 square mile area in NW Clayton County. It is the Galena carbonate bedrock which we are interested in because of its karst nature (less than 30' deep, with sinkholes). Below the Galena formation lies the Shallow Bedrock (less than 50' deep, without sinkholes) and the Deep Bedrock (50-500' deep, without sinkholes.)

The median precipitation is 33" in the BSB. The dominant soil type is silty, well drained, and with moderate permeation: Fayette and Down types. The 420' relief in the area is an important feature because of its potential for erosion.

Land use is 3% urban, 22% cover crop, 9% strip crop, 48% row crop, and 6% forest. "Good farm management" is practiced, with less than 15% of row crops using conventional tillage.

Methods: Iowa Geological Survey inventoried 271 wells from which 18 domestic wells were chosen for continuous monitoring during a water year as a representative sample. Two wells were chosen as controls (deep bedrock); two wells outside the basin and the remaining 14 in the basin were in shallow-bedrock or karst areas in the center of the basin. Big Spring, the Turkey River and other surface waters were also monitored.

The water quality analysis was divided into four sections: field, chemical, discharge, and land use. Field analysis measured conductivity, pH, turbidity, and the temperature of the water. Chemical analysis measured nitrate (NO₃, ppm), bacteria (MPN), and pesticides (ppm). Discharge was measured on the BSB and Turkey River. Lastly, land use was categorized as (1) cover crop, (2) terraced cover-crop, (3) row crop—corn, terraced row crop, (5) strip cropping, (6) terraced strip-cropping, (7) forest, and (8) urban.

The sampling concentrated on the water quality problem associated with nitrates and bacteria, and the karst topography's role in increasing or decreasing the water quality in the BSB.

Findings: The authors choose to describe the ground water system in BSB by the Galena aquifer discharge components. The two main components are (1) surficial discharge into the Turkey River, and (2) downward leakage into the underlying St. Peter sandstone aquifer. The second discharge is particularly important because it establishes a connection between surface water runoff and the deeper aquifers.

The average monthly discharge of nitrogen from ground water was computed to be 8100 pounds, based on the BSB discharge rate. In 1982 this amounted to a mass of nitrogen equivalent to 33% of the chemical fertilizer-N applied. Chloride (potassium chloride) was also found.

Bacteria levels for the wells and springs were an average of 2.2 MDN. Most of the wells which showed persistently high bacteria levels had cistern problems, exhibited seepage, or opened into large conduits. However, not all of the bacteria problems are associated with well construction; local water system also have an effect.

The pesticide monitoring detected seven pesticides; atrazine was the most persistent in soil and water. In 1982 atrazine in the BSB peaked at .75 ppm in June and was at .11 ppm in December. Bladex and Lasso were undetected after June 1982. Sediment analysis showed atrazine and dieldrin at a peak of 5.1 and 8.1 ppm, respectively. Total calculated atrazine discharge from ground water was 14.2 lbs in 1982. This discharge represents a .04% loss of applied atrazine.

Conclusions: Historically in the Big Spring Basin, there have been two main increases in the agricultural sector: livestock and corn production. Accompanying these increases was an increase of 30% in manure N and 250% in fertilizer-N applied since the 1960's. Based on this increase in fertilizer application and the relatively few point sources of nitrogen in the basin, the authors concluded that 55% of the nitrogen in the ground water was from fertilizer-N. In an area such as NE Iowa where wells are an important source of domestic water, the high nitrogen levels can cause adverse health effects, especially in infants.

The results of the BSB study show that a very carefully conducted study can find that fertilizers and pesticides are present in ground water. In addition, the nature of the study area, i.e., mostly agricultural, enabled the authors to state that the nitrogen source was mainly fertilizer applied to the agricultural land.

c. Temporal Changes in Nitrates in Ground Water in NE Iowa (4)

Objectives: To show the historical trends of nitrate in ground water and its relation to land use changes during the same period in NE Iowa.

Study Area: Domestic water supply samples were obtained from wells in Clayton, Allamakee, and Winneshiek counties. Temporal changes were determined by comparing 50 wells sampled in 1975 and 40 wells sampled in 1983. The sampling was done in an area geologically similar to the Big Springs Basin.

Methods: Two of the 40 wells tested in 1983 finished in the shallow carbonate aquifers and were also tested for pesticides. Nitrate concentrations fluctuate seasonally and in order to provide

conservative estimates, both the 1975 and the 1983 samplings were done in October. The wells tested were divided into five groupings: (1) background-shallow aquifer with shale, (2) background-deep aquifer, (3) Galena aquifer, (4) two other surficial aquifers of shallow depth, (5) deep aquifer with casing in shallow depth.

Findings: The two background well groups have remained constant for the 8 year span, but the three other groups (3-5) showed increased levels of nitrate in comparison to background levels in 1975 and 1983. (See table below)

	<u>1975</u>	<u>1983</u>
Galena (3)	2-8 times*	3-12 times
Other Surficial Aquifers (4)	2-9	3-12
Deep Aquifer (5) (casing in shallow)	2-8	4-10
	*times higher level of nitrates as compared to background levels	

Results from the total sample show 28% of the background wells had no change, while the other wells showed a 12% decrease and a 60% increase. The over-all change ranged from 21-100% as compared to 1975 and the main levels of nitrates found was 26 ppm.

Pesticides were found in only one of the two wells tested (1.1 parts per billion of atrazine).

Conclusions: The authors of this study believe that their findings show a direct correlation between fertilizer application and the amount of nitrate found in ground water. This conclusion was based on the comparison made between fertilizer application rates and well nitrate levels in 1975 and 1983.

d. Ground Water Quality and Hydrogeology of Devonian-Carbonate Aquifers in Floyd and Mitchell Counties, Iowa (5)

Objective: To define the relationship between surficial geology, hydrology and resultant ground water quality.

Study Area: Floyd and Mitchell counties are in the NW corner of the 22 county area in NE Iowa. This is an area with karst topography: shallow limestone bedrock with a thin soil cover that facilitates the infiltration of chemicals into ground water. The majority of sinkholes in this area are located between the two Cedar rivers in Mitchell County. Corn and soybeans are the major crops, which differs somewhat from the Big Spring Basin area, where corn was predominant. The testing year 1982-83 was wetter and warmer than normal.

Methods: The bedrock was divided into four geological regions: (1) deep bedrock, (2) shallow bedrock, (3) karst, and (4) incipient karst, where water can't directly enter, but there is a high infiltration. Analysis of samples for nitrates, bacteria, and pesticides was performed. After an inventory of wells, 21 sites were selected: 16 wells, 2 surface water sites, 2 tile drainage outlets, and one spring. Nitrate and bacteria were collected monthly and the whole network sampled four times for pesticides (once in the spring, twice in the summer, and once in the fall).

Findings: Based on 277 samples, nitrate levels were: less than 5 ppm (deep), 22 ppm (shallow), 41 ppm (karst) and 68 ppm (incipient karst). The low level of nitrates in the deep bedrock area provides a background against which the water quality from the other "less protected" regions may be compared. In comparison to Turkey River, the Cedar River exhibits a similar trend and magnitude of nitrates. The median bacteria level measured was zero except for the karst regions where the monthly median was 5.1 MPN (for karst) and 2.2 MDN (for incipient karst).

Pesticide levels based on 121 samples showed 44% of the ground water samples contained pesticides, all 11 of the tile samples contained pesticides, and 88% of the surface water samples contained pesticides. Pesticide levels categorized by bedrock level were:

Shallow bedrock (atrazine)	.10 - .85 parts per billion
Karst (atrazine, sencor)	>1 parts per billion
Incipient Karst (atrazine, bladex, Lasso)	>16 parts per billion

Infiltration was determined to be the means of transportation for the pesticides. The pesticide levels were higher in the Floyd - Mitchell study than in the Big Springs Basin study because intensive row cropping is 2 - 5 times greater in the Floyd - Mitchell area.

Conclusions: The ground water quality in the combined Karst - Shallow bedrock regions is being degraded. These results suggest the possibility that the levels of nitrate, bacteria, and pesticides found in the Floyd-Mitchell study could be found in SE Minnesota if a similar study were done in the SE. The topographical similarities between SE Minnesota and the Floyd - Mitchell area suggest the possibility that SE Minnesota could have a greater than 10 ppm level of nitrates in 4 out of its 5 aquifers, as was the case in the Floyd - Mitchell study.

3. SOUTHWEST REGION

A. Area Background

There are two major basins that can be found in this region: the Missouri-Des Moines Basin (M-DMB) and the southern half of the Minnesota River Basin (MRB). The M-DMB covers the SW corner counties in Minnesota and its features will be described first.

The M-DMB topography consists of moraines, outwash plains, and fill plains varying from gently sloping to an undulating slope of 1-10%. The annual average precipitation in the M-DMB is 26" and the growing season is 200 days. Water resources in this basin (per 40 acre plots) are 2% lakeshore and 6.7% permanent streams. The lake quality is low: the rivers contain above average nitrate and phosphorus levels, and the ground water contains above average nitrogen and fecal coliform levels.

Agriculture is the dominant land use in M-DMB, accounting for more than 85% of the land use in the basin. This dominance means that almost all surface waters are bounded by agriculture. Livestock (cows, hogs, and chickens) and cash grain are the main agricultural uses. There are therefore a large number of feed lots. The types of crops are 61% row (corn and soybeans), 25% small grain (oats), and 14% alfalfa.

Erosion in the M-DMB is considered medium, but the nutrient loss from upland agricultural areas is considered the greatest in the state. Bacteria is also at a high level because of the proximity of the feed-lots to water resources. This high level of nutrient loss from upland agricultural areas and feedlots can cause lakes to become eutrophic.

The Minnesota River Basin (MRB) is the other major river basin in SW Minnesota. This area covers the Blue Earth Till Plain and the Minnesota Lake Plain, both plains with little slope. The annual precipitation in the MRB is 27" with a 200 day growing season. The water resources (per 40 acre parcel) are slightly greater than in the M-DMB, with 5.2% lakeshore and 7% permanent streams. Lake clarity is low.

Agricultural land use predominates in the MRB, with more than 90% of land in livestock agriculture or crops. The two dominant crops are corn and soybeans, representing 95% of row crops in Faribault County.

Because agricultural land use is so predominant in the basin, the erosion, rated medium, can be attributed to the upland agricultural areas. Unlike the M-DMB, nutrient loss is not rated "high", possibly due to application levels and surface slope. This doesn't mean that the nutrient level is low in the water resources, but only that it is not as high as in the M-DMB. The lakes in MRB are eutrophic and the streams have nutrient levels which have the potential for creating adverse effects.

B. SW Area Studies

a. Public Water Supply Quality in the Rock River Watershed, Southwest Minnesota (6)

Objective: To determine the seasonal variability in water quality in wells serving a rural municipal water supply, and relate these changes in water quality to land use practices.

Study Area: The counties containing the municipal wells tested were Nobles, Pipestone, and Rock. The rural town we are interested in is Luverne (in Rock County) because there is a concern over the impact of agriculture on water quality. Ground water samples were taken in 5 rural communities and Luverne was one of these.

In Luverne, 14 wells were tested (7 in each of two fields). All these wells were shallow outwash sand and gravel wells, 20-66' deep. The Luverne area population was 4707 in 1970. The wells tested were divided into the south field (actively farmed) and the north field.

Method: At each sampling point (5 rural communities and one rural well) 27 samples were taken per month from April 1978 - May 1980, for a total of 1077 samples. The parameters analyzed were nitrate-nitrogen, sulfate, chloride, calcium carbonate, TDS, conductivity, pH, and various ratios between parameters.

Findings: The wells located in the agricultural area (south field) of Luverne showed marked increases in chloride. The results showed higher levels of nitrate-nitrogen and total dissolved solids in the wells located in the actively farmed south field, compared to the levels found in the north field (little agriculture). No appreciable changes were found in the north field, but nitrate-nitrogen levels were high in the south field, with 15% of the samples greater than 10 ppm. In general, 47% of all the samples (5 communities and rural wells) exceeded the standards for nitrate-nitrogen, and similarly, 78% exceeded the standards for TDS.

Conclusions: Nitrate-nitrogen concentrations are highest in those wells located in actively farmed areas. The source of the increased chloride in the south field at Luverne is not readily identifiable at this time. The seasonal variations as seen in the data were the result of land use practices and precipitation effects. The report states that the problem of increasing concentrations of nitrate-nitrogen in small rural communities is particularly significant.

b. A Limnological Compilation of Water Quality of the Minnesota River Watershed, in Minnesota. WRRC #107 (7)

Objective: To compile the water quality data, from 1957-1975, on the Minnesota River into a form that can be used to analyze changes in land-use, soils, geomorphology, and biota. Interpretation of the data and water quality comparisons to the agricultural drainage ditches in the area are the subjects of a report of progress.

Study Area: The water quality data for this study was obtained from the MN Pollution Control Agency's (MPCA) monitoring sites in the Minnesota River Basin. The MRB flows NW to SE, from the South Dakota border to Faribault County in south central Minnesota. This basin drains an area where agriculture represents 90-95% of the land use.

Method: The data from the MPCA's 23 monitoring stations was transferred to a Wang computer and analyzed by month, from 1957-1975, to determine the means, standard deviations, and variances of the 44 parameters tested. Quarterly statistical summaries were made to analyze the seasonal variation of the parameters tested. The four quarters were: (1) March, April, May; (2) June, July, August; (3) September, October, November; (4) December, January, February.

Findings: The four parameters that are indicators of possible adverse agricultural effects on water quality are nitrate-nitrogen, total phosphate, fecal coliform bacteria, and chloride. These four parameters were tested during different periods between 1957 and 1975 with the majority being tested between 1967-1975. The range of the average values (of the 23 monitoring sites) for the four parameters are shown in the table below.

<u>Parameter</u>	<u>Spring</u>	<u>Summer</u>	<u>Fall</u>	<u>Winter</u>
Nitrate-Nitrogen (ppm)	3 - 8.8	.4 - 7.5	.2 - 6.6	.4 - 5.9
Total Phosphate (ppm)	4 - .72	.22 - .75	.14 - 1.18	.11 - 1.51
Chloride (ppm)	2 - 30	7 - 40	13 - 73	13 - 54
Fecal Coliform Bacteria	234 -	569 -	749 -	237 -
(MPN conf/100mm1)	33,625	110,000	20,286	135,200

The nitrate-nitrogen levels were high in the summer and spring, but none of the quarterly averages for the 23 monitoring sites were above the 10 ppm recommended level. The eastern section of the basin (Faribault County) had the highest nitrate-nitrogen levels.

The levels of total phosphate were generally higher in the spring and summer, but a few monitoring sites exhibited high fall and winter levels. There are varying opinions on what the maximum phosphate level should be, and they range from .2 to 1.0 ppm. If the .2 ppm criteria is used, then the averages are too high for all of the monitoring sites for spring and summer, and half for fall and winter. If the 1.0 ppm level is used, then there are only two sites in the fall and winter which had levels higher than 1.0 ppm.

The chloride monitoring site averages were all well below the 250 ppm maximum recommended level, with the highest level measured in the fall at 73 ppm. The chloride levels were higher in the fall and winter; this contrasts with the nitrate-nitrogen and phosphorus levels, which were higher in the spring and summer.

The fecal coliform bacteria levels were high, greater than 1 MPN for all of the sites, as can be seen from the ranges given in the table above. These high levels show there is a significant problem caused by point-sources (communities) or non-point sources of pollution that should be corrected.

Conclusions: There were no formal conclusions reported in this study because its purpose was to gather the water quality data and perform basic statistical analysis. Conclusions, however, can be drawn from the quarterly data presented for each parameter by monitoring site. The data presented on the four parameters analyzed above showed that only the fecal coliform bacteria levels exceeded the recommended levels consistently. It can be concluded from the seasonal variation in nitrate and phosphorus that there are some agricultural impacts on water quality, but not a significant amount, given the low levels of nitrate and phosphorus found. Conclusions of a significant impact of agriculture on water quality, however, can be drawn from the very high levels of fecal coliform found in a basin which drains an intensively agricultural area.

3. CENTRAL REGION

A. Area Background

The basin covering the central part of Minnesota is the Upper-Mississippi River Basin (UUMB). The geomorphology in this basin is made up of drumlin (small hills), moraine complexes, outwash plains, and fill plains. Specifically, there is the Alexandria Moraine with a 6% slope in the west, the Itasca Moraine with a 12% slope in the north, and the St. Croix Moraine with a 10% slope in the south. There are also numerous plains intermixed with slopes of 0 -5%.

The annual average precipitation in the UUMB is 25" and the growing season is 185 days. The water resources (per 40 acre plot) are 10.7% lake shore (concentrated in the north), and 10% permanent streams. These water resources have below average phosphorus and nitrogen levels.

The agricultural land use area in the UUMB is mainly in the southern section where it is 50-70% agricultural. This concentration of agriculture in the southern part reflects the transitional nature of the basin, moving from prairie to forest. Agriculture focuses on livestock and cash crops in the south, and on general farming in the north.

Stearns and Benton counties are particularly high in livestock production (turkeys, dairy, beef and hogs), and thus have the highest average number of shoreland feedlots in the state. The crops in the south are 71% row (corn and soybean), 21% small grain (oats), and 2% hay. Irrigation is also common in Stearns and Sherburne counties.

Erosion is mainly from agricultural uplands, and nutrient loss is medium to low. Bacteria levels are high in the south due to the large number of feedlots.

B. Central Area Studies

a. Nutrient and Hydrologic Budget and Trophic Status of Lake Koronis, Paynesville, Minnesota and Elk Lake Near Clear Lake, Minnesota (8)

Objective: There are three relationships between nutrients and lakes that this study addresses: (1) What is the limiting nutrient? (2) What is the quantity and source of the nutrient? (3) What is the trophic state of each lake?

Study Area: Lake Koronis and Elk Lake are in similar watersheds (based on slope and soil type), both are used extensively for recreation, and 53% of residences are seasonal.

Lake Koronis is located in a terminal moraine in Stearns and Meeker counties. It has a mean depth of 8.9 meters and 21.8 kilometers of lake shore. The Crow River enters on the east and is the primary source of runoff from the predominant agricultural land use in the area (dairy).

Elk Lake is located in a gently rolling area in Sherburne County. It has a mean depth of 1.8 meters and 5.6 kilometers of lakeshore. The land surrounding the lake is used predominantly for farming, and thus the primary source of runoff is agriculture.

Method: Water samples were taken from both lakes, their inlet/outlets, and from wells adjacent to each lake biweekly from 3/78 - 11/78. Nine sites were located in Lake Koronis, and 196 wells adjacent to it were sampled. Five sites in Elk Lake and 53 wells adjacent to that lake were sampled. The ground water samples were collected by citizens three times during the summer. In addition, fluorescein dye was flushed into residential septic systems to determine the ease with which water from them could enter the lake.

The samples were divided into three groups and tested for appropriate parameters: (1) rain--total phosphorus, orthophosphorus, nitrate; (2) wells--coliform bacteria, conductivity, phosphorus, nitrate; and (3) lakes--orthophosphorus, ammonia, and nitrate.

Findings: The limiting nutrient depended on the time of year in both lakes: nitrogen in August through September; phosphorus in October through November. During the testing period there was normal precipitation, but it was concentrated in June and July.

The mean well water levels (citizen collected) for Lake Koronis were .267 ppm phosphorus and .40 ppm nitrate-nitrogen; 13% of the samples were contaminated with fecal coliform. The mean well water levels for Elk Lake were .236 ppm phosphorus and 1.245 ppm nitrate; 11% of the samples had fecal coliform contamination. The results were basically the same for the two lakes except the nitrate levels were higher in Elk Lake.

In Lake Koronis the mean level of phosphorus was .114 ppm, while the secchi disk reading (to measure water clarity) was 1.78 meters. The main source of nutrients is the Crow River and its non-point inputs above Paynesville. The lake water mean levels for Elk Lake were .176 ppm phosphorus and .72m secchi disc.

In this study, the well samples indicated high phosphorus and fecal coliform concentrations in 16% of the samples. Lastly, fluorescein dye was found less than 24 hours after flushing, indicating poor adsorbing capabilities of lakeshore soils.

Conclusions: When phosphorus and nitrates are both present in sufficient quantities, they yield 2 times the algae growth as when just one is present. In Lake Koronis, the phosphorus loading from the watershed runoff was 74% of the total phosphorus going into the lake. The author concluded that the water runoff was mainly due to the agricultural activities, fertilizers and feedlots above the lake.

In Elk Lake the flow of water was low in 1978, so the amount of phosphorus and nitrogen loading was also down. However, in an average year the phosphorus loading from runoff is 96% of the phosphorus influx and the nitrogen loading from runoff is 99% of the nitrogen influx. The author concluded that these high loading percentages result mainly from agricultural runoff in the watershed.

b. Ground Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota (9)

Objective: To determine the occurrence, availability and quality of ground water in the western half of the Anoka Sand Plain with emphasis on the surficial aquifer.

Study Area: The western half of the Anoka Sand Plain is in Benton, Sherburne, Stearns, and Wright Counties. The area is bisected by the Mississippi River and contains Sherburne National Wildlife Refuge and the Sand Dunes State Forest. The surface waters in this area are the Platte, Sauk, Elk, and St. Francis Rivers. Irrigation is the greatest single use of ground water in the area and increased greatly during the 1970s.

Methods: This 3 year study began in July 1976, with the augering of 450 test wells to determine the thickness of the surficial aquifer. After this was completed, the ground water levels, ground water quality and surface water quality were analyzed. These water quality analyses were performed on 35 wells and 17 surface water sites for heavy metals, pesticides, nitrates, phosphorus, potassium and chloride levels.

Findings: Irrigation is commonly associated with increased use of fertilizers, and because infiltration is rapid in these sandy soils, the infiltration of chemicals is likely. In addition, it was shown that nitrogen, phosphorus, potassium and chloride levels were higher in irrigated areas than in the wildlife refuge. No pesticides were found in the 3 wells checked for them.

Based on the 38 ground water samples, the wells with the highest levels of nitrate-nitrogen were the irrigation wells. The range of nitrate-nitrogen (for all the wells tested) was .00 - 22 ppm with a mean of 5.7 ppm. Specifically, 18% of the ground water samples were greater than the recommended 10 ppm safety level.

The total phosphorus levels were not as high for the irrigation wells as for the other observation wells. The phosphorus levels ranged from .00 - .19 ppm with a mean of .16 ppm. As mentioned before, there is some dispute about the recommended maximum level of phosphorus, but most of the ground water samples in this study were low.

The chloride levels found in the ground water samples were highest for the irrigated wells. The chloride levels ranged from .6 - 41 ppm with a mean of 10.63 ppm. All of the ground water samples were considerably below the recommended maximum level of 250 ppm.

The 17 surface water samples showed low levels for both nitrate-nitrogen and chloride, so there did not seem to be an impact on surface water quality from irrigation.

Conclusions: The use of irrigation (and its subsequent increase in fertilizer use) can cause the levels of nitrogen, phosphorus, potassium, chlorides, and dissolved solids to increase. The levels of phosphorus and chlorides found were low, but almost 20% of the nitrate-nitrogen ground water samples were above the 10 ppm recommended level. Levels of nitrate-nitrogen that are above 10 ppm could cause health effects such as the "blue-baby syndrome" which affects infants. The general water quality in this area has not greatly deteriorated with the introduction of irrigation, but the potential is there, as seen by the high nitrate-nitrogen levels.

c. Limnological Characteristics of Selected Lakes (Minnesota), 1976-78, MPCA '84 (10)

Objective: To do an extensive survey of several lakes to determine the effects of suspected point or non-point sources of pollution. This was done by evaluating the trophic condition, point and non-point nutrient concentrations, water and nutrient budgets, and efficiency of nutrient control alternatives.

Study Area: The Minnesota lakes that were studied are mainly in the central region with a few in the southeast, northeast, and western parts of the state. The general littoral area (the percentage of total lake area which is less than 15' deep) of the 26 lakes range from 30 - 100%, with the majority around 40%. The lakes tested are therefore fairly shallow.

Method: During the period 1976-79, 26 lakes were surveyed three times a year: spring, July, and August. A few of the parameters tested were: secchi disc, total phosphorus, nitrate-nitrogen, chloride and chlorophyll a.

Findings: Eleven of the 26 lakes studied were in watersheds with more than 40% cultivation, and thus can be analyzed to determine the relationship between agriculture and water quality. Seven of these eleven lakes in cultivated watersheds were in the central region of Minnesota. The range of lake depth in the seven central area lakes was 4.2' - 20', the range of average nitrate-nitrogen levels was <.01 - .386 ppm, the range of average phosphorus level was .38 - 1.41 ppm, and the range of average secchi disc readings was .30 - 1.36 meters. The phosphorus levels and secchi disc readings would, under most conditions, indicate a eutrophic lake.

Conclusions: The lakes in the cultivated watersheds were consistently lower in secchi disc readings and higher in phosphorus levels than the twelve other lakes in watersheds with little farming. These two indicators, as well as chlorophyll a levels, are used to determine the trophic condition of the lakes. The chlorophyll a levels in the eleven lakes in cultivated watersheds are consistently higher than in the twelve other lakes. Based on these three indicators, the eleven lakes in cultivated watersheds were more eutrophic than the twelve lakes from less cultivated watersheds. These results suggest a connection between cultivated watersheds and lake eutrophication, but the magnitude of the connection is not certain.

4. WESTERN REGION

A. Area Background

In the western area of Minnesota is the Red River of the North Basin (RRB). This basin is characterized by the Agassiz lacustrine plain (clays and silts deposited by glacial Lake Agassiz) with 0 - 1% slope in the west, and, in the east, the Beltrami wetland area and the Fergus Falls till plain with 3 - 6% slope.

The annual average precipitation in the RRB is 20" (50% falling in the summer) and the growing season is 185 days. The water resources (on the basis of 40 acre plots) are 5.7% lakeshore and 5.5% permanent streams. Lake clarity is poor in the Red River Valley (the western-section of RRB) and good in the eastern section of the basin.

The agricultural land use in the Red River Valley (more than 90%) is greater than in the eastern part of the basin. The major agricultural activities in the RRB are cash crops and livestock (dairy, hogs, sheep, chicken, and turkeys). The percentage of row crops in the RRB is lower than in other basins described. The crops that are unique to this area are: potatoes, rye, flax, and sugar beets. Fertilizer application is especially high for potatoes and sugarbeets in Polk County. Irrigation is common in a few of the counties, e.g., Otter Tail and Clay.

Water erosion does not seem to be a problem, but wind erosion is prevalent. Nutrient loss is high where nutrient application is high, as on potatoes. Sediment in the streams appears to be largely the result of agricultural activities.

B. Western Area Studies

a. Appraisal of Pelican River Sand-Plain Aquifer - Western Minnesota (1982) (11)

Objective: To determine the quantity and quality of water available from the surficial aquifer, the effects of developing the surficial aquifer, and the effects of irrigation pumping.

Study Area: A 200 square mile area containing an outwash surficial aquifer (maximum depth 140') in Becker, Otter Tail and Clay counties. This area is characterized as hilly lake country with 20% of the land area in water resources. Precipitation falls mainly in the summer, with two-thirds falling between May and September.

Methods: Aerial maps were used to determine the thickness of the surficial aquifer, and the physical and hydrological characteristics were also determined. Modelling was used to estimate annual recharge and discharge. Chemical analysis was obtained from an earlier study (next study reviewed.)

Findings: The chemical quality of the ground water depends on the rock type in which it moves and components of the water it is recharged with. In this study, the analysis showed high concentrations of nitrate-nitrogen. The source of the nitrate-nitrogen levels was most likely agricultural activities: barnyards, domestic septic systems, and infiltration of fertilizers.

Conclusions: Recharge of the ground water is mainly through infiltration during snowmelts and rainfalls. Water quality was not a problem at the time of the study, but may become a problem with increased irrigation and the accompanying increase in fertilizer use. The conclusion that the higher nitrate-nitrogen levels are probably caused by agricultural activity is not supported by an analysis of the data presented in the study. Instead, the conclusion was based on the personal observations of the author, as disclosed in an interview with him.

b. Hydrologic Data for the Pelican River Sand Plain Aquifer, Western Minnesota. USGS Open-File Report 80-695 (12)

Objective: To compile hydrological data to be used by state and local officials for water development and management decisions. This report is a supplement to the previous study reviewed (Study 1).

Study Area: (see Study 1, Western Area)

Methods: In addition to the historical samples used, data was obtained from October 1978 to January 1979. These samples were numbered 1 to 253 (1978-79), and 253-353 for the previous years. Analysis was performed in four areas: logs on test notes, water levels, aquifer tests, and water quality analysis (33 wells). The water quality analysis included tests of 18 parameters on samples taken three times per well: December 1978, May 1979, and September 1979.

Findings: The three parameters that indicate possible agricultural effects on water quality are nitrogen, phosphorus, and chloride. Reported below are the average levels of these three parameters for the sampling period.

<u>well</u>	<u>nitrate level</u> (ppm)	<u>phosphate level</u> (ppm)	<u>chloride level</u> (ppm)
224	2.6	.02	2.1
229	8.7	.01	12.3
235	6.7	.013	12.6
247	.07	.01	6.8
300	.08	.026	5.9
240	.93	.013	1.5
250	.056	.046	3.03
252	.07	.013	1.76
244	28.6	.01	3.9
245	.01	.210	2.5
347	.08	.08	120.0

Nitrogen levels were greater than the 10 ppm recommended level in only 4 of the 33 samples summarized in the table above, and only one well averaged greater than the 10 ppm criteria. There has been no indication as to which wells are close to agricultural activities, but based on a personal communication with the author, the wells with higher nitrogen levels are in the agricultural areas.

The phosphorus levels were low for the 11 reported wells, as can be seen from the averages given above. The low levels of phosphorus are particularly significant in an area with relatively high numbers of lakes.

Most of the chloride levels were also very low, significantly below the 250 ppm criteria level. The one high well sample was taken from a site close to a former storage site for road salt.

Conclusions: As discussed in the previous study, the only water quality parameter (indicating agricultural impacts) that was greater than the recommended level was nitrogen. The personal observation of the author (when collecting samples) led him to conclude that agriculture was the primary source of the higher nitrogen levels. The low levels of phosphorus and chloride, and the generally low levels of nitrogen show that the agricultural impacts on water quality in this area are small.

c. Watershed Plan and Environmental Impact Statement, Burnham Creek Watershed, Polk County, Minnesota, USDA 1982 (13)

Objective: The description of a plan and impact statement of the multiple purpose floodwater retarding-wildlife structure. Included in the plan are a project for watershed protection, flood prevention, agricultural waters management, and fish and wildlife habitat improvement. Water quality studies were also performed in conjunction with the U.S. Geological Survey.

Study Area: The Burnham Creek watershed covers 104,200 acres in the northern section of the Red River Valley Basin and is 27 miles long. The normal precipitation level in the watershed is 21.5 inches, with 71% occurring between May and September. As described before, this is an active agricultural area, with 90% of the land used for agriculture. The major crops are sugar beets, wheat, barley, and sunflowers.

Erosion in the watershed is mainly wind erosion, and problems occur on 30,000 acres of cropland in the area. Included in this 30,000 acres are 8,400 acres where soil loss is greater than 5 tons per acre per year.

Method: Since the topic of this report is agriculture and water quality, this summary of the Burnham Creek watershed plan will concentrate on the water quality findings. The water quality data presented in this study were collected from 16 sites between 5/20/75 and 5/22/75 by the U.S. Geological Survey. The samples obtained were then analyzed for 30 water quality parameters. In addition, bottom material sediments in streams were collected for pesticide and PCB tests.

Findings: The four parameters analyzed for the possible impact of agriculture on water quality were fecal coliform bacteria, nitrite/nitrate, total phosphorus, and chloride. There were 24 pesticides tested at four sites, but only six pesticides were detected.

The table presented in this study listed the data for six of the 16 sites samples. The data for the four parameters of interest are presented below.

Parameter	SITES					
	1	3	4	10	19	21
Nitrite/Nitrate (ppm)	.00	—	—	.01	.11	.00
Total Phosphorus (ppm)	.10	—	—	.06	.02	.04
Fecal Coliform (MPN)	25	20	31	113	21	720
Chloride (ppm)	6.5	—	—	4.3	4.0	5.0

As shown in the table, the nitrite/nitrate, phosphorus, and chloride levels are low. There seems to be no indication from these three parameters that agricultural activities, such as high fertilizer application, are having any impact on water quality.

The fecal coliform levels, however, are high at a few of the sites. Site 21 is way above the 200 MPN/100 ml standard for class 2C streams (fish and wildlife habitat). However, the fecal coliform levels aren't consistently high, which shows there is relatively little agricultural impact on water quality in the basin.

It is rare to see such extensive pesticide testing as was performed in this study. The six pesticides detected were TDE, DDE, DDT, Dieldrin, Dyfonate, and Lindane. The pesticide levels found ranged from .1 to 11 ppb (the high level was Lindane). These levels are considered low for an agricultural area where 20 to 50 ppb are considered normal for bottom sediments. However, any level of pesticides in streams is of concern because of the possibility of getting into the food chain.

Conclusion: The impact of agriculture on water quality is not significant based on the data presented in this report. The only parameter that was above the recommended levels in a few cases was fecal coliform.

The significant findings are the low levels of pesticides present in the bottom sediments in such an agriculturally active area. A weakness of this report is the short period in which the samples were taken (one week). This short period of testing during May in 1975 could bias the data positively or negatively depending on the agricultural application dates and precipitation dates. This short sampling period should be kept in mind when assessing the significance of the data.

5. STATE-WIDE STUDIES

There are several programs in the state which gather data on a statewide basis. Many of those which deal with ground water concentrate on quantity rather than quality. Others deal with quality, but do not have their data summarized in such a way as to make generalizations possible. A good summary of existing programs is found in "Ground Water Protection Strategy Framework for Minnesota," Chapter 3, published by the MPCA in June 1983. The following programs are of some interest in drawing conclusions about water quality on a statewide basis.

A. Ambient Ground Water Monitoring Program (STORET). The data from this program has been published by the MPCA in five volumes (1978-84) entitled "Ground Water Quality Monitoring Program." (14)

Objective: To characterize the ambient ground water quality of principle state aquifers through the sampling of a number of wells. A secondary aim is to determine the relationship between the surface activities and ground water quality through the observation of significant changes.

Study Area: This is a state-wide study that began in February 1978. Currently, data has been collected on 360 wells and springs in 68 of Minnesota's 87 counties. The wells and springs were selected to be representative of each of the 12 major aquifer groups in the state.

Method: Data has been published on samples taken from 1978-1982. Each year new stations were monitored and some previously sampled stations were monitored again. The number of stations newly and previously monitored are shown in the chart below.

<u>Year</u>	<u>New</u>	<u>Previous</u>	<u>Total</u>
1978	137	---	137
1979	77	28	99*
1980	60	1	61
1981	50	12	62
1982	46	54	99*

*Totals do not equal new plus previous as reported by the PCA

The data collected from 1978-1982 is analyzed four ways in each volume (starting with the one published in 1981). The first analysis is the ground water quality by major aquifer for the most current data reported. The second analysis is of the ground water quality by major aquifer for all of the data collected, i.e., 1978-1982. The third analysis is independent of time and aquifers and is just a statistical summary of the parameters. Lastly, the fourth analysis is a graphic characterization of ground water quality by principle aquifer.

Findings: In addition to the year to year summary statistics on the parameters tested, there was a special study done in Southeast Minnesota, in 1982. This special study at 18 stations tested for four pesticides. In only one well (in Winona) were any pesticides detected. In that well, Lasso was measured at .3 ppb in June.

A great deal of information can be gleaned from these volumes on such parameters as nitrites and nitrates, total phosphorus, total coliform bacteria, fecal coliform, etc. These are summarized according to the mean levels found in Minnesota, the maximum and minimum amounts found, etc. For example, the mean level of nitrates is 3.61 ppm with a maximum of 43 ppm and a minimum of .01 ppm. The volumes do not present any summary of how many wells have nitrates at over the 10 ppm standard. In order to determine this, we looked at the site reports in Volumes 1 - 5. We discovered that 29 of the 370 wells sampled, or 7.9%, had nitrate concentrations of more than 10 ppm. Of the 29 wells, 11 (38%) were located in Southeastern Minnesota.

Conclusions: The above study appears to be the most comprehensive analysis of ground water quality in Minnesota. Nevertheless, it leaves quite a bit to be desired regarding the analysis of agriculture and water quality. The main problem is that each well is usually sampled no more than once every five years. If someone is interested in nitrate levels, however, it is advisable to take several samples at different times during a single growing season. It is also useful to sample during both wet and dry years. Thus it is not possible to use this study to prove any link between agriculture and water quality. Nevertheless, the fact that 8% of the wells sampled had nitrates above 10 ppm is a danger signal and an indication that more comprehensive work is definitely needed.

B. As far as CNDP staff knows, the most recent summary about the status of surface waters in Minnesota is "Minnesota Water Quality" 1982-3, released by the Minnesota Pollution Control Agency (15). Some of their findings were:

a. Of the river waters they monitored, 66% "supported designated use." Among other things, this meant that 39% of these river waters were unimpaired for swimming and 94% were unimpaired for fishing.

b. There are 3,411,200 acres of lakes in Minnesota, of which 17,298 acres (or 0.5%) were assessed. They found that 65% of these lake waters "supported designated use" and that 35% "partially supported designated use." All Minnesota lakes are designated as fishable/swimmable.

c. Of the streams and rivers which do not support designated use, 72% of this is caused by non-point source pollution. Of the lakes which do not support designated use, 75% of this is caused by non-point source pollution. Although sewer overflows, urban runoff and septic tanks contribute to non-point source pollution, the PCA estimates that the major contributor to non-point pollution in the state is agriculture.

C. The Minnesota Department of Agriculture has undertaken a pilot study and analysis of 30 Minnesota wells to look for the presence of pesticides in ground water. The wells are located in areas where ground water is thought to be especially vulnerable to surface contamination. Findings to date are tentative. Some wells contained no pesticides, while others had some at very low levels. In 1985, MDA will sample 100 wells in the spring, summer and fall in order to obtain more definitive results (assuming that the grant for this project from the LCMR is ratified by the state legislature). (16)

D. The Minnesota Department of Health (MDH) is in charge of a well-log program wherein records are supposed to be made on every new well drilled in Minnesota. Water quality analyses, including levels of nitrates and a bacteria count, are part of the record. Currently, the Department estimates that logs are created for about 70% of new wells drilled. The logs are an uncertain data source because the water quality analyses are of variable quality. Also, funds are not currently available to catalogue the data into a computerized system.

E. The MDH monitors the water quality on 2500 public water supplies for a large number of possible contaminants. They also monitor 10,000 non-community wells (i.e., wells for restaurants, shopping centers, etc.). Some of these wells are monitored as frequently as once a week. The understanding of the CNDP staff is that over the past few years they have found nitrates over 10 ppm in about 2 to 3% of these community wells, but steps have been taken to correct this and the number is now lower. Since most of these wells are quite deep, an analysis of their quality may reflect only the deeper aquifers in the state, rather than giving an accurate overview of all of the major aquifers, as is intended with the STORET data.

F. The Minnesota Department of Agriculture monitors the wells of over 8000 dairy operations and 1000 food, meat, and poultry facilities in the state. Sampling frequency varies according to the size of the facility. At least some of the records are destroyed after five years. Testing is done for coliform bacteria. This would appear to be an interesting source of information on ground water quality, but the data are stored in manual files and no one has undertaken a careful analysis of them, as far as CNDP staff has been able to discover.

NOTES

1. "Agriculture Package I - Water Quality Management Plan 208," Minnesota Pollution Control Agency, May 1979. The information in the area background sections is taken mainly from the appropriate sections of the 208 report.
2. "Ground Water Quality in Southeast Minnesota," Water Resources Research Center, Bulletin 109, Oct. '82.
3. "Hydrology, Water Quality, and Land Management in the Big Springs Basin, Clayton, Iowa," Iowa Geological Survey Open-File Report, 83-3 June, 1983.
4. "Temporal Changes in Nitrates in Groundwater in Northeastern Iowa," G.R. Hallberg, R.D. Nibra, G.G. Ressmeyer, E.A. Bettis III, B.E. Hoyer, Iowa Geological Survey Open-File Report 84-1, 1984.
5. "Ground Water Quality and Hydrogeology of Devonian Carbonate Aquifers in Floyd and Mitchell Counties, Iowa," R.D. Libra, G.R. Hallberg, G.G. Ressmeyer, B.E. Hoyer, Iowa Geological Survey Open-File Report 84-2, 1984.
6. "Public Water Supply Quality in the Rock River Watershed, Southwest Minnesota" C.P. Straub, V.M. Guppers, R.D. Singer. Water Resources Research Center Bulletin 110, Oct. 1982.

7. "A Limnological Compilation of Water Quality of the Minnesota River Watershed, in Minnesota," T. Feind, D. Braaten, H.W. Quade; WRRC Bulletin #107, Feb. 1981.
8. "Nutrient and Hydrologic Budget and Trophic Status of Lake Koronis, Paynesville, Minnesota, and Elk Lake, Near Clear Lake, Minnesota," John Barten, SCSU, Aug. 1979.
9. "Ground Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota," USGS-WRI 80-1285 Open-File.
10. "Limnological Characteristics of Selected Minnesota Lakes 1976-78," Minnesota Pollution Control Agency, 1984.
11. "Appraisal of Pelican River Sand-Plain Aquifer - Western Minnesota," R. Miller, USGS 82-347.
12. "Hydrologic Data for the Pelican River Sand Plain Aquifer," USGS 80-695.
13. "Watershed Plan and Environmental Impact Statement, Burnham Creek Watershed, Polk County, Minnesota," USDA-SCS, Feb. 1982.
14. "Ground Water Quality Monitoring Program: A Compilation of Analytical Data." Minnesota Pollution Control Agency, 5 volumes.
15. "Minnesota Water Quality: Water Years 1982-1983. The 1984 Report to the Congress of the United States by the State of Minnesota Pursuant to Section 305b of the Federal Water Pollution Control Act." Minnesota Pollution Control Agency.
16. Information about this program can be obtained from Mike Fresvik, supervisor, Agricultural Chemicals, Agronomy, Minnesota Department of Agriculture.

Section IV

EXISTING PROGRAMS DEALING WITH AGRICULTURE AND WATER QUALITY IN MINNESOTA

This document is intended to provide a brief outline and description of ways in which major federal, state and local units of government directly function to address the problem of agricultural impacts on water quality in Minnesota. The outline is divided into four sections: Research and Monitoring, Education and Information, Planning, and Implementation.

This outline has distinct limits. Given the large number of units of government involved or potentially involved with Minnesota's water resources, some may have been overlooked. This is also true with regard to programs within agencies, which change, or change names, somewhat frequently. The report, therefore, is not comprehensive. Nor does it provide an analysis of how effectively each agency is carrying out its responsibilities. Many anecdotes exist concerning the value of some of these programs, but we do not have sufficient information to carry out an evaluation.

Readers seeking more extensive, albeit somewhat dated, information on Minnesota water quality programs should consult the 1980 Water Quality Management Planning (208) documents, especially the "Description of Existing Institutions and Programs Related to Water Quality Management Study Topics," available from the MPCA. Useful also for both information and analysis is "Management Problems and Alternate Solutions," Technical Paper #14 from the Minnesota Water Planning Board, now part of the Environmental Quality Board. It is available from the State Planning Agency. Finally, it is important to consult with the people working in the various agencies in order to understand the nature and extent of current and proposed programs. Especially helpful in the preparation of this outline were Gaylen Reetz, MN Pollution Control Agency; Marilyn Lundberg, Linda Bruemmer, and John Wells, State Planning Agency.

1. A List of Federal, State and Local Units of Government Involved With Farming and Water Quality in Minnesota.

- Federal
- A. USDA, U.S. Dept. of Agriculture: SCS, Soil Conservation Service; ASCS, Agricultural Stabilization and Conservation Service; SEA-AR, Science and Education Administration - Agricultural Research; FmHA, Farmers Home Administration.
 - B. USDI, U.S. Dept. of the Interior: USGS, U.S. Geological Survey; USFWS, U.S. Fish and Wildlife Service
 - C. Corps: U.S. Army Corps of Engineers
 - D. F.A.A., Federal Aviation Agency
 - E. EPA, U.S. Environmental Protection Agency

- State
- A. DNR, Department of Natural Resources: DOW, Division of Waters; DFW, Division of Fish and Wildlife; DOE, Division of Enforcement; MEEB, Minnesota Environmental Education Board
 - B. EQB, Environmental Quality Board: SMRBC, Southern Minnesota Rivers Basin Council
 - C. *MASWCD, Minnesota Association of Soil and Water Conservation Districts
 - D. MDA, Minnesota Department of Agriculture: SWCB, Soil and Water Conservation Board; AD, Agronomy Division
 - E. MDH, Minnesota Department of Health
 - F. MPCA, Minnesota Pollution Control Agency: DWQ, Division of Water Quality
 - G. SPA, State Planning Agency: LMIC, Land Management Information Center; SWIM, Systems for Water Information Management
 - H. UM, University of Minnesota: AES, Agricultural Extension Service; AgExp, Agricultural Experimental Stations; MGS, Minnesota Geological Survey; WRRRC, Water Resources Research Center.
 - I. WRB, Water Resources Board

- Regional
- A. RDC, Regional Development Commission
 - B. RC&D, Resources Conservation and Development Areas
 - C. REEC, Regional Environmental Education Council
 - D. LRRWMB, Lower Red River Watershed Management Board
 - E. Metro Council, Metropolitan Council
 - F. MHB, Mississippi Headwaters Board
 - G. PRBB, Project River Bend Board
 - H. GLC, Great Lakes Commission (an interstate function)
 - I. MPBP, AREA II, Minnesota River Basin Project, Inc.
 - J. MWBC, MN-Wisconsin Boundary Commission (interstate)
 - K. RC-RCA, Redwood-Cottonwood Rivers Control Area
 - L. UMRBA, Upper Mississippi River Basin Assoc. (interstate)

- Local
- A. County: CE, County Extension; PZ, Planning and Zoning; LID, Lake Improvement District
 - B. Townships
 - C. SWCD, Soil and Water Conservation District
 - D. ASCS County Committee
 - E. WD, Watershed Districts
 - F. DCD, Drainage and Conservancy Districts

*(MASWCD is not, strictly speaking, a governmental unit).

2. Research and Monitoring

"Research" refers to an investigation of water pollution and related matters in order to establish basic facts and principles. "Monitoring" means the systematic sampling of water quality in order to create "baseline" data.

Due to cooperation and overlap between federal, state and local agencies, they have been lumped together, as appropriate, under one description. The accompanying chart indicates the essential differences between them.

A. US Department of Agriculture: Soil Conservation Service; Soil and Water Conservation Board; Soil and Water Conservation District: In cooperation with other agencies, such as the Agricultural Experiment Station, SCS and the SWCDs carry out soil erosion studies in order to estimate the soil loss taking place in particular regions and throughout the state. SCS is also carrying out a county-by-county "Soils Survey" providing maps and descriptions of soil types, a valuable tool for land use management. About 50 of Minnesota's 87 counties have been mapped. Completion date for the remaining counties is 1992. SWCD offices are also the source of information about current land use, including the application of various conservation practices having potential for water quality maintenance and improvement.

B. Environmental Protection Agency: This federal agency conducts and administers research and demonstration projects on water pollution resulting from soil erosion, nutrient runoff, animal wastes and pesticides. Although the agency maintains several major research facilities, including one in Duluth, much of its work is carried out through grants given to researchers in other agencies and in universities. A trip to a major library will acquaint the reader with a truly enormous amount of research regarding the effects of agriculture on water quality and the ways in which such effects can be mitigated.

C. US Department of the Interior: US Geological Survey: This agency performs surveys and prepares maps and reports on water resources, including limited information on water quality in Minnesota. A recent series of studies have examined the potential for as well as some of the effects of irrigation in Central and West Central MN.

D. US Department of the Interior: US Fish and Wildlife Service: Fish and Wildlife conducts research, usually in conjunction with universities, on pesticides, drainage and agricultural runoff to determine their effects on fish and wildlife and their environments.

E. US Department of Agriculture: Science and Education Administration-Agricultural Research; University of Minnesota: Agricultural Experiment Stations: Although separately funded and administered, these two programs often work in conjunction on the several agricultural campuses of the University of Minnesota. While their work is generally directed toward increasing the productive efficiency of agriculture, offshoots of such research have implications for water quality. Such investigations include the effects on water of various manure management systems, the movement of nitrogen fertilizers through the soil, the effects of varying rates of fertilizer and irrigation application, and the relationship between soil loss and varying tillage practices. Research results may appear in newspapers and farm publications, and are available as reports or in booklet form from Extension offices.

F. MN Pollution Control Agency: Division of Water Quality: This agency maintains a statewide surface water and ground water quality sampling network. It also maintains an Emergency Response "Spills" unit responsible for investigating reported spills, including

pesticide accidents. The MPCA is responsible for setting water quality standards in Minnesota as well as establishing allowable limits for discharges to waters.

G. Department of Natural Resources: Department of Fish and Wildlife, Department of Waters: Fish and Wildlife conducts surveys and samples the quality of certain surface waters in order to determine the effects of various activities upon fish and wildlife. This division also investigates and records fish kills, including those suspected of being agriculturally related.

DOW has been working with the USGS to develop ground water quality data in the sand plain areas of central Minnesota. Because results seem to show a relationship between high nitrate concentrations in shallow ground water and irrigation of farmland, the agency now plans to analyze the nitrogen to determine its source, i.e., from fertilizers or from humans or animals. The DOW is also beginning to coordinate a computer-based program designed to collect and standardize all Minnesota water-related information into one readily accessible system.

H. University of Minnesota: MN Geological Survey: The Survey is responsible for mapping the state's hydrogeology and for maintaining a record of state well-drillers' logs. Survey personnel from the Department of Geology and Geophysics are currently carrying out an extensive study of S.E. Minnesota's karst region. MGS has also recently completed a geologic atlas on Winona County, a tool considered invaluable for land use and water quality management planning.

I. MN Department of Agriculture: The Dairy Industries Division collects about 4400 dairy farm well samples each year. These samples are analyzed by the Laboratory Services Division. Agronomy Services recently began a program, working with MDH, to monitor ground water in target areas for pesticide contamination. Areas chosen include Hubbard-Morrison-Otter Tail-Wadena counties, the Bonanza Valley in Douglas-Kandiyohi-Pope-Stearns counties, and the Anoka Sand Plain in Anoka-Isanti-Sherburne counties. MDA plans to sample 31 wells in these three areas a total of 3 times each. Initial results should be available in early 1985. A follow-up survey will be more extensive.

J. MN Department of Health: The Department of Health monitors two kinds of drinking water systems, "community" (municipalities) and "non-community" (motels, restaurants) for water quality. Both ground and surface waters are checked. The frequency of the monitoring varies with the size of the population served, so that large cities may be checked more than 100 times a month, and small towns checked 4 times a year. The Health Department has just embarked on a survey of 1000 public water systems to check for the presence of agricultural chemicals, and with the Agriculture Department, will also carry out a 600-sample survey for agricultural chemicals in areas thought to be especially sensitive to ground water contamination.

K. County: Some counties, such as Olmsted in the SE, keep records of local water quality, based on samples taken from private wells of individuals seeking to have their water tested. Multi-county networks are now being established, for example in SE Minnesota, to pool this data and provide regional water quality information.

RESEARCH AND MONITORING

<u>FEDERAL</u>	<u>STATE</u>	<u>LOCAL</u>
<u>USDA</u> : SCS; SEA-AR	<u>MDA</u> : SWCB; AD	<u>SWCD</u>
<u>USDI</u> : USGS; FWS	<u>UM</u> : AgExp; MGS	<u>County</u>
<u>EPA</u>	<u>MPCA</u> : DWQ	
	<u>DNR</u> : DOW; FW	
	<u>MDH</u>	

3. Education and Information

"Education and Information" refers to establishing, maintaining and communicating information on problems and solutions related to water quality and farming. The list of those serving this function is divided into programs primarily serving farmers, programs aimed at school children, and those designed for others, including the general public. The reader should be aware that much overlap exists between most of these programs.

Farmer-Oriented Programs

A. US Department of Agriculture: Soil Conservation Service; MN Department of Agriculture: Soil and Water Conservation Board; Soil and Water Conservation Districts: These related agencies prepare and distribute educational materials, including pamphlets, slide shows and films, on pesticides and fertilizer use, livestock facilities, and soil and water conservation. These materials are often used as part of workshops, conservation tours, field days and demonstrations designed to inform farmers about best management practices and associated cost-share programs.

SCS has recently issued an excellent slide-tape series designed to educate its personnel specifically about the ways in which farming can degrade water quality.

The SWCB has just started a major "comprehensive-coordinated information-education program" aimed at both farmers and the general public. Its coordinator must assess all conservation-education efforts currently under way in Minnesota. Programs successful in other states will also be reviewed; also, surveys will be carried out among relevant groups, such as farmers and agribusiness people, to determine their level of conservation knowledge regarding problems, solutions, and programs. This kind of information will then be used to design and coordinate better educational efforts in this area.

B. University of Minnesota: Agricultural Extension Service, Agricultural Experimental Stations; County Extension: Research on, for example, the effectiveness of conservation tillage as a best management practice is carried out and published by the Agricultural Experiment Stations. This information is then made available to farmers via the University and County Extension programs. Technical reports are available upon request or summarized in Bulletins. Press releases also serve to summarize ongoing and completed research. County agents, responsible for keeping up with the latest information, provide demonstrations, hold workshops, and give advice to individual operators.

C. MN Department of Agriculture: Working through Extension, this agency conducts pesticide workshops to inform farmers about pesticide regulations, pest management techniques, and on the proper selection, safe use, storage and disposal of these chemicals. Such training prepares farmer-applicators to meet state certification requirements.

School-Oriented Programs

A. Soil and Water Conservation Districts: Individual Districts conduct "Education Field Days" where grade school children are introduced to conservation issues, including water quality, in an outdoor setting. District personnel may also visit classrooms with appropriate information.

B. County Extension: County agents work with 4-H and other youth groups to promote understanding of agricultural and related conservation issues.

C. MN Department of Agriculture: This department is in the process of creating a task force composed of farm groups, agribusiness and extension representatives, and educators to set up an "Agriculture in the Classroom" program in Minnesota schools. Whether or not the proposed curriculum will include conservation issues is not known at this time.

D. Department of Natural Resources: The DNR administers a state volunteer program designed to provide environmental education for teachers and school children. Environmental education materials are prepared and distributed to schools, and environmental in-service workshops are held for teachers. The program includes a state board, the Minnesota Environmental Education Board (MEEB), and 13 Regional Environmental Education Councils (REECs).

Public-Oriented Programs

A. University of Minnesota: Agricultural Extension Service; County Extension: While designed for the agricultural community, extension publications and programs are also available to a wider public. News releases also are the most obvious way in which non-farmers are made aware of University research and other extension information.

B. Dept. of Natural Resources: MN Environmental Education Board/Regional Environmental Education Councils' programs go outside of the classroom to engage adults via forums, fairs, conferences and radio spots. The DNR also publishes The Volunteer magazine, which frequently carries articles on conservation topics, including water quality. When appropriate, the agency also puts out news releases on such matters as drainage, for example.

C. State Planning Agency:

a) Land Management Information Center (LMIC) maintains information about land and its characteristics for use by state agencies and local governments. Information such as soil types and erodibility, soil nutrient factors, water resources, and land use patterns can be used in the analysis of soil erosion and nutrient runoff problems.

b) Systems for Water Information Management (SWIM) links together users of all Minnesota water resource data with the agencies

and institutions that collect and use such data. It is, essentially, a constantly updated catalog of sources of information on ground and surface water in the state.

D. MN Department of Health: This department maintains water quality data on about 2,000 of the state public water supplies. Since 1975, all wells drilled in Minnesota are required to be on file as a well log with MDH. This log includes the name and license of the well-driller, pertinent data about the type and location of the well, and a check for water quality in the form of coliform bacteria and nitrates. About 50-70% of wells drilled in the state actually comply with this requirement.

E. U of MN: Water Resources Research Center: The center sponsors conferences and seminars and publishes and distributes Bulletins, Informational Circulars and a Newsletter on water related research carried out in Minnesota's universities and colleges.

F. MN Pollution Control Agency: This agency maintains a library, open to the public, covering issues related to the environment. Brochures and manuals are published and distributed to the public. Public informational meetings, newsletters and formal training seminars are regularly held on various water quality issues.

EDUCATION AND INFORMATION

<u>Federal</u>	<u>State</u>	<u>Local</u>
<u>USDA</u> : SCS	<u>MDA</u> : SWCB	<u>SWCD</u>
<u>EPA</u>	<u>MDH</u>	<u>County</u> <u>Ext.</u>
	<u>UM</u> : AES; WRRC	<u>REEC</u> -
	<u>DNR</u> : MEEB	
	<u>SPA</u> : LIMC; SWIM	
	<u>MPCA</u>	

4. PLANNING

"Planning" refers to the design, coordination and review of policies and programs related to the potential effects of agricultural activity upon water quality.

A. Environmental Protection Agency: This federal agency oversees national water pollution control programs which are implemented by state agencies such as MPCA in MN. EPA develops nationally applicable regulations and guidelines which states must abide by and implement.

B. US Fish and Wildlife Service: The National Fish and Wildlife Coordination Act requires that all water-related projects undertaken by federal agencies be reviewed by FWS to determine potential project effects on fish and game. Programs developed by the SCS would fall into this category.

C. US Dept. of Agriculture: Soil Conservation Service: Two federal programs, the Rural Clean Water Program (RCWP) and the Resources Conservation Act Program (RCA), describe SCS planning requirements. RCWP provides that SCS create plans to implement the best-management practices required to control non-point-source pollution at specific sites. There is currently only one such project in Minnesota, i.e., the Garvin Brook Watershed in Winona County. The second, broader focus is on the development of a general soil and water conservation program.

D. MN Dept. of Agriculture: Soil and Water Conservation Board; Soil and Water Conservation Districts: Under the state Soil and Water Conservation Planning Program, the Board is charged with developing a comprehensive soil and water conservation program for the state. In doing so, it creates guidelines to be used by SWCDs in drawing up their individual plans, including their budgets. After reviewing (and possibly changing) District plans, the Board incorporates them into the statewide plan. The plan serves to establish conservation priorities, including the allocation of scarce funds.

The Board has 12 members. Seven of them are SWCD supervisors appointed by the governor. The other members include the Director of Agricultural Extension, Dean of the Institute of Agriculture, Director of the MPCA, the Agriculture Department Commissioner, and the Commissioner of the DNR. The State Conservationist (SCS head) serves as an advisory member, as do the state Executive Director of ASCS, the President of MASWCD, and representatives from Association of MN Counties (AMC) and the League of Minnesota Cities.

E. Water Resources Board: Watershed Districts: This Board establishes watershed districts and reviews their water management plans. Plans can include erosion and other pollution control measures. They are reviewed and subject to change every two years. An independent agency with its own staff, the Board has 3-5 citizen members who are appointed by the governor.

Watershed districts are also governed by boards. District boards create water management improvement plans and may adopt rules essential to fulfilling the plans. Such rules can include those with water quality management programs, such as MPCA feedlot regulations, or DNR shoreland management regulations. While districts have it within their scope to address water quality issues, only two of the 37 currently in existence were set up primarily to enhance water quality, the rest being primarily concerned with the control of water quantity flow and drainage.

When a district is first established, its five initial managers are appointed by the state Board. Subsequent appointments, however, are made by commissioners of the counties included in the district.

F. MN Pollution Control Agency: This agency exists to address problems related to the pollution of water and other resources. Regarding water, the agency goal is to maintain or achieve a degree of water quality "consistent with maximum public enjoyment and use." MPCA is the unit of government chiefly responsible for the planning of water quality management in Minnesota. In the mid-1970s, MPCA began a Water Quality Management Planning effort required under Section 208 of the Federal Clean Water Act. In 1980 the MPCA published the report "Water Quality Management: Minnesota 208 Plan." The plan, with several updates, remains the official water quality management plan of the state, excluding the seven-county Metro Area.

The 208 contains a major review of agricultural impacts on water quality, a description of relevant government programs, and suggestions about necessary corrective measures.

MPCA policy is set by a board consisting of nine citizens and a Director, all appointed by the governor. The Director carries out policy assisted by a staff located in Roseville and 5 regional offices.

G. Dept. of Natural Resources: Division of Waters: This division plans and administers programs which regulate the appropriation and use of state water. Of particular concern are activities which alter the course, current or cross-section of public waters or which take place in flood plain and shoreland areas. DNR develops guidelines and standards for local governments to use in developing ordinances designed to control activity in the shoreland area of a lake or river, or in a floodplain. Such an activity might include, for example, a farm feedlot operation. If a county or municipality fails to adopt an ordinance, the DNR Commissioner can put one into effect. DNR also advises counties and cities regarding lake improvement and stream maintenance programs, and reviews plans for any drainage projects affecting public water. DNR is supervised by a Commissioner who is appointed by the governor. Staff are located in St. Paul and throughout six administrative regions.

H. Environmental Quality Board: The EQB is the principal state forum for the discussion of problems related to the environment and which encompass the responsibilities and require the interaction of several state agencies.

The EQB is a decision-making body independent of SPA, but is supported by its staff.

The EQB decides issues relating to environmental review, power plant siting, and critical areas programs. It is also responsible for coordinating water planning activities. The board promotes cooperation among state agencies on environmental matters by serving as a forum for discussions regarding significant environmental issues.

The EQB is composed of the top officials of six state agencies: agriculture, energy and economic development, health, natural resources, pollution control, and transportation. In addition, there are five citizen members appointed by the governor, and a governor's representative who serves as chairperson. There is also a Technical Advisory Committee which is composed of technical representatives from each state agency represented on the Board.

I. State Planning Agency: This agency serves as the umbrella planning organization for other agencies. The agency manages two major sources of water quality-related information, the Land Management Information Center (LMIC), and Systems for Water Information Management (SWIM), which are described in the preceding "Education and Information" section.

Several SPA staff members have been responsible for creating a series of planning documents giving an evaluative overview of a variety of water quality management problems and programs in Minnesota. SPA coordinates both long-range and short-term policy development and legislation for the administration and the executive branch. Agency priorities are issues identified by the governor and legislature. The Environmental Division serves as the focal point for the coordinated development and analysis of statewide environmental policies. This division provides staff support for the EQB.

J. U of MN: Water Resources Research Center: The Center plans and facilitates academic research on water-related issues at the U, state colleges, and MN private colleges. Its primary function is to encourage and support the kind of multidisciplinary research efforts required by the complexity of many water quality problems.

K. Metro Council: Whereas MPCA was given the responsibility of preparing the 208 Water Quality Management Plan for the state of MN, the Council was required to develop a separate 208 for the seven-county Metro Area. The plan is complete, and like the MPCA document, provides evidence for the negative effects of some farming activity upon water quality, as well as suggesting ways to mitigate the problem.

L. Regional Development Commissions: 11 RDCs, including the Metro Council, currently exist in Minnesota. Responsible for creating comprehensive development plans for their region, RDCs can review and comment upon city, county, town, watershed district and SWCD plans.

M. Southern MN River Basins Council: The Council was created by the legislature in 1971 to guide the creation and implementation of a comprehensive environmental conservation and development plan for the Minnesota River Watershed and the watersheds of river tributaries to the Mississippi River south of where it joins the Minnesota. The plan, in the form of two reports, is complete.

Now merged with the EQB, the council meets monthly to review matters related to its charge, provides information to local groups within its region, and serves in an advisory capacity to the EQB.

N. Great Lakes Commission: This multistate agency serves many functions, among them planning for the conservation and cleanliness of water in the Lakes.

O. Minnesota-Wisconsin Boundary Commission: This agency is concerned with ". . . present and future protection, use and development in the public interest of the boundary lands, river valleys and waters" of the Minnesota-Wisconsin boundary area.

P. Redwood Cottonwood-Rivers Control Area: This is a joint-powers planning board involving Lincoln, Lyon, Redwood, Pipestone, Murray, Cottonwood, Yellow Medicine, and Brown counties. This group's efforts are aimed at enacting flood and erosion control on a local basis.

Q. The Upper Mississippi River Basins Association (UMRBA): Serves as a cooperative forum for MN, Wisconsin, Iowa, Illinois and Missouri. Its major effort has been the creation of a "Comprehensive Master Plan for the Management of the Upper Mississippi River System", which it is now trying to move to the implementation stage. Additionally, the Association is preparing erosion control strategies for critical backwaters of the Mississippi threatened by sedimentation.

R. Counties: Most of Minnesota's 87 counties have comprehensive land use planning programs and ordinances controlling land use and development. Within established state requirements, counties can organize their comprehensive land use planning programs according to local circumstances and the judgement of local officials.

As the legislative branch of county government, the county board establishes the land use planning program. The county board appoints members of the planning commission and hires a county planning staff. The county board has five commissioners elected to four-year terms from five separate districts that are approximately equal in population. The county board has authority to prepare, and adopt by ordinance, a comprehensive land use plan that is the basis for county zoning ordinances.

Since county boards have many other responsibilities, state law encourages them to appoint planning commissions to advise them in formulating, implementing, and administering land use policies. If appointed, the planning commission must have from 5 to 11 regular members. The responsibilities delegated to the planning commission by the county board generally fall into four categories: (1) helping to

develop a comprehensive land use plan; (2) recommending specific ordinances and amendments for adoption by the county board; (3) conducting hearings on proposed ordinances and amendments, and transmitting findings and conclusions to the board, and (4) being actively involved in land use control programs, including the review of applications for conditional use permits.

Counties can join in formal associations, i.e., joint-powers agreements, or informal associations to address water quality issues on a regional basis. (The above-mentioned RC-RCA is an example of this.) In Southeast Minnesota, for example, two multi-county task forces are currently sharing water quality concerns, information, and protection ordinances.

S. Townships: Townships can create planning and zoning programs which can significantly affect land use and water quality management within their domain.

PLANNING

Federal:

EPA

USDI: USFWS

USDA: SCS

State:

MDA: SWCB

EQB

WRB

SPA

MPCA: DWQ

UM: WRRC

DNR: DOW

Regional/Local:

WD

RC-RCA

SWCD

UMRBA

Metro Council

County

RDC

Townships

SMRBC

GLC

M-W BC

5. IMPLEMENTATION

"Implementation" has reference to the technical and financial assistance, such as the designing and funding of erosion control structures, which units of government provide toward alleviating the problem of farming's effect on water quality. It also refers to regulation, i.e., the enforcement of standards and laws having to do with the maintenance or improvement of water quality.

Technical Assistance

A. US Dept. of Agriculture: Soil Conservation Service; Soil and Water Conservation Districts: SCS is the technical agency responsible for soil and water conservation within USDA. The agency's primary function is to provide technical assistance to landowners who want to apply conservation practices. Such assistance is also available to other government agencies. The state office, headed by the State Conservationist, is located in St. Paul. In addition, there are seven area and 89 district offices throughout the state. Each district employs a District Conservationist (DC) and his staff who work directly with those wanting to install conservation measures.

SWCD's, although local entities independent of USDA, work so closely with SCS that the two are often indistinguishable to landowners. Districts, of which there are 92, share office space with SCS. Districts are responsible for enlisting farmer-landowners as "cooperators" in the conservation program. District technicians visit a cooperator's farm site, review conservation needs with the farmer, suggest and then create designs for appropriate measures and aid landowners in obtaining cost-share assistance where available. District policy is set by a board of locally-elected supervisors.

B. Dept. of Natural Resources: Div. of Waters: The Shoreland and Floodplain Management Programs of the DNR offer technical aid to counties and municipalities. DOW staff provide model ordinances, data and general technical advice to counties and towns in their administration of zoning ordinances and sanitary codes.

C. MN Pollution Control Agency: Div. of Water Quality: As part of its feedlot permit program, DWQ can provide limited technical assistance to farmers. Such assistance is usually provided in conjunction with an application for a permit to build or modify a feedlot facility. DWQ staff can give advice concerning animal waste pollution control systems and will refer applicants to other relevant agencies such as SCS.

D. Lower Red River Watershed Management Board: This board combines several watershed districts in an attempt to deal with a regional flooding problem. It is assisted in some of its efforts by the DNR.

E. AREA II, Minnesota River Basins Project, Inc.: This is a joint-powers agreement among 10 counties in South Central and Western Minnesota to develop and manage flood control structures. The SWCB provides the project with an engineer and grants for specific projects.

F. Counties: County extension agents provide direct technical advice to farmers on a variety of conservation-related matters, including fertilizer and pesticide use and the construction of animal confinement facilities.

Financial Assistance

A. US Dept. of Agriculture: Agricultural Stabilization and Conservation Service: Through the Agricultural Conservation Program (ACP), ASCS provides financial aid or "cost-sharing" to landowners seeking to install conservation measures on their land. Such measures may include the construction of animal waste control facilities. Cost-sharing ranges up to 90% of the cost of a high priority practice, such as handling waste in a feedlot located in shoreland area. The maximum that can be spent for any one practice, however, is \$3500.00.

This agency also administrates a Federal Water Bank Program which enables owners of certain valuable wetlands to be paid not to drain them. Owners are paid the approximate value of the use of the land if it were drained and used for crop production, up to a maximum of \$55/acre. Funds for this program are of decreasing availability, with the result that contracts signed with some farmers are not being renewed, and many more landowners want to participate than can.

Policy decisions as to what practices and which landowners should receive funds at the local level are made by county ASCS committees, which are made up of locally-elected landowners.

B. US Dept. of Agriculture: Farmers Home Administration: A federal lending agency, the FmHA has several programs which provide loans to farmers for the installation of conservation practices and structures.

C. Environmental Protection Agency: This agency provides money for research and planning efforts in the area of water quality. Most of the 208 water quality management study carried out in Minnesota, for example, was funded by EPA.

D. US Dept. of Agriculture: Soil Conservation Service: In 1984, SCS provided a small amount of financial aid to RC & D Areas. A much larger sum was spent on providing conservation-oriented employment in several economically depressed areas of the state.

E. Soil and Water Conservation Board, SWCD: The Board provides state money to Districts to help offset their operational expenses. The Board also administers a state cost-share program wherein landowners who enter a cooperative agreement with a District are eligible for up to 75% of the cost of a particular conservation practice.

F. Dept. of Natural Resources: Div. of Waters: As somewhat of a supplement to the Federal Water Bank Program, DNR has a program designed to compensate landowners who have been denied permits to drain wetlands. Such lands may be placed in a variety of lease/easement agreements, or if the owner wishes, the DNR may purchase them outright. Because the state's definition of wetlands eligible for this program is much more restrictive than the federal program, however, the state program does not include many areas left open due to decreased funding of the ASCS Water Bank Program.

Regulation

A. Corps: The Corps of Engineers administers a regulatory program requiring approval of plans to dispose of dredged or fill materials into wetlands and other federally-protected waters.

B. Environmental Protection Agency: Under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), EPA registers all pesticide producers and pesticides and requires that all pesticides meet certain requirements of effectiveness as well as safety to humans and the environment. As a result, some pesticides are banned and others are available only for restricted use. All pesticides are required to have a label containing explicit directions as to purpose, rate, time and method of application and disposal. Because the label serves as a legal document, use of the pesticide in a way other than described on the label is a violation of law. EPA also has the authority to set water quality standards for pesticides, but is in need of a great deal more information about how they behave in surface and ground water.

C. The Federal Aviation Agency (F.A.A.) requires the certification of aerial pesticide applicators on the basis of a test of their knowledge of proper usage and safety precautions. Aerial applicators are also required to keep records of their pesticide applications.

D. MN Dept. of Agriculture: The Agriculture Department regulates the sale and use of pesticides in Minnesota. All pesticides sold or distributed in the state must be registered; all applicators must be certified and licensed; all restricted-use pesticide dealers must be licensed; pesticide application records must be maintained, and all pesticides must be properly stored and disposed of.

E. Dept. of Natural Resources: Div. of Waters, Div. of Enforcement: The Enforcement Division ensures public compliance with resource management laws, including specific water pollution and litter laws which prohibit depositing materials harmful to fish or wildlife in "public waters", i.e., any Minnesota waters having a "material beneficial public purpose." If violations occur, such as the deliberate dumping of pesticides or manure into lakes or streams, conservation officers may ticket the offenders. Fines for such activities may go up to \$500.00.

DOW regulates drainage activities by requiring permits for any activity involving work in the bed of a public water, and by reviewing proposed watershed district drainage plans. Under the Floodplain and Shoreland Management Programs, DNR may take court action against a county or town which fails to enforce its ordinances. Agricultural activities, such as a feedlot located within a shoreland area, fall into this category.

F. MN Pollution Control Agency: Div. of Water Quality: DWQ is in charge of regulating feedlots under both the National Pollution Discharge Elimination System Permit Program (NPDES) and the state Animal Feedlot Permit Program. Both programs are designed to abate or prevent water pollution from feedlot operations. Feedlot permits are required for any confined animal facility which begins or expands operation, modifies facilities, changes ownership, or constitutes a potential pollution hazard. MPCA can take enforcement action against feedlot operators who violate MPCA rules or permit conditions.

G. County: Counties may, in concert with MPCA, establish feedlot control programs wherein a county official may inspect and issue or deny permits for animal confinement facilities. Counties may also enact planning and zoning programs which can regulate agricultural and other activities in designated areas. In shoreland and floodplain areas, and along the banks of DNR-designated "Wild and Scenic Rivers," counties are required by the state to create and maintain ordinances giving such areas special protection. Counties are also empowered to create Lake Improvement Districts (LID) under rules put forth by the DNR. Among the several powers granted to such districts is that of developing and implementing a comprehensive plan to eliminate water pollution.

With regard to soil erosion, Fillmore County has an ordinance allowing landowners affected by a neighbor's haphazard land use to complain to the county. If the complaint is verified, the offending landowner is required to install appropriate conservation measures or face a fine. A 1984 state law now encourages all counties to adopt similar ordinances.

Notable too is the fact that several Southeast Minnesota counties are considering the adoption of ordinances designed to protect ground water.

H. Townships: Townships may also establish zoning regulations to regulate land use, providing that they are more restrictive than existing county ordinances.

I. Watershed Districts: Watershed districts may adopt rules providing for the prevention of pollution in district waters, including the regulation of feedlot operation. Districts can take enforcement action in the courts, or report violators to MPCA or DNR.

J. Regional Conservation and Development: These are regional organizations designed to address conservation needs on a regional, public-need basis. Funded by SCS, they are run by a small technical staff and a committee composed of county commissioners and SWCD

supervisors from the area involved. Projects include roadside erosion control, parks and the improvement of lake water quality. There are currently three RC & D areas in Minnesota: Hiawatha Valley (SE), Onanagazie (Aitkin County), and Westmin (West Central). RC & Ds are without regulatory authority.

K. Mississippi Headwaters Board: When the National Park Service planned to designate the headwaters of the Mississippi as a "Wild and Scenic River," the eight Minnesota counties potentially affected forestalled the plan by forming a joint-powers agreement to take care of the river through local control. Their comprehensive land-use plan has ordinances designed to protect the river and nearby areas.

L. Project River Bend: Like the MHB, this group was formed in response to an attempt by DNR to designate part of the Minnesota River as a "Wild and Scenic River." Six counties, including Le Sueur, Nicollet, Brown, Renville, Redwood and Blue Earth, instituted a joint-powers agreement involving the establishment of land use regulations for the river area. The regulations are similiar to those required by the Scenic Rivers program.

IMPLEMENTATION

Federal: USDA: SCS, ASCS, FmHA
EPA
Corps
F.A.A.

State: DNR: DOW, DOE
MPCA: DWQ
SWCB
MDA

Regional/Local: LRRWMB
MRBP
County
SWCD
Townships

WD
RC & D
MHB
PRB

REGIONAL OFFICES FOR THE MINNESOTA POLLUTION CONTROL AGENCY,
THE DEPARTMENT OF NATURAL RESOURCES, DIVISION OF WATERS,
THE SOIL AND WATER CONSERVATION BOARD, AND THE SOIL CONSERVATION
SERVICE MAY BE LOCATED AS FOLLOWS:

MPCA: Region I, Duluth, 218-723-4660
 Region II, Brainerd, 218-828-2492
 Region III, Detroit Lakes, 218-847-1519
 Region IV, Marshall, 507-537-7146
 Region V, Rochester, 507-285-7343
 Headquarters, Roseville, 612-296-7373

DNR, DOW: Region 1, Bemidji, 218-755-3973
 Region 2, Grand Rapids, 218-327-1716
 Region 3, Brainerd, 218-828-2605
 Region 4, New Ulm, 507-354-2196
 Region 5, Rochester, 507-285-7430
 Central Office, St. Paul, 612-296-4800

SWCB: Northwest, Bemidji, 218-755-3963
 Northeast, Duluth, 218-723-4752
 West Central, Staples, 218-894-1692
 South Central, New Ulm, 507-354-2196
 Southeast, Rochester, 507-285-7458
 Southwest, Marshall, 507-537-7260
 East Central, East St. Paul, 612-296-3767

SCS: Area 1, Thief River Falls, 218-681-6600
 Area 2, Fergus Falls, 218-736-5445
 Area 3, Duluth, 218-727-6692
 Area 4, Brooklyn Center, 612-566-2941
 Area 5, Marshall, 507-537-0541
 Area 6, St. Peter, 507-931-2530
 Area 7, Rochester, 507-289-7454

Section V

ISSUES IN DEBATE

As is to be expected on a complex issue such as agricultural impacts on water quality, there were disagreements among the witnesses who appeared before the five regional Citizens Panels. Some of these disagreements were clear to the panelists since they occurred between witnesses who appeared before the same Panel. Other disagreements were not obvious, since they occurred between witnesses who testified at different Panels. This section summarizes five of the major disagreements encountered. Part of the aim here is to clarify the nature of the disagreements, because this may not be clear even to those panelists who heard both sides presented. Since the testimony is on tape, the staff was able to listen carefully to what was said and summarize this in such a way as to make the areas of agreement and disagreement as clear as possible. Another reason for doing this was to help all of the panelists be aware of some of the significant issues which may have been brought out in Panel hearings other than the one they attended.

The five issues chosen here are by no means the complete list of significant issues. There is nothing included on pesticides, mainly because the information available is sparse and the area very complex. The problems of how best to implement policies are also ignored (e.g., should it be the counties or the PCA that enforces the regulations about feedlots?). But this section does include discussions about some of the major issues: nitrates in ground water, phosphorus in lakes, the ability of wetlands to absorb nutrients, the levels at which nitrates are dangerous, and the economics of soil conservation for farmers. The last two issues were chosen not because there was a clear disagreement between two or three individual witnesses who appeared before the Panels, but because the staff noticed a significant disagreement that appeared as a secondary theme in the statements of several witnesses. It should be apparent that the summaries presented here are by no means the last word on these issues.

ISSUE #1

TO WHAT DEGREE DOES AGRICULTURE POLLUTE OUR GROUND WATER WITH NITRATES?
HOW DOES THIS OCCUR?

Positions: The strongest claims of ground water pollution by nitrates were made by Bernard Hoyer and George Hallberg of the Iowa Geological Survey. They did not appear as witnesses before any of the regional Panels, but their work was frequently mentioned by various professionals in Southeastern Minnesota, and therefore CNDP staff presented their data to several regional Panels. They have been studying ground water in Northeastern Iowa, an area quite similar geologically to Southeastern Minnesota. In the 22 counties they studied, 18% of all wells sampled exceeded the 10 parts per million drinking water standard for nitrates. This ranged from 25% of the

samples in the Karst areas to 15% of the samples in the Deep Bedrock areas. In the Big Spring Basin, they found a 230% increase in nitrate concentrations in ground water from the late 1960's to 1982. They attribute this increase to fertilizer - N, the use of which increased by about 250% in the same time period. (See Section III, SE Minn. Studies, for a summary of this work.)

A different point of view was presented by Dr. Wallace Nelson, a soil scientist and Superintendent of the Southwestern Experimental Station in Lamberton, Minnesota. He reported on research done at Lamberton over a 12 year period. Their aim was to determine how far down into the soil nitrogen would leach under different application levels. They sealed off a number of plots of land so that no water or nutrients could move laterally through the soil from one plot to another. They then applied fertilizer - N at the rates of 0, 100, 200, and 400 pounds per acre, the latter chosen as an amount larger than any farmer would ever apply under normal conditions. They planted identical crops of corn on these plots for 12 years (during the last four of which no fertilizer at all was applied).

They discovered that even at the rate of 400 lbs/acre, the nitrogen did not move any further down in the soil than 9 feet, even after eight years of application (although at the 3 to 4 foot level the concentrations were approaching 100 ppm with the heavy application). On the average after 8 years, 60% of the nitrogen which had been applied was still in the soil, available for plant use. That this nitrogen could be used was demonstrated by corn grown for 4 years with no fertilizer application at all. They did, however, discover that nitrates were lost through the tile lines which ran through the plots. The losses are shown in Figure 1 for the Lamberton study and for a similar study done in Waseca. (Note the amount lost at Lamberton even when no fertilizer was applied. Dr. Nelson said that this occurs due to the high level of organic matter found in the soils in their region.)

Figure 1: Nitrate losses through tile lines in test plots in Lamberton and Waseca.

<u>Application rate</u> (in pounds per acre)	<u>Lamberton</u>		<u>Waseca</u>
	pounds lost	percent lost	percent lost
0	73 lbs	--	--
100	143	10%	9%
200	267	14%	14%
300	--	--	20%
400	559	17%	--

A third perspective on the loss of fertilizer - N was presented by Dr. Henry Quade, a professor of biology at Mankato State University. He reported on two studies done by his students, Catherine Larson-Albers and Mark Davidson. They found that drainage ditches and tile lines from agricultural areas were contributing anywhere from 1.2 ppm

to 22.3 ppm nitrates to the rivers into which they drained. It was Quade's view that nitrates were so soluble that it made little difference whether they percolated through the soils to tile lines and thus moved into adjacent waters or whether they ran off over the surface. On the other hand, phosphates and organic nitrogen are removed from water as it percolates through soils to tile lines. Thus, the latter two substances enter the surrounding waters largely through surface run off.

Areas of Agreement:

1. There was an agreement between Quade and Nelson that nitrates are lost through tile lines which drain fields and that these losses can often be at concentrations of over 10 ppm.
2. There was an agreement that nitrates can percolate down through sandy soils into water supplies. Nelson said that 95% of the crop soils in the Southwest are on a till with 25 - 30% clays, but that in other areas, such as the Anoka Sand Plains, there indeed should be a concern about nitrates leaching into water supplies.
3. The staff did not encounter any disagreement with the results of the Lamberton studies about the lack of movement of nitrates down through clay soils.

Areas of Disagreement:

1. The main disagreement seems to be over the significance of the nitrate loss through tile lines. Nelson did not appear to believe this was leading to a degradation of our waters, while Quade did. This disagreement may stem from the fact that Nelson spoke mainly about the effects of nitrates on ground water, while Quade spoke mainly about surface waters.
2. There appear to be doubts that Hallberg and Hoyer have really proven that the increase of 230% in nitrates in Big Spring Basin is simply the direct result of the 250% increase in fertilizer - N over the same period. This is not a point which the staff has had a chance to pursue in any depth. Certainly the Lamberton studies showed the contribution which organic soils can make to nitrates in the water coming from tile lines.

Policy Implications:

1. The loss of nitrates through tile lines would seem to have a major significance for the type of corrective actions which can be taken. If the only concern about nitrates used on clay soils were with regard to surface runoff, then the use of standard conservation practices would solve much or all of this problem. But if significant amounts are lost through tile lines, it will not be easy to take corrective action to prevent this.

2. It seems imperative that good research be done on the amounts of nitrates lost under differing soil, drainage, and precipitation conditions. Also we need to know the degree to which nitrates lost into surface waters are able to enter the ground water in different parts of the state. Clearly this will be more rapid in the Southeast than in other parts of the state, but even in areas where the process is slow, we need to know what the rate of change is. CNDP is aware that Alfred Blackmer of Iowa State University is involved in a major study of nitrate movement, tracing this through the isotope N-15. His initial results indicate that "leaching of nitrate from the rooting zone of crops may be more important as a mechanism of fertilizer loss than has been generally recognized." His results will be published in 1985 and would appear to warrant a careful analysis. If it turns out that nitrates are dangerous for adult consumption at lower levels than previously assumed (see Issue #4), then the need for good research in this area is doubly important.

ISSUE #2

TO WHAT DEGREE IS PHOSPHORUS FROM AGRICULTURAL ACTIVITIES CAUSING A RAPID INCREASE IN THE EUTROPHICATION OF MINNESOTA'S LAKES?

Positions:

John Barton, a limnologist now working for the city of Waseca, testified to the Panel in St. Cloud about a study he did on Lake Koronis for his masters thesis. One of his major conclusions was that phosphorus was the major nutrient which was increasing the eutrophication of the lake. He estimated that 78% of the phosphorus came from the watershed drained principally by the North Fork of the Crow River, 11% came from the city of Paynesville and its sewage lagoons, 8% came from septic tanks around the lake, and 3% came from precipitation. In light of these findings, and of other studies showing the exports of nutrients from agriculture to water, Barton concluded that the major contributor of phosphorus to the lake was agricultural activities.

Lowell Hanson, a professor emeritus of soil science at the University of Minnesota who also testified at St. Cloud, urged caution about drawing this conclusion. He noted that since the watershed is 60 times the size of the lake, and since 3% of the phosphorus came from rain on the lake, then if all the rain on the watershed were to reach the lake with its phosphorus, this would lead to more than twice as much phosphorus entering the watershed as compared to what now occurs. Also, he cited studies which show that hay and natural grasslands can lead to a considerable runoff of phosphorus into waters. Since Barton never directly measured the phosphorus runoff from any agricultural activity, one should be very cautious about making assumptions about where the phosphorus is coming from.

Areas of Agreement:

1. Hanson appeared willing to accept Barton's findings about the percent of phosphorus entering the lake from the watershed drained by the Crow River.
2. The two men agreed that the 62 major feedlots in the watershed were a potential source of phosphorus and that limiting runoff from them (if this has not already been done) would reduce the phosphorus input to Lake Koronis. Barton noted that a study in the Water Resources Bulletin, 1976, #10 pp 117-122 found that in a watershed on the Iowa-Minnesota border, the primary contributor of phosphorus was feedlots.
3. The two men agreed that conservation practices could cut down on the contribution of phosphorus from row crops. Barton cited a study in the Water Resources Bulletin, v. 19, October 1983, pp 753ff which showed that, in a watershed where conservation practices were introduced over a six year period, this led to a 22% reduction in phosphorus. Hanson found nothing in this contrary to his views. He noted that phosphorus fixes tightly to soil particles and that by preventing erosion, one can keep phosphorus where it belongs.

Area of Disagreement:

There was disagreement between Barton and Hanson about the extent of phosphorus runoff from row crops versus runoff from fields planted in hay or even in natural cover.

1. Hanson pointed out that the freezing and thawing of hays and grasses breaks down their structure and releases phosphorus. A study done at Morris by D.R. Timmons, R.E. Burwell, and R.F. Holt in 1968 (cited in J. Agr. Food Chem. vol. 18, #5, 1970) showed that a field in hay had three to four times more phosphorus runoff than fields which were planted in cultivated crops. This occurs in part because in row crops the soil is exposed and the phosphorus can easily attach to the soil, whereas in grass and hay fields there is a barrier between the phosphorus released and the soil which might absorb it.
2. Barton appeared willing to accept the findings of the Morris study regarding comparative runoff in those cases, but raised questions about the amount of phosphorus which had been applied to the fields and the implications of this. He noted that with aquatic plants there is a phenomenon called "luxury uptake" of phosphorus, where an abundance of phosphorus can lead a plant to take up much more phosphorus than would normally be the case. Since about 26 pounds per acre of phosphorus had been applied in the Morris study, Barton questioned whether the release of phosphorus found there would be similar to what would occur with natural cover.
3. Hanson replied that plants take most of their nutrients from the soil and therefore the addition of phosphorus in the Morris study should have made little difference in the amount the plants took up. The range of phosphorus used by a plant under differing levels of

phosphorus application is really rather narrow. In response to a question, Hanson agreed that the amounts of phosphorus currently advocated by some people are irresponsible. Back in the 1930's, there was a need for a fair amount of phosphorus in this area, but now an application of 20 to 25 lbs per acre is on the high end of what should be used.

4. (This point has been inserted in this report in January, 1985, in light of a response sent to CNDP by John Barton.) Barton notes that the "rainfall" phosphorus noted in his study includes both rainfall and any dry fallout phosphorus. "Since the bulk of the Lake Koronis watershed is agricultural land, it can be assumed that the bulk of atmospheric dust is of agricultural origin. The phosphorus loading to the watershed from this source is more of a movement of nutrients within the watershed than an actual outside source of phosphorus" which is what it appears that Dr. Hanson was saying.

Policy Implications:

1. It appears that in an agricultural watershed which empties into a lake, both Barton and Hanson would agree that the first place to look to reduce phosphorus would be from feedlots.

2. Both men agree that with any particular lake it is important to know how much phosphorus is being added from a watershed where there is heavy agricultural use and how much is being added from urban sources, septic tanks serving homes around the lake, etc.

3. Both men agree that the use of conservation practices to limit erosion will reduce the amount of phosphorus getting into a lake due to eroded soil from row crops. (This agreement is understandable if one looks at some of the more recent work of the soil scientists from Morris. In J. Envir. Qual. v.6 #4, 1977, pp 369-373, Timmons and Holt report that the phosphorus in surface runoff from agricultural plots is greater than the runoff from native prairie. They point out that their studies have shown that sediment eroded from cropland accounted for 95% of the annual loss of phosphorus and therefore erosion control practices "must be used to minimize the nutrient contribution to crop waters.")

4. It is not clear what they think about the use of wetlands as nutrient sinks to remove phosphorus before it gets to a lake. Hanson did not comment on this and Barton, although he believes wetlands can serve this purpose, noted that some studies now indicate that wetlands can become overloaded with phosphorus and no longer serve as nutrient sinks (see Issue #3).

5. Clearly Hanson would advise against the turning of row crops into hay, grass, or pastureland if the purpose is to reduce phosphorus runoff in a watershed (he agrees that turning a row crop into hay or grass can prevent erosion). It appears that Barton might favor turning row crops into hay to reduce phosphorus runoff, especially if no phosphorus were applied to the grass or hay. It is not clear what Barton and Hanson would recommend about the use of grass or hay strips

interspersed with row crops as a way of reducing the amount of soluble phosphorus in an agricultural watershed.

ISSUE #3

TO WHAT DEGREE DO WETLANDS ACT AS A NUTRIENT SINK? IN PARTICULAR, CAN THE WETLANDS OF MINNESOTA SERVE AS A WAY TO ABSORB PHOSPHORUS FROM AGRICULTURAL RUNOFF AND THUS HELP MAINTAIN THE QUALITY OF OUR LAKES?

Positions:

It seems to be common knowledge among those concerned with phosphorus runoff into lakes that wetlands can absorb phosphorus and hence purify the water running into lakes. This view was expressed by a number of witnesses who testified to the regional Panels.

But even among those who favor wetland preservation, there is a concern about the amount of phosphorus which can be absorbed. John Barton (mentioned in issue #2 regarding his study of Lake Koronis) advocated running water through wetlands as a way of reducing phosphorus input into Lake Koronis. Nevertheless, he expressed doubts about how much could be absorbed, saying that he was aware of studies showing that wetlands could become saturated after 8 to 10 years of having municipal wastewater run through them. Henry Quade (mentioned in issue #1 regarding the work he and his students at Mankato State University have done) cited a study by one of his students on Forest Prairie Creek where she discovered that the water coming from wetlands was high in phosphorus and low in nitrates, while the water from tiles draining agricultural areas was low in phosphorus and high in nitrates.

(In a response sent to CNDP in December, 1984, Barton added a clarification to the above. It is important to know whether the phosphorus entering a wetland is dissolved or whether it is adsorbed to soil sediment. In the former case, the wetland's capacity for phosphorus absorption is limited to a large degree by the amount which can be absorbed by the vegetation and existing soil in the wetland. But if the phosphorus is adsorbed to soil particles, then these can settle into the wetland. This means that the absorption capacity of the wetland will be limited primarily by the rate at which eroded soil fills in the wetland, something Barton believes is likely to be a long-term phenomenon for most wetlands. Hence, one must beware about generalizing from studies on the absorption capacity of wetlands based on sewage effluent to the absorption capacity of wetlands for agricultural runoff.)

Status of the Research:

Since the discussion of wetlands was sprinkled throughout the testimony at Windom, Fergus Falls, and St. Cloud, most of the witnesses did not get a chance to talk with each other. Therefore there is no easy way to summarize areas of agreement and disagreement. John Barton mentioned the work of Curtis Richardson at Duke University; he in turn referred the staff to some journal articles. This led the staff to

discover an article by Dale S. Nichols, a research soil scientist at the USDA Forest Service, North Central Forest Experiment Station, in Grand Rapids, Minnesota. His article, "Capacity of Natural Wetlands to Remove Nutrients from Water," vol.55, Water Pollution Control Association Journal, May 1983, summarizes a great deal of research which has been done. His conclusions are:

1. Wetlands can provide a simple and energy-efficient way to remove nutrients from treated waste-water. Wetlands retain phosphorus and nitrogen largely through reactions with the soil.
2. The retention of nutrients has its limits. In typical wetlands with large amounts of organic matter in the soil, the removal of nitrogen does not seem to decline with time. But the capacity of wetland soils to retain phosphorus declines as the soils become saturated. Indeed, the process can reverse: some phosphorus that is adsorbed to the soil when concentrations of phosphorus in the water are high can be released when water concentrations become low.
3. Wetland vegetation can absorb large quantities of nitrogen and phosphorus during the growing season, but much of it is released into the water when the plants die.
4. The removal of nitrogen and phosphorus are most efficient at low concentrations; removal efficiency falls off rapidly as concentrations increase. On the average perhaps 2 to 3 acres of wetland is required to remove half of the nitrogen and phosphorus from the wastewater produced by 60 people. (This assumes 2.2 grams P and 10.8 grams N produced per person per day. It would seem that these figures should allow one to calculate the capacity of wetlands to deal with agricultural runoffs.) But the capacity of wetlands can vary considerably depending upon water capacity, flow, and soil type.

Policy Implications:

1. Before any major effort is made to use a wetland to remove phosphorus from agricultural runoffs, a careful analysis should be made of whether the given wetland is likely to be able to handle the task effectively for more than just a few years.
2. It appears that wetlands are much more effective over the long run in removing nitrogen from wastewater than in removing phosphorus. (Here the additional information sent to CNDP in December by Barton may mean that this is not as true for agricultural runoff as for municipal wastewater).
3. Even if a wetland is unable to serve as a nutrient sink, this does not mean that it serves no purpose. Many witnesses, including Barton and Quade, stressed the other contributions (such as flood control, wildlife habitat, etc.) made by wetlands. Judgments about when a wetland should be drained should be made in light of all the purposes it serves.

ISSUE #4

TO WHAT DEGREE IS THE CURRENT STANDARD FOR THE LEVEL OF NITRATE-NITROGEN PERMISSIBLE IN DRINKING WATER A GOOD SAFEGUARD AGAINST HEALTH HAZARD? IS THE STANDARD SET TOO HIGH, OR CAN IT BE SAFELY EXCEEDED?

Position:

Nitrates, or nitrate-nitrogen, are not uncommonly found in ground water. When water containing excessive nitrates is used in mixing formula for infants under six months of age, the digestive tract of the infant will convert the nitrates into nitrites, which are potentially dangerous to the infants. Aside from its impact on infants, the consumption of water with more than 10 ppm nitrate-nitrogen has been thought to have little effect on older children and adults. Recent research, however, suggests that nitrates may be linked with several diseases, and that the current standard may be set too high. What are safe levels, if any, of nitrate-nitrogen in drinking water?

Roger E. Machmeier, an agricultural engineer with the Agricultural Extension Service, UM, writes in an Ext. Bulletin ("Drinking Water Quality in Minnesota") that older children and adults have been known to consume water with a nitrate-nitrogen content of up to 100 ppm without apparent ill effects. His position is based on evidence from the Minnesota Department of Health that adults have consumed water "having concentrations a good deal higher than 100 parts per million" and not suffered any reported illnesses.

The Council for Agricultural Science and Technology (CAST), in a 1983 booklet entitled "The Double-Edged Sword of Nitrogen Fertilizer," states that "Healthy human adults can consume considerable amounts of nitrate with little or no ill effect." Regarding infants, the CAST document also suggests that the current 10 ppm standard may be inaccurate. Infants have been known to consume water much higher in nitrate-nitrogen and not be subject to blue-baby syndrome. The critical variable in nitrate consumption, CAST says, is coliform bacteria, which can give infants diarrhea. The latter creates an acidic imbalance in a child's stomach which promotes the growth of certain bacteria which convert nitrates to the more dangerous nitrites. Thus it is not nitrates in water per se which are dangerous to babies, but nitrates accompanied by coliform bacteria, a combination sometimes found in private wells, but rare in public water water systems.

In 1977, the National Research Council published a research review entitled "Drinking Water and Health." The report agrees that bacteria which change nitrate to nitrite can exist more readily in infant stomachs, but suggests that such a stomach condition may be more natural for babies than CAST's diarrhea-induced theory suggests. In addition, other factors in a newborn's physical makeup may make them prone to blue-baby disease. The Council concludes that "As opposed to adults, several clinical, physiologic, and metabolic factors predispose

infants to the development of methemoglobinemia and acute nitrate poisoning." As to the 10 ppm standard, research has shown that some infants can be affected with blue-baby disease by consuming water with concentrations below 10 ppm. Thus it is noted that "there appears to be little margin of safety for some infants with the standard at this concentration."

Regarding the consumption of high-nitrate water by adults, the Council's report is somewhat at odds with Machmeier and CAST. The Council reviews research that raises suspicion of nitrates as "procarcinogens," meaning that after their consumption in food or water, they may become converted in the body into cancer-causing compounds. A 1973 study showed ". . . that the town of Worksop, England, with 90 parts per million (ppm) in the drinking water for many years, had an increase in gastric cancer 25% greater . . . than that of similar control towns." Another study, in 1975, indicated that "the unusually high incidence of stomach cancer in certain mountainous areas of Columbia is associated with high concentration of nitrate in the drinking water."

Such findings, however, are not conclusive proof. Machmeier writes (private communication in response to an initial draft of this section) that diet "may be as important or more important than the amount of nitrates in water. For example, many preserved meats have high levels of nitrates or nitrites as do some vegetables such as broccoli. The nitrate content of water may be an item which is easily measured and consequently conclusions are drawn about the adverse effects of nitrates levels." As the Council notes: "Findings such as these are preliminary and suggestive. They provide no firm evidence of a causal link between incidence of cancer and high intake of nitrate. They do indicate a need for caution in assessment of each of the adverse health effects even at the 10 ppm concentration level for nitrate as nitrogen and a need for continued intensive study on the metabolism and effects of nitrate in man."

In a recent (April, 1984) article in the American Journal of Epidemiology, several Australian researchers suggest further reason for concern over the notion of adults consuming water high in nitrates. Their work also suggests that the 10 ppm standard may be set too high. Having noticed a peculiarly high incidence of malformed births in a community in South Australia, the doctors began to look for differences in maternal behavior and consumption patterns between local residents giving birth to normal children and those bearing malformed infants. The major difference that they were able to identify was drinking water consumption, as follows: "Compared with women who drank only rainwater during their pregnancy, women who consumed principally ground water had a statistically significant increase in risk of bearing a malformed child. Statistically significant risk increases occurred specifically for malformation of the central nervous system and musculoskeletal system. Reanalysis of the data by estimated water nitrate concentration demonstrated a nearly threefold risk increase for women who drank water containing 5-15 ppm of nitrate, and a fourfold increase in risk for those consuming over 15 ppm of nitrate."

This study is also not conclusive. Variables other than nitrates could have been overlooked or could not be counted. Parental work histories, involving possible exposure to harmful substances, were not collected. "In summary," the researchers conclude, "given that other teratogenic (fetal-malformation producing) factors could be correlated with water supply . . . it would be premature to interpret our case-control findings exclusively in terms of water nitrate exposure. Nevertheless, we believe that the internal cohesion of our findings, and their consistency with our earlier study and experimental evidence, lend weight to the possibility of a real association between ground water nitrate consumption and malformations."

Policy Implications:

1. It appears quite important that there be increased research efforts regarding the possible carcinogenic and teratogenic consequences of nitrate consumption.
2. If the standard of 10 ppm (or even possibly lower) appears to be appropriate, then policy makers face two broad options:

A. Take steps to insure that agricultural activities do not increase the existing level of nitrates in ground water above 10 ppm (STORET data currently indicates that the average level in the wells in Minnesota they analyze is 3.6 ppm, with 8% of the sample over 10 ppm). This is likely to be a major undertaking.

B. Decide that it is easier to allow ground water to exceed 10 ppm and take steps to see that those who may be harmed do not drink it. Before making this decision it would be wise to review carefully how easy it will be to make sure that certain groups of people do not drink the water, what the costs of water purification might be, or what the cost of bottled water might be over the long run.

ISSUE #5

ARE SOIL CONSERVATION PRACTICES SOMETHING WHICH WILL BRING LONG RUN ECONOMIC BENEFITS TO THOSE FARMERS WHO ADOPT THEM?

Positions:

CNDP staff has heard a number of comments on this issue, pro and con, but has not encountered much data which helps resolve the question. Recently, however, an article by Pierre Crosson appeared ("New Perspectives on Soil Conservation Policy", Journal of Soil and Water Conservation July-August 1984, pp 222-225) which indicates that there is some consensus on the amount of soil which is likely to be lost in the future if conservation practices are not adopted. From this, Crosson makes an estimate of the national costs to the farmer of not undertaking conservation practices. Staff adapted these figures to apply to Minnesota and then compared them to some 1982 estimates of

what it will cost to implement a full program of soil and water conservation in the state.

Analysis of the Research:

Crosson's article reviewed three studies that look at the percentage loss in productivity from soil erosion and found similar results in all three. The Resource Conservation Act (1980) found 8% loss in 50 years, a study done at the University of Minnesota found 5 - 10% loss in 100 years, and a Resources For the Future study found 2 - 3% loss in 30 years. Based on these similarities Crosson determined what the income loss of reduced productivity for American farmers would be under certain assumptions. The assumptions were: (1) 10% decline in corn and soybean yields over the next 100 years (at equal annual increments), (2) corn at \$3/bushel and soybeans \$7/ bushel and, (3) interest rates of 10%. The result of his analysis was that there would be a loss of \$40 million for American farmers in the first three years and these losses would be cumulative, e.g. the second year losses would be \$80 million, for a total of \$120 million lost in the first two years. The "present value" of the nation's loss would be \$4 billion over 100 years.

It is important to note that Crosson's figure may be off by a fair amount. He points out that his estimate does not include fertilizer costs and special measures such as terracing which might become crucial if land, over a period of many years, is allowed to erode too far. To cover these problems, and the fact that input costs of farming may increase dramatically over the next 100 years, he is willing to increase his estimate of losses to farmers by a factor of five.

The costs in Minnesota for a full program of soil and water conservation are found in "Minnesota's Soil and Water Conservation Program," published by the Minnesota Soil and Water Conservation Board in March 1982. They provide estimates of what it would take over a 20 year period to install needed conservation practices. Their estimates of the total technical and installation costs for controlling soil erosion, promoting water quality, and providing for proper land disposal of animal wastes is \$1.46 billion. They suggest that one-third of these costs be paid by farmers and that two-thirds be paid for by federal, state, and local governments.

In order to know the benefits of conservation practices to Minnesota's farmers, one must estimate their percent of the national benefits. Since Minnesota produces 5% of the total value of U.S. agricultural products, we assume that 5% of the benefits would also occur here. This amounts to \$2 million in the first year; assuming a 10% interest rate, the "present value" of these benefits over a 20 year period would be \$128 million.

This benefit of \$128 million represents 9% of the SWCB's estimated costs of \$1.46 billion. This means that it would make economic sense for Minnesota's farmers as a whole to undertake conservation practices only if various governmental agencies put up 91% of the costs (as compared to the 66% suggested by the SWCB).

But what if Crosson's estimates of benefits are too low? He was willing to concede that he might be off by as much as a factor of five. If the \$128 million is increased by this amount (\$640 million), then the benefits to farmers become 44% of the estimated costs. This would mean that so long as "cost-sharing" of at least 56% were available, it would make sense for farmers to adopt the conservation practices.

Another adjustment which could be made is with the estimate of costs. The \$1.46 billion figure includes \$629 million for water quality improvements. It could be argued that these should not be included since the question simply asks when it makes economic sense for farmers, in terms of their own incomes, to adopt conservation practices. (Many farmers who adopt conservation practices do so out of love for the land or a sense of stewardship, but this is not relevant to the economic question posed.) If the costs of conservation to promote water quality were removed, then total conservation costs would be \$831 million. Using this figure and the \$128 million for benefits, the benefits are 15% of the costs. Farmers would then require governmental cost-sharing of 85% to make their investment economically worthwhile. If farmers' benefits were as high as \$640 million (due to Crosson's "fudge-factor" of five), then their benefits would be 75% of costs and a cost-share of only 25% would be needed.

Policy Implications:

The analysis of this issue, in the staff's opinion, is the weakest of the five issues discussed. Although Crosson uses three different studies for his estimates of soil loss, a person must still rely only on his economic analysis to come up with estimates of benefits to farmers for adopting conservation practices. The different assumptions used lead to estimates that farmers will need anywhere from 91% to 25% in governmental cost-sharing in order to make conservation practices economically worthwhile. Such a wide range of estimates is so great as to make the data almost worthless as a guide for policy formation. Nevertheless, there are still some policy implications worthy of consideration which can be listed at this time:

1. It is important to get good estimates of the benefits of conservation practices, broken down by practice and who benefits. It would seem that the prevention of erosion would be the practice most directly beneficial in the long run to those farmers who use it. But the reduction of pollution from feedlots and other practices to promote water quality may not benefit the farmers who adopt these practices, except as the community as whole is benefited. This means that the adoption of these practices by any one farmer would not make economic sense for him unless all in the area who were contributing to the water pollution were to join in. Even then, there may be no economic incentive for the farmers to adopt the conservation practices needed to protect water unless there were a high level of cost-share monies available.

2. Even for those who believe conservation practices should be adopted by farmers as part of stewardship or an ethic of conservation, the estimates of costs and benefits is vital. The concern of this project is with water quality, and it may be that the practices needed to promote this are the ones which are of least direct benefit to farmers. If, as noted under Issue #1, it turns out that normal conservation practices do not keep nitrates out of the water, then the steps needed to prevent this may be very expensive. Those who believe in the ethic of conservation cannot responsibly urge this view upon farmers without knowing what economic sacrifice they are suggesting.

3. A careful estimate of the costs and benefits of conservation practices as related to water quality are very important to the people of Minnesota as a whole. If Crosson's original figures (as extrapolated to Minnesota) are correct, then 90% or more cost-share funds will be needed to induce farmers to adopt these practices. Where will such money come from? Minnesota tax-payers are not going to be enthusiastic about picking up the major portion of the \$66 million per year required to raise the 90% of the \$1.46 billion needed. It would be possible to impose mandatory controls on farmers to force the changes needed, but even if such a program were carried out "effectively" (requiring a large regulatory staff to police it), the economic burden on farmers would be very heavy. Farm foreclosures, already at a unusually high level, would probably increase greatly.

Thus good economic data on the conservation practices needed to protect our water would allow Minnesotans to decide to what degree the natural resources of our state are being exploited to provide cheap food for the nation and, to some degree, for the world. If this is the case, then there is a strong argument for calling upon the nation as a whole to help us. The "Land of 10,000 Lakes" is a recreational resource for the nation as a whole. Beyond this, the majority of Minnesotans are likely to want their ground water to remain relatively free of nitrates and pesticides. If the structure of agriculture in America does not give farmers sufficient profits to take care of these problems with their own resources, then someone else will have to help them foot the bill. If Minnesotans believe the costs are more than they can or should handle on their own, then they will need very solid economic data if they are to convince the rest of the nation to help them.

Section VI

RECOMMENDATIONS

Minnesota is known nationally as the land of 10,000 lakes and as the land of sky blue waters. We also rank 5th in the nation in agricultural exports and in gross farm income, with total cash receipts from farm marketing reaching over \$6 billion in 1982. These two vital resources of our state are coming into increasing conflict.

These findings and recommendations are the result of the deliberations of both the regional and the statewide Panels. The former met from June through October, spending four days each on the issue and hearing a total of 86 witnesses. The latter met for six days in November and December, hearing recommendations from 13 different organizations and agencies. The results are as follows:

1. THE SIGNIFICANCE OF THE ISSUE

Each regional Panel was asked to respond to the question: "How significant is the problem of agricultural impacts on water quality in your area?" The first Panel in Rochester decided to answer this using a scale of 1 to 10, with 10 being the highest rating. The rest of the Panels followed suit. The decisions of all five regional Panels are shown in Figure 1.

Figure 1 How significant is the problem of agricultural impacts on water quality in your area?

Rochester	8.2
Windom	7.2
Fergus Falls	7.8
St. Cloud	5.4
Metro	8.0
<hr/>	
average	7.3

In answering this question, the panelists were told to compare the significance of this issue to that of other issues facing their communities and the state. We believe that a finding of 7.3 on a 10 point scale clearly shows that they think there are other issues facing their communities which are of greater significance, but also that this problem is clearly above average in terms of its importance.

Some people have asked why a group of average citizens should be used to define the significance of the issue. Isn't this something that is determined by experts who conduct careful studies to gather

data? The answer is two-fold. First, as can be seen by looking at the review of existing data, the information on this topic is spotty. Although a great deal of data exists, there are only bits and pieces which give an overview of water quality in Minnesota and the possible effects of agriculture on this. In light of this, we believe that anyone making a judgement on this question would have to rely heavily on the observations of people who work in the area. This is just what the regional panelists did when they listened to the testimony on days 2 and 3 of their hearings. Their conclusions may be fallible, but we believe they were reached in a sound way, given the spotty nature of the data.

Second, we strongly believe that the significance of an issue is something which should not be left up to experts alone. Experts can help with data, but it is the people themselves who must judge the significance of the problems facing their community. The regional panelists were instructed to draw conclusions about the significance of the issue by comparing it to other problems facing them and their community. We do not claim that the regional Panels came up with the best possible answer to this question, but we believe that 60 people from around the state are likely to have a good overview of the problems facing us. Therefore, we believe their estimates about the significance of the issue should be carefully considered and strongly addressed.

2. THE NEED FOR ACTION

Each regional Panel was asked to respond to the question: "How important is it that something more be done in your area to deal with the issue?" We believe the answers of the regional Panels (see Figure 2) show that they feel that agricultural impacts on water quality is one of the most important areas in their communities where action should be taken. As with the previous question, there were some Panels which felt more strongly than others about this.

Figure 2

Rochester	9.0
Windom	9.0
Fergus Falls	9.3
St. Cloud	8.0
Metro	9.1
<hr/>	
average	8.9

3. HOW MUCH SHOULD BE SPENT AND WHO SHOULD PAY?

As our project has advanced, there have been several indications that the public is willing to help pay for the actions needed to reduce the negative effects of agriculture on water quality. In March of 1984 a public opinion poll was conducted for our project by Jeanne Drew Surveys (a survey organization often used by the Minneapolis Star and Tribune to conduct the Minnesota Poll). In the survey a number of statements were read and the respondents were asked to agree or disagree. One of the statements was: "If it turns out that farming is hurting water quality in Minnesota, then all Minnesotans should help pay for the solution, since we all benefit from the food farmers produce." Of those surveyed, 66% agreed and only 21% disagreed with the statement.

Each of the regional Panels was asked, "How much additional money would you as taxpayers be willing to see spent on this?" The results of this question are listed in Figure 3. We believe that their answers show that the general public, once they understand the nature of agricultural impacts on water quality, would be willing to help pay for a solution even if it meant increasing the median tax in the state by \$10 per taxpayer.

Figure 3

Rochester	\$5.00
Windom	\$10.00
Fergus Falls	\$8.00
St. Cloud	\$10.00
Metro	\$11.35

median \$10.00

As any legislator knows, questions about raising additional revenues for a project are most complex, given the variety of ways of doing this and the reluctance of the public as a whole to see taxes raised. But we felt it would not be responsible for our Panelists to recommend that more be done in an area without indicating what responsibility they were willing to take. The most direct way to find out how serious people are about wanting their government to do more is to ask them what they would pay out of their own pockets. Thus we asked our panelists to assume that the only way more would be done about agricultural impacts on water quality would be if they were willing to pay more in taxes.

The answers of our panelists to this questions ranged from \$1 to \$500, with the median answer being \$10. From this it would not be correct to say that our panelists are "calling for a tax increase of an average of \$10 per taxpayer." We do think that the results of our process show that when average people in the state understand what is going on, they would be willing to see a tax increase of about \$10 per year in order to deal with agricultural impacts on water quality.

Nevertheless, we assume that if it were possible to pay for added programs through a reallocation of federal, state, or local taxes, a large majority of the public would choose this over a tax increase.

We on the statewide Panel feel that the steps taken to solve the problem should not add to the financial burdens farmers already face, nor should the burdens be laid on the counties unless they too are given appropriate economic aid from the state. We are encouraged by the willingness of the public to help solve this problem since the economic and social well-being of all Minnesotans is so closely tied to the quality of our water and the success of our agriculture.

The amount recommended by the regional Panels was based on our estimates of what is currently being spent by federal, state, and local governments. If \$10 per median taxpayer were raised, this would amount to an approximate 100% increase in what the federal, state and local governments in Minnesota are currently spending on the problem, with about \$12 million in additional funds being spent. We of the statewide Panel feel that at least this amount must be spent annually to deal effectively with the issue.

4. RECOMMENDATIONS FOR SPECIFIC ACTION

We believe that the counties and the state government should accept a joint responsibility for dealing with the issue.

County Responsibility

We believe that the problems of agricultural impacts on water quality will be addressed most effectively by the counties. We recommend that the state legislature require the counties to set up and implement plans for the entire county, including incorporated areas, for dealing with these problems. We recommend that the counties be required to complete this task within a three year period, but this deadline may have to be modified to correspond to other deadlines which have been established regarding agricultural and water planning. The counties should be allowed to delegate to other groups, such as the SWCDs, some of the actions that need to be taken.

The plan drawn up by the counties should include the following elements:

- A. A statement of how the county and the local SWCD(s) will coordinate their activities in order to deal with agricultural impacts on water quality.

We recommend:

- a. The county boards are urged to rely on the advice of the SWCD's when approving or denying acquisitions of wetlands (or easements regarding them). Strong consideration should be given to restoring wetlands of types 3, 4, and 5 where economically feasible.

- b. We encourage the removal of marginal land from intensive cropping based on the county soil survey, using recommendations and guidelines of the local SWCD.
- c. Soil loss limits should be considered by all counties, similar to what is being done in Fillmore County. (The Association of Minnesota Counties is working on a model ordinance which we understand is addressing this issue.)

B. A statement of how the county will work with the MPCA regarding feedlot regulations.

- a. We recommend adoption by the counties of the County Feedlot Permit Processing Program.

C. A statement of how the county will work with the DNR on their shoreland regulations in order to deal with agricultural impacts on water quality.

We recommend:

- a. incentives for conversion of some pasture to wild-life habitat to reduce the effects of pasturing cattle along streams.
- b. that there be a 40 ft. vegetation buffer zone along agricultural land which borders on lakes, rivers and streams. Land use cost of maintaining and controlling weeds shall be reimbursed through the DNR and tax incentives.

D. A statement of priority areas within the county where action is most needed.

- a. We encourage the counties to adopt the state well code regarding well drilling and well abandonments.
- b. We urge the counties' full participation in state efforts in the accelerated mapping of ground water resources.
- c. It is strongly recommended that counties take a more active role in regulating the disposal of hazardous agricultural chemical containers.
- d. Counties are encouraged to take action insuring the appropriate disposal of waste oil.
- e. Counties are strongly encouraged to cooperate with ongoing MPCA research efforts to pinpoint the movement of soil from particular locations on land to particular bodies of water.

State Responsibility

We recommend that there be state oversight of what the counties are doing. This would promote consistency in the approaches the counties take, especially between counties which border on each other, but leave room for regional differences. The number of personnel in the field should be increased, if necessary at the expense of those in state offices. It is especially important that field agents/techs be well-trained and able to communicate effectively with farmers.

We believe strongly that the state must assume a financial responsibility for seeing that agricultural impacts on water quality are reduced. In the section under funding, we state that the major percentage of funding should go to the local level and that at least \$12 million of additional money should be spent annually. We recommend that all of these funds should come from state sources, so that the counties do not have to bear any of the burden of raising these additional funds.

If the state is not prepared to adopt this financial commitment, then we do not believe that the counties should be required to be responsible for planning and implementing programs to reduce agricultural impacts on water quality. We take this stand because virtually the only source of revenue for the counties is the real estate tax and this tax has already placed a major burden on the farmers.

In order to meet this financial responsibility, we recommend incentives and more government subsidies to help the farmer adopt conservation practices.

New programs should be introduced in such a way as to avoid economic disadvantage to farmers. We should consider introducing pilot programs where cost-share monies are available at 100% rather than the current 75% maximum. Incentives should be introduced to encourage the adoption of best management practices and some way should be found to reward farmers already using them.

There should be a conservation credit, analogous to the depletion allowance currently enjoyed by mining, oil, and lumber companies. This might be something like \$10 per acre.

There should be tax breaks to owners of land kept out of production or made less productive because of soil and water conservation practices, e.g., grass waterways.

There are a number of existing state laws regarding land use management. There should be improved enforcement of these existing land use management programs.

Education

There is a strong need for increased education to create awareness and inform the public of the need for improved water quality. This should be aimed at farmers first, then the general public through schools and media, including volunteer public involvement.

We recommend:

- a. that farm suppliers, farmers and county agents should be encouraged to keep water quality in mind when recommending and applying pesticides and fertilizers, particularly nitrogen.

- b. that there should be seminars for the general public on the costs of flooding problems on water quality, as these relate to agricultural impacts on water.
- c. mandatory education in rural and urban high schools on land stewardship.
- d. that before the implementation of any new programs, including pilot projects, it is essential the targeted public, e.g. farmers, be given a thorough understanding of what is proposed. One absolute requirement here is that agency personnel charged with introducing programs be able to communicate effectively with their audiences.
- e. more funding should be made available to the Volunteer (published by the Minnesota Department of Natural Resources) to increase the number of subscribers.
- f. that the public be educated on the significance of abandoned wells and the dangers they pose to the quality of ground water.

Research

It is important that high quality research be done to answer questions of the public interest on agricultural impacts on water quality. Currently we lack comprehensive data regarding surface and ground water quality in Minnesota and the exact impact which agriculture has on this. We are not in a position to recommend a comprehensive research program, but we have several specific concerns.

We recommend:

- a. the prompt completion of the soil mapping of the state of Minnesota.
- b. that there be strong state laws to ensure that new agricultural chemicals are introduced only after additional testing. Economical ways must be found to monitor how long pesticides last in the environment and what their effects are.
- c. that more public funds be made available to the University of Minnesota for its research on agricultural chemicals, so that a more balanced job of research can be done in this area.
- d. that the state should support ongoing research efforts into the relationship between water quality and the karst geology of Southeast Minnesota.

Funding

As noted in section 3, we believe that at least \$12 million annually in additional state funds are needed to deal adequately with agricultural impacts on water quality. Given the complexity of what needs to be done, it is not easy for us to say precisely how these funds should be spent. Nevertheless, we feel it is important to give a general indication of how the funds should be allocated.

The table on page 9 is divided into "Phase 1" and "Phase 2." Phase 1 is intended to be a two year period during which the counties do their planning. (Under "county responsibility" we suggest a 3-year start-up period; we assume the first year of this would be required for the state to gear up and adopt the necessary rules. During this initial year before Phase 1, we assume that much less than the suggested \$12 million annual expenditure would be needed.) Phase 2 is the period during which the plans are implemented. We realize that some counties will be able to draw up a plan in less than two years and others will find it difficult to do in two years, but we feel that for most counties a two year planning period is reasonable.

As can be seen in the table, we have divided the amount to be spent between state and local governments. It is important to remember that we recommend that all of the funds come from the state. During Phase 1 we believe that more of the funds will be needed at the state level than will be needed during Phase 2. "Research and monitoring" and "technical assistance" are especially important during this initial phase. During Phase 2, we believe it is important to spent 90% at the local level, with the majority of this going to farmers through cost-share programs, incentives, low-interest loans, etc. Some will wonder why we suggest that only 10% be spent at the state level, but it must be remembered that we are talking here about funds in addition to current expenditures.

We spent considerable time discussing what set of categories to use in order to show our priorities. We decided that, short of a very elaborate list, any set of categories would have drawbacks and we finally agreed on a list supplied by a representative of the MPCA. The heading "research and monitoring" is assumed to include data collection; the training of staff at the state level is included under "education"; the administrative costs of programs are included under each heading. In Appendix 2, the recommendations of the Panel are grouped according to the headings in the funding chart below.

	Phase 1		Phase 2	
	% of Total 25%	% of State	% of Total 10%	% of State
<u>State</u>				
Research and Monitoring		35%		15%
Technical Assistance		35%		10%
Enforcement		0%		20%
Education		30%		55%
		<u>100%</u>		<u>100%</u>
		% of		% of
		Local		Local
<u>Local</u>	75%		90%	
Implementation Planning		30%		5%
Education		30%		10%
Implementation:				
Technical Assistance		35%		15%
Financial Assistance for farmers		5%		65%
Enforcement		0%		5%
		<u>100%</u>		<u>100%</u>
	<u>100%</u>		<u>100%</u>	

Appendix 1

REGIONAL PANELS: WITNESSES AND SPECIFIC RECOMMENDATIONS

SOUTHEASTERN PANEL WITNESSES (Rochester)

Dr. Arvid J. Houghlum	Olmsted County Department of Health
Chris Mechenich	" " "
Roger Steinberg	Agricultural Extension Service
Dr. Sagor Goyal	U. of Minnesota, Vet. Diagnostic Lab
Dr. R. Ashley Robinson	U. of Minnesota, Veterinary Hospital
Charles Smith	Winona County Board
Claire Vomhof	Farmer, Wykoff
Jerome Hildebrandt	Soil Conservation Service
Russell Harding	Citizen, Austin; Integrated Pest Management
Jim Schneider	DNR, Fisheries
Larry Landherr	Rochester (PCA Regional Representative)
Paul Kottschode	Farmer, Spring Valley
Dr. J. Don Jones	Izaak Walton League, Rochester
Loni Kemp	Minnesota Project, Preston
Janet Quandt	Farmer, Grand Meadow
Eugene Kalmes	Farmer, Rollingstone
Cleon Heusinkveld	Farmer, Rochester
Charles Radatz	Winona Co. Ext. Office
Walter Prigge	Farmer, Byron

SOUTHWESTERN PANEL WITNESSES (Windom)

Steven Sellnow	District Conservationist, Cottonwood SWCD
Dr. Henry Quade	Biology Department, Mankato State University
Wayne Edgerton	Gov. Units Liaison, DNR, Div. of Waters
William Merritt	Chair of County Board, Lyon County
Kenneth Helgeson	Sec., Yellow Medicine Watershed District
Gene Lundquist	Mountain Lake Area Sportsman Club
Charles Lehman	Mountain Lake Area Sportsman Club
Frank Wallner	MN Pollution Control Agency
Larry Beiderman	Health Officer, Brown-Nicollet Board of Health
Dr. Dan Skow	Veterinarian, Fairmont
Les Anderson	Blue Earth County Commissioner
Eugene Holmes	Farmer, Waldorf
Art Mason*	Asst. Dir., Plant Industry Div., MDA
Dr. Jeffrey Stevens*	Asst. Prof. of Toxicology, Env. Health Dept., UM
Dr. Don Wyse*	Dept. of Agronomy, U. of M. (St. Paul)
Dr. Wallace Nelson	U. of M. SW Experimental Station, Lamberton
Dr. Don Gordon	Biology Dept., Mankato State University

*Videotaped presentations

WEST CENTRAL PANEL WITNESSES (Fergus Falls)

Art Engelbrecht	Douglas County Board, Alexandria
Tom Burau	President, Otter Tail County Farm Bureau
Douglas Rasmusson	Chair, Pomme de Terre River Association
Harold Luthi	Irrigators Association of MN, Morris
John Rose	Fergus Falls Fishland Game Club, FF
Chester Runck	Farmer, Twin Valley
Amer Froysland	Farmer, Audubon
Thomas M. Stringer	Izaak Walton League, Fergus Falls
John Schmidt	Technician, SCS, Otter Tail County
Robert Merritt	Hydrologist, DNR, Detroit Lakes
Rollin Siegfried	US Fish & Wildlife Service, Fergus Falls
Will Steffen	" " " "
Dr. Jerry Van Amberg	Dept. of Biology, Concordia College, Moorhead
Willis Mattison	MN Pollution Control Agency, Detroit Lakes
Rick Gauger	Area Extension Agent, Morris
David Siegenthaler	Env. Educator, Audubon Society, Warren

CENTRAL PANEL WITNESSES (St. Cloud)

Dale Homuth	Area Hydrologist, DNR, St. Cloud
Jacqueline Carr	Env. Health Div., Wright County
Robert Bixby	Instructor, Geography Dept., St. Cloud U.
John Peck	St. Cloud U., St. Cloud Area Env. Council
Dr. John Cronn	Biology Dept., St. Cloud State University
Paul Bugbee	Lake Koronis, Paynesville
Phillip Behr	" " "
Paul Oman	" " "
Wayne Nelson	" " "
Mike Garvey	Farmer, Eden Valley
Russell Schmidt	Farmer, Paynesville
John Barten	Limnologist, City of Waseca
Dr. Lowell Hanson	Dept. of Soil Science, U. of M. (St. Paul)
Curtis Wegner	Farmer, Paynesville
Loren Goenner	Farmer, Clear Lake
Willard Kreitlow	Farmer, Howard Lake
Robert Siegel	Farmer, Little Falls
Dave Vold	District Conservationist, Meeker SWCD
Joe Fitzgerald	Executive Director, Stearns SWCD
Kerry Saxton	Resource Conservationist, Wright SWCD
Stuart Steelman	Consultant, Clear Lake

METRO AREA PANEL WITNESSES

Joe Neaton	Carver County Commissioner
Doug Felton	SE Irrigator's Association of Minnesota
Don Hoese	Carver County SWCD
Paul Toren	VP, Izaak Walton League of MN
Gary Oberts	Environmental Planning, Metropolitan Council
Mark McAfee	Legislation & Programs, MN Farmers Union
John Berg	Minnesota Farm Bureau
Craig Sallstrom	MN Plant Food and Chemical Association
Bill Bulger	Dir., Agronomy Div., MN Dept. of Agriculture
Art Mason	Asst. Dir., Div. of Plant Industry, MDA
Willis Munson	Monitoring and Analysis Section, Div. of Water Quality, MN Pollution Control Agency
Gaylen Reetz	Permits Section, Div. of Water Quality, MPCA
Jon DeGroot	Asst. State Conservationist, SCS, USDA
Wayne Edgerton	Gov. Liaison Hydrologist, Div. of Waters, DNR
Dr. Edward Pryzina	Envir. Services Consultant; U.W. River Falls

Each of the Panels made a number of specific recommendations about what should be done to deal with the problem. These recommendations are as follows:

SOUTHEAST (Rochester)

The Panel Recommends:

- A. Increased education to create awareness and inform the public of potential solutions and management practices. This should be aimed at farmers first, then the general public through schools and media; including volunteer public involvement.
- B. County and state mandated land management, enforcement of existing regulations, and use of integrated pest management.
- C. Federal revenue programs, enforced by local governments, subsidized agriculture, tax breaks for farmers using good conservation practices, and removal of marginal land from intensive cropping.
- D. Tests to check for more pollutants, better equipment and technology, research to explore alternative farming methods, and emergency pollution response teams.

NOTE: Three people wanted C and D reversed in priority, but the majority of 8 prevailed.

SOUTHWEST (Windom)

"We the panel feel, by a large majority, that additional action is needed in the following areas:

- A. There needs to be more education done on the issue, both in the schools and through activities to increase public awareness.
- B. Research is necessary regarding the effectiveness of existing programs and policies. Also there is a need for more scientific research.
- C. There should be tax incentives and more government subsidies to help the farmer adopt conservation practices.
- D. There should be decentralization of governmental agencies to the county or regional level using state funds.

"Consideration should also be given to the following:

- A. A grass buffer zone around rivers and lakes. (This land should not be taxed, but the farmer retains use of the land for hay.)
- B. Research into the effects of salt discharge from water softeners and highway applications.
- C. A tax on tourists to enhance water quality.
- D. Discontinue the manufacture and export of banned chemicals.
- E. Statistics on organic farming should be included in the Minnesota Agricultural Statistics compiled by the MN Dept. of Agriculture

WEST CENTRAL (Fergus Falls)

"We as a panel reached a general consensus that the following ideas should be carefully explored:

- A. There should be an expanded educational effort on the problem, in particular;
 - a. Seminars for farmers on the costs of flooding problems as these relate to agricultural impacts on water;
 - b. Mandatory education in rural and urban high schools on land stewardship.

- B. It is important that high quality research be done to answer questions of the public interest on agricultural impacts on water quality. Specifically, the University of Minnesota research on pesticides and integrated pest management should not be tainted with private funds.
- C. The best management practice of crop rotation should be encouraged.
- D. There should be a 20% sales tax on fertilizers and a 25% sales tax on toxic insecticides and herbicides to discourage their use and raise revenue to promote soil conservation and water quality. This should be done only if the revenues raised indeed find their way back to the farmers.
- E. Agricultural zoning, based on soil surveys, should be encouraged.
- F. There should be a conservation credit, analogous to the depletion allowance currently enjoyed by mining, oil, and lumber companies. This might be something like \$10 per acre up to 240 acres.
- G. Since 78% of Minnesota's wetlands have been destroyed, strong consideration should be given to restoring wetlands of types 3, 4, and 5. This is important because wetlands are a critical part of the water purification system and also aid in flood control. An increase in rates of wetland tax credits to farmers should be considered.
- H. There should be soil loss limits which are applied by all counties, similar to what is being done in Fillmore County.
- I. More power should be given to the Soil and Water Conservation Districts and the role of Watershed Districts should be reevaluated.

CENTRAL (St. Cloud)

"The panel reached a general consensus that whatever is recommended, the most localized group which can cover the scope of the problem addressed should be authorized to do so. Voluntary compliance and education were preferred over mandatory controls, which should be used only if they prove to be necessary."

"If money were generated through a tax increase to address the issue of agricultural impacts on water quality (see question #3), then the panel recommends spending it in the following ways:

- A. 50% of the increased funding should go to the Soil and Water Conservation Districts.
- B. 20% should go for water pollution research, educational programs, and monitoring of water quality.

- C. 20% should go for granting tax breaks to owners of land kept out of production or made less productive because of soil and water conservation practices. This was detailed as follows:
 - a. Reinstate tax breaks on protected and unprotected wetlands.
 - b. Grant tax breaks for shoreland and stream bank properties.
 - c. Grant tax breaks for other properties taken out of production for erosion control (such as grassed waterways).
- D. The final 10% should be used to cover the cost of administrating the programs funded by the increased money."

"In addition, the panel also recommended the following :

- E. We would like to encourage the prompt completion of the soil mapping in the state of Minnesota.
- F. The University of Minnesota should increase its promotion of and cooperation in the testing of soils for nitrates.
- G. Dealers, farmers and county agents should be encouraged to keep water quality in mind when recommending and applying fertilizers and pesticides, nitrogen in particular.
- H. Township boards, in consultation with SWCD personnel, should take the initiative in identifying areas with feedlot runoff problems, and funding should be made available to carry this out and correct the problems.
- I. \$15 an acre should be made available to a farmer who plants "no-till," based on soil conservation practices, for a period of up to 3 years."

METRO AREA

We recommend that the following be given due consideration: (These are not listed in their order of priority.)

- 1. There must be strong state laws to ensure that new agricultural chemicals are introduced only after adequate testing.
- 2. The setting aside of wetlands and highly erodable lands should be made economically feasible for farmers.
- 3. The costs of drainage ditches should be assessed in an equitable way within a watershed.
- 4. Existing standards should be enforced with regard to those farmers not in compliance.
- 5. The public must be educated about the importance of the issue of agriculture and water quality. We are all stewards of our land and water.
- 6. There should be monitoring of irrigation systems which directly introduce agricultural chemicals into the water.

7. Much research needs to be done. What is the significance of toxic chemicals which are present in minute quantities? Are the current limits for toxic chemicals set too high or too low? What are the synergistic effects when several chemicals mix in the environment? Long term research on the effects of nitrates and the effectiveness of best management practices is needed.
8. Minnesota should introduce a program similar to the "Wisconsin Fund" to provide funds for stream and ditch improvements and maintenance.
9. Consideration should be given to the use of a tax checkoff on state and federal returns to raise money to deal with this issue.

All of the above should be undertaken with several points kept in mind:

- A. We believe an improvement in the management of existing programs is needed. Interagency communication and cooperation is needed.
- B. We are opposed to the creation of new agencies; existing programs and personnel should be used where possible.
- C. Farmers should be involved in the planning of new programs which will affect them.
- D. New programs should be introduced in such a way as to avoid economic disadvantage to farmers. We should consider introducing pilot programs where cost-share monies are available at 100% rather than the current 75% maximum. Incentives should be introduced to encourage the adoption of best management practices and some way should be found to reward farmers already using them.

Appendix 2

RELATIONSHIP OF STATEWIDE RECOMMENDATIONS AND FUNDING

The statewide Panel felt that it was important to relate their specific proposals to the funding chart shown above, page 87, so that people would know where, when and how they proposed that monies should be spent. The following shows the connections between the recommendations and funding. The letters refer to the recommendations found on pages 82-87.

1. STATE

Phase 1, Planning: During this phase, attention should be paid to:

A. Research and Monitoring

- C: Creation of county cooperative agreements with DNR regarding Shoreland Management
- Cb: Investigation of feasibility of 40' buffer zones along lakes and streams
- Rb: Research into creation of stronger state laws about introduction of new agricultural chemicals

B. Education

- Ea: Creation of an educational program about water quality hazards for farm suppliers, county agents, and farmers.

Phase 2, Implementation: In this phase, funds should be spent on:

A. Research and Monitoring

- Rb: Monitoring of longevity and effects of pesticides in the environment
- Rc: Research on agricultural chemicals
- Rd: Research Karst-water quality relationship in S.E. MN

B. Technical Assistance

- C: DNR to work with counties on implementation of Shoreland Regulations

C. Enforcement

- B: PCA to work with counties on feedlot regulation

D. Education

- Ea: Educate farmers, farm suppliers and county agents about water quality hazards and prevention
- Eb: Water quality seminars for the general public
- Ec: Required conservation courses in rural and urban high schools
- Ed: Program implementation be preceded by thorough education of target groups
- Ee: Increase funding available to DNR's Volunteer magazine

2. LOCAL

Phase 1, Planning: During this phase, locally-designated funds should be spent on:

A. Implementation Planning

- A: Preparation of a plan of cooperation between county and SWCD about agriculture/water quality programs
- Ab: Creation of a plan for removal of marginal land from intensive cropping
- Ac: Consideration of a soil loss limits ordinance similar to that adopted by Fillmore County
- Ba: County adoption of the Feedlot Permit Processing Program
- C: County plan to work with DNR on Shoreland Regulations
- Ca: Creation of incentives for conversion of pasture to wildlife habitat
- Cb: Plan for creation of 40' buffer zones between agricultural land and lakes, streams

Phase 2, Implementation

A. Education

- Ea: Continuing education for farmers, etc. on water quality hazards and prevention
- Eb: Water quality seminars for the public
- Ec: Required conservation education in high schools
- Ed: Program implementation to be preceded by thorough education of target population

B. Technical Assistance

- Aa: SWCD's aid counties in decision about wetlands
- Ab: SWCD's aid county in identifying and removing marginal lands from intensive cropping
- Ra: Completion of soil mapping

C. Financial Assistance to Farmers

- Ca: Encourage conversion of streambank pasture to wildlife habitat by incentive payments

D. Enforcement

- Ac: Implementation of soil loss limits ordinance
- Cb: Encourage creation and maintenance of 40' buffer strips between agricultural land and shoreland by incentive payments

Appendix 3

BRIEF SUMMARY OF QUESTIONNAIRE RESULTS, BOTH STATEWIDE SURVEY AND INFORMATIONAL MEETINGS

1. Below is a list of things which some people feel our state government should be working on. Please indicate how high a priority you think we should place on these.

	STATEWIDE					INFORMATIONAL MEETINGS				
	very high	high	med	low	don't know	very high	high	med	low	don't know
education	37%	54%	8%	1%	0%	46%	43%	10%	1%	0%
transportation	7	38	45	7	3	10	35	46	9	0
agriculture	25	50	21	3	1	43	40	15	2	0
crime	37	49	12	1	1	22	43	30	4	1
business	31	39	22	4	4	20	39	35	5	1
water quality	25	49	22	3	1	55	36	6	2	0
air quality	25	45	27	3	1	43	33	21	4	0
welfare	7	29	45	16	3	4	20	48	27	1
recreation	5	20	57	17	1	2	17	46	33	2
health	21	52	25	2	0	18	36	36	9	1

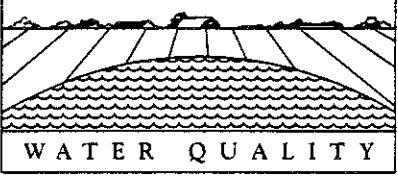
The following are a list of statements that were given to those taking the questionnaire. They were asked to say whether they agreed or disagreed with the statement, or whether they were unsure.

		INFORMATIONAL	
		STATEWIDE	MEETINGS
2. The majority of farmers in Minnesota earn a fair return on their labor and investment.	Agree	31%	22%
	Disagree	49	66
	Unsure	20	12
3. Most farmers don't work any harder than the average person.	Agree	24	24
	Disagree	72	69
	Unsure	4	7
4. Taking steps to reduce acid rain should be one of our top priorities in Minnesota.	Agree	69	67
	Disagree	17	14
	Unsure	14	19
5. Recently environmentalists have been carrying their demands for clean air and clean water too far.	Agree	26	18
	Disagree	61	68
	Unsure	13	14

- | | | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----|----|
| 6. If it turns out that higher taxes are needed to improve water quality in Minnesota, then this is something we ought to do. | Agree | 50 | 60 |
| | Disagree | 38 | 21 |
| | Unsure | 12 | 19 |
| 7. We should continue to improve the environmental standards in Minnesota even if this means that a few more industries will leave the state. | Agree | 31 | 49 |
| | Disagree | 49 | 26 |
| | Unsure | 20 | 25 |
| 8. If it turns out that farming is hurting water quality in Minnesota, the all Minnesotans should help pay for the solution, since we all benefit from the food farmers produce. | Agree | 66 | 69 |
| | Disagree | 21 | 15 |
| | Unsure | 13 | 16 |
9. Here is a list of some occupations. Please check the appropriate box to indicate how much you admire those who work in these occupations.

	STATEWIDE				INFORMATIONAL MEETINGS			
	a great deal	some-what	not very much	don't know	a great deal	some-what	not very much	don't know
Minister	48%	41%	10%	1%	49%	41%	9%	1%
Teacher	52	40	7	1	46	46	8	0
Farmer	64	33	3	0	59	38	2	0
Environmentalism*	21	59	16	3	34	46	17	3
Doctor	60	36	3	1	38	53	9	0
Politician	7	50	41	2	7	54	37	2
Banker	15	65	19	1	6	56	35	3
Lawyer	13	59	26	2	6	44	49	1
Business Execs	15	66	17	2	9	60	26	5

* There was considerable debate in making up the questionnaire as to whether the term "environmentalist" or "conservationist" should be used. All agreed that the latter term was likely to elicit a more favorable response. Nevertheless, it was felt that conservationist was too general a term to include as a profession.



AGENDA FOR THE CITIZENS PANEL
IN WEST CENTRAL MINNESOTA

DAY 1: FRIDAY, AUGUST 10 This day will be devoted to an overview of the issue, presented by the staff of CNDP.

Morning Session 8:30 AM - 12:00 PM

1. Introduction to the project and the goals of the regional panels. Discussion of procedures and the role the staff will play in the project.
2. "Runoff, Land Use, and Water Quality", a film released by the Soil Conservation Service.
3. Basic information on agriculture and water quality. What gets into water, how does it get there, and what can farmers do about it?
4. "The Price of Abundance", a film released by the SCS.

Afternoon Session 1:00 PM - 4:30 PM

1. A review of some studies done on water quality.
2. Excerpts from "Down on the Farm", a video-tape obtained from the TV program "Nova".
3. Discussion with the staff about conflicting views on how dangerous different levels of contaminants are.
4. Discussion of what groups and agencies are working to solve the problem and how much is being spent.
5. There will be about $\frac{1}{2}$ hour reserved at the end of the day for discussion by the Panel of the materials presented. (There will be additional time for questions and some discussion during the rest of the day as well.)

DAY 3: FRIDAY, AUGUST 17

Morning Session 8:30 AM - 12:00 PM

- 8:30 Thomas M. Stringer Izaak Walton League, Fergus Falls
"Policy Considerations and Local Initiative: a League
Perspective on Farming and Water Quality"
- 9:45 John Schmidt Technician, SCS, Ottertail County
"Water Quality and Best Management Practices in the West
Central Region"
- 11:00 Robert Merritt Hydrologist, DNR, Detroit Lakes
"Wetland Drainage and Water Quality"

Afternoon Session 1:00 PM - 4:30 PM

- 1:00 Rollin Siegfried U.S. Fish & Wildlife Service, Fergus Falls
Will Steffen " " " "
Dr. Jerry Van Amberg Department of Biology, Concordia College,
Moorhead
"Downstream Consequences of Water Distribution"
- 2:15 Willis Mattison MPCA, Detroit Lakes
"Groundwater Impacts of the Distribution and Use of Agricultural
Chemicals"
- 3:15 Rick Gauger Area Extension Agent, Morris
"Integrated Pest Management and its Implications for Water
Quality"
- 4:00 David Siegenthaler Environmental Educator, Audubon Society,
Warren
"Agriculture and Water Quality in the Red River Valley"

DAY 4: SATURDAY, AUGUST 28: This day will proceed as outlined in
the initial agenda proposal: discus-
sion and decision-making by the Panel.

DAYS 2 and 3: Testimony will be given by the following professionals and local citizens. Witnesses will discuss the severity of agricultural impacts on water quality in West Central Minnesota, the need for additional research into the problem, the kinds of corrective action that should be taken, and the cost of such measures.

DAY 2: SATURDAY, AUGUST 11

Morning Session 8:30 AM - 12:00 PM

8:30 Art Engelbrecht Douglas County Board, Alexandria
"The Effects of Agricultural Activities on Area Water Quality"

9:45 Tom Burau President, Ottertail County Farm Bureau,
Fergus Falls
"Farming and Water Quality, a Conservative Perspective"

11:00 Douglas Rasmusson Chair, Pomme de Terre River Association,
Hancock
"The Pomme de Terre River Association"

Afternoon Session 1:00 PM - 4:30 PM

1:00 Harold Luthi Irrigators Association of Minnesota, Morris
"Water Quality From a Farmer's Point-of-View"

2:00 John Rose Fergus Falls Fishland Game Club, FF
"Agricultural Chemicals and Water Quality"

3:00 Chester Runck Farmer, Twin Valley
Amer Froysland Farmer, Audubon
"Drainage and Water Quality"

Appendix 5

BRIEF SUMMARY OF PANEL EVALUATIONS

This appendix is made up of three parts: A. A condensed version of the questionnaire given to both the regional and the statewide panelists for them to evaluate their experience with Citizens Panels (there were slight variations in the wording between the different forms). B. A sample of comments made by the panelists about their experiences (these were taken either off of tape recordings of the sessions or from the answers to the questionnaire). C. The answers to three of the questions on the questionnaire.

A. CONDENSED VERSION OF THE QUESTIONNAIRE

- * 1. In general, how do you feel about your participation in the the Citizens Panel?
- * 2. During the meetings you have had information presented to you by staff, by witnesses, and through movies and videotapes. In general, how do you feel about each of these kinds of presentations?
- 3. Were there any presentations which you found especially interesting, informative, or well done? If so, please list.
- 4. Were there any presentations which you found especially uninteresting, uninformative, or poorly done? If so, please list.
- * 5. One of our aims is to have the staff approach the issue in an unbiased way. We also want to provide a balanced group of witnesses. How do you feel about our performance?
- 6. Other comments? (Space left to write in answer.)
- 7. Name (optional)
- * Panelists were asked to check one of five options: very satisfied, satisfied, neutral, dissatisfied, or very dissatisfied.

B. SELECTED COMMENTS BY PANELISTS

Shelley Steva: The process was wonderful. It was a chance for an ordinary citizen to get together and listen to people in government agencies and get to meet them, and find out facts that I probably never found before. I was a participant in the Fergus Falls panel, and it was interesting to see some of the panelists there who were just amazed by what they heard. They said they had no idea that there was such a problem, and they were fascinated to find out something that they had no idea had that kind of state-wide or regional ramifications. I think it's a wonderful idea to be able to have ordinary citizens get together and listen to different people talk about the magnitude of some kind of problem. To have people of all kinds of different backgrounds be able to get together and try to come up with some kind of statement on the scope of the problem, and try to see if there was some way it could be put together into a bill that could be introduced into the legislature.

Jim Becker: It's almost unbelievable that this many people could get together to talk about water and not have a pretty good fight. We didn't have it at the regional and we haven't had it here. It's about the first water meeting I ever went to where we didn't have people throwing things at each other. I'm impressed on that. I think if this

thing ends right here, I guess I'd be disappointed, but then in another way I wouldn't be disappointed because I think there's been an awful lot of education on water quality done by this process.

Tom Holm: I feel wonderful about the process, the way everything has fallen together in such a short amount of time, and the way 15 people from all over the state of Minnesota and agencies can come to a final consensus, considering the different range of problems that we experience throughout the state.

Norm Penner: I think the staff did a very good job with the logistics of these meetings, and I am very appreciative of this and the opportunity to serve on this Panel. This has been an informative and enriching experience for me. I feel that this forum was good in bringing together people from many areas and walks of life, and a chance to meet people from agencies in the state that I could not normally meet. I hope that the conclusions will be helpful, and a contribution to the people of Minnesota. I would like to be informed as to where these findings go.

(The following comments were made after regional Panels.)

Tim Dykstal: I sense some confusion among the panelists about the direction the presentations are taking. Your jury analogy holds only to a point, because in a trial, positions are taken that must be proven. Perhaps the process would benefit by more advocacy and less concern with neutrality. In particular, have you thought about extending the analogy to include "attorneys" and "public defenders"? If we had a couple of experts on different sides of the issue cross-examine the witnesses and promote their own views, we may be better able to decide among the alternatives ourselves. I found this last day the most frustrating, the charge to the Panel somewhat misdirected.

Frank Clifton: I like this process. The more intelligently informed, and unbiasedly informed, citizens that there are, the better the chances that the public will be able to have a hand in proper governmental decisions. If ever you need some additional labor, I might be able to help.

Peggy Johnson: I find being on the panel very interesting and informative; but also very frustrating, as there are no clear-cut solutions to a very definite problem.

Phil Burnett: The information furnished to the panel by the staff and witnesses was, on the whole, well presented and sufficient for us to make a decision on water quality and the solution to the problem.

Audrey Austin: This whole "Panel" has been very well organized. I congratulate you on a job well done. I found the experience to be very informative and intellectually stimulating. It has far surpassed my expectations and I'm glad I had the opportunity to be a member.

Dwight Ault: An excellent endeavor!! And superbly done. My hat's off to all. I feel optimistic again, when I see this type program in action.

RESULTS OF EVALUATIONS

1. In general how do you feel about your participation in the Citizens Panel?

	<u>very</u> <u>satisfied</u>	<u>satisfied</u>	<u>neutral</u>	<u>dissatisfied</u>	<u>very</u> <u>dissat.</u>
Rochester	9	3			
Windom	6	5		1	
Fergus Falls	10	2			
St. Cloud	3	6	2		
Metro	9	3			
Statewide	9	6			
	46	25	2	1	*

5A. Do you feel satisfied that the staff acts in an unbiased way?

Rochester	9	1		
Windom	8	3	1	
Fergus Falls	11	1		
St. Cloud	2	8	1	
Metro	11	1		
Statewide	6	9		
	47	23	2	

5B. Do you feel satisfied that there was a balanced group of witnesses?

Rochester	5	5		
Windom	5	4	1	2
Fergus Falls	5	7		
St. Cloud	3	7		
Metro	8	4		
Statewide	7	8		
	25	35	1	2

	Men	Women	Farmers	Farmers going to state-wide
Rochester	6	6	3	2
Windom	7	5	4	2
Fergus Falls	7	5	4	1
St. Cloud	10	2	6	3
Metro	5	7	0	0
	35	25	17	8 of 15
Statewide	11	4	8	--

*Although each Panel had 12 members, there are not always 12 responses from a Panel. In St. Cloud one member was taken ill and did not attend the last two days; in some other cases a few Panelists failed to answer a question.

STATE WIDE CITIZENS PANEL

AGENDA FOR DAYS 1, 2, AND 3

Monday, November 26

8:30 AM Introduction

- A. Review of the process
- B. Review of the findings of regional Panels

12:00 PM Lunch: Members of the Citizens Panel are requested to lunch together; visitors and commentators are welcome to join them.

1:00 - 4:30 PM First major presentation *

An overview of the issue and what should be done about it from the perspective of the Minnesota Pollution Control Agency. Wayne P. Anderson, Division of Water Quality, PCA.

7:00 - 8:30 PM: Committee of the Panel to discuss PCA presentation (closed to public).

Tuesday, November 27

8:30 AM: Second major presentation *

An overview of the issue and what can be done about it from the perspective of the counties. Mike Rhyner, associate director, Association of Minnesota Counties.

12:00 PM: Lunch: Members of the Citizens Panel are requested to lunch together; visitors and commentators are welcome to join them.

1:00 - 4:30 PM: Third major presentation *

An overview of the issue and what can be done about it from the perspective of the soil and water conservation system. Ron Nargang, director, Minnesota Soil and Water Conservation Board.

7:00 - 8:30 PM: Committee of the Panel to discuss the two presentations (closed to the public.)

Wednesday, November 28

8:30 AM: Fourth major presentation *

An overview of the issue and what can be done about it from the perspective of the Minnesota Department of Natural Resources. Ron Harnack, DNR Division of Waters.

12:00 PM: Lunch: Members of the Citizens Panel are requested to lunch together. If they decide to deliberate over the DNR presentation, visitors and commentators will be asked to lunch separately.

1:00 - 4:30 PM: Discussion of agenda for December 10, 11, and 12th. The Panel will work with staff to set up this agenda. Meeting is open to the public.

*In each of the major presentations, 1 hour will be given to the person making the presentation, 1 hour will be set aside for "commentators," and 1 hour for questions from the Citizens Panel. The commentators are an important part of the program and consist of representatives from our eleven sponsors (see bottom of page 1), as well as the Agricultural Extension Service, Minnesota Department of Health, State Planning Agency, and Water Resources Board.

Appendix 7

STATEWIDE PRESENTORS AND COMMENTATORS

1. Presentors

a.	Wayne Anderson	MPCA
b.	Mike Rhyner	AMC
c.	Ron Nargang	SWCB
d.	Ron Harnack	DNR

2. Commentators

a.	Kimberly Benson	SWCB
b.	Linda Bruemmer	SPA
c.	Bill Bryson	MASWCD
d.	Bill Bulger	MDA
e.	Paul Burns	MDA
f.	Jack Frederick	MN Assoc. of Planning & Zoning Admin.
g.	Michelle Gran	SWCB
h.	Howard Hanson	SFC
i.	Carol Hanson	SFC
j.	Tom Halbach	Ag. Ext. Service
k.	Mike Howe	MAPZA
l.	Pat Leonard-Mayer	MDH
m.	Marilyn Lundberg	SMRBC
n.	Tom Peek	CURA
o.	Steve Prestin	DNR
p.	Jack Puterbaugh	MAPZA
q.	Gaylen Reetz	MPCA
r.	Mel Sinn	WRB
s.	Erika Sitz	Ikes
t.	Dan Steward	WRB