OVERSIGHT OF HAZARDOUS WASTE MANAGEMENT AND THE RESOURCE CONSERVATION AND RECOVERY ACT

HEARINGS

BEFORE THE

SUBCOMMITTEE ON OVERSIGHT OF GOVERNMENT MANAGEMENT

OF THE

COMMITTEE ON GOVERNMENTAL AFFAIRS UNITED STATES SENATE

NINETY-SIXTH CONGRESS

FIRST SESSION

JULY 19, AND AUGUST 1, 1979

Printed for the use of the Committee on Governmental Affairs

U.S. GOVERNMENT PRINTING OFFICE

53-361 O WASHINGTON : 1979

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OVERSIGHT OF HAZARDOUS WASTE MANAGEMENT AND THE RESOURCE CONSERVATION AND RECOVERY ACT

THURSDAY, JULY 19, 1979

U.S. SENATE,
SUBCOMMITTEE ON OVERSIGHT OF GOVERNMENT MANAGEMENT,
COMMITTEE ON GOVERNMENTAL AFFAIRS,
Washington, D.C.

The subcommittee met at 9:35 a.m., pursuant to notice, in room 357 of the Russell Senate Office Building, Hon. Carl Levin, chairman of the subcommittee, presiding.

Present: Senators Levin and Cohen.

Staff present: Stephen H. Klitzman, Chief Counsel and Staff Director, Richard L. Tallman, Staff Investigator, Kathleen F. Chapman, Chief Clerk, Frances de Vergie, Assistant Chief Clerk, James Rosen, Research Assistant, William Tucker, Intern, Jean Perwin, Counsel, and Carol Upshaw-Anderson, Counsel.

Senator LEVIN. Good morning, everybody. The Subcommittee will come to order.

OPENING STATEMENT OF SENATOR LEVIN

Senator LEVIN. This morning the Subcommittee on Oversight of Government Management begins 2 days of hearings on what has been described as the environmental sleeping giant of the decade—uncontrolled and unsafe disposal of toxic hazardous wastes. The focus of the hearings will be on how well Government is managing its response to the hazardous waste nightmare. Land pollution and the need for improved hazardous waste management are some of the most important environmental problems facing the Nation and the Government today.

The problem is truly national in scope: from Jacksonville, Ark., and the imminent hazard posed by some of the highest levels of dioxin ever recorded, found in a Vertac Corp. landfill dumpsite; to Gray, Maine, where 750 families drank polluted groundwater for 4 years as a result of leaks from an inactive solvent and oil-processing facility; to Montague, Mich., where the Hooker Chemicals and Plastics Corp. dumped numerous chemical wastes contaminating the water supply at a scenic lake; to Shakopee, Minn., where Pollution Controls, Inc., which incinerated combustible paint sludges, solvents, and waste oils, is under court injunction to clean up and eliminate an inventory of 30,000 drums.

Of the 92 billion pounds of hazardous waste disposed of annually, waste residues of highly toxic dioxin, C–56, trichlorophenol, et cetera, it is estimated that as much as 90 percent are being disposed of in non-secured ponds, landfills, and lagoons, or are being incinerated without proper controls.

Contaminating the land, the food chain, our drinking water, toxic chemical wastes can poison our families and our animals, causing cancer, miscarriages, birth defects, and other problems.

This morning we will focus on Government's response to the hazardous waste problem. At a later date, we will hear testimony on the management of the hazardous waste program of the Environmental Protection Agency and delayed implementation of the Resource Conservation and Recovery Act (RCRA) passed in 1976 to control toxic wastes but still not implemented.

Our first panel today, Mrs. Carol Jean Kruger and Mrs. Kathryn Jungnitsch, will testify on the serious and bizarre animal and human health problems they and their neighbors have experienced in the last several years in the small southeast Michigan farming community of Hemlock. These problems range from high levels of miscarriages and paralysis to geese born with their wings on backwards and chickens born with their stomachs on the outside.

We will examine the adequacy of Government's response to the problem. We'll consider what further Government action is indicated.

The Hemlock case illustrates the apparent slowness and unwillingness of Government to respond to public concerns over possible chemical contamination. I'm equally concerned that private citizens like Mrs. Kruger and Mrs. Jungnitsch have had to invest their time and resources in order to pursue this investigation when it should have been and should continue to be the responsibility of Government.

We will then hear from a panel of Michigan officials, headed by Dr. Howard Tanner, Director, Michigan Department of National Resources, on the State hazardous waste programs, including State studies of the Hemlock problem, and on State enforcement actions against the Hooker Chemical Co.'s operation at Montague, Mich.

Because of the importance of the EPA regional offices in helping the States confront the toxic waste issue, we have invited as our next panel of witnesses two EPA regional administrators, John McGuire, head of EPA's upper midwestern region, and Fran Phillips, Assistant Administrator for the Agency's south-central region. They will testify on the latest hazardous waste developments in their regions including site investigations and enforcement actions.

Our final witness this morning is Lee Botts, chairman of the Great Lakes Basin Commission. She'll testify, among other issues, on the effect of uncontrolled hazardous waste disposal on the Great Lakes, the effect of the RCRA regulatory delay on the development of State programs, and the need for regional solutions to hazardous waste problems, including the siting of hazardous waste facilities.

The issues the Subcommittee will examine are all complex and important, and include:

One, the governmental response to the health problems at Hemlock:

Two, the governmental response to the dioxin contamination in Jacksonville, Ark.;

Three, the reasons for and effects of EPA's regulatory delay in issuing hazardous waste regulations;

Four, EPA management of the hazardous waste program, including organization, leadership, and priorities; and

Five, the siting of hazardous waste facilities.

But more important still is the overriding issue—protection of the public from the invidious effects of hazardous waste. We need to keep the human focus in mind at all times as we conduct these hearings. As Colman McCarthy has recently written: "It is men, women, and children [that Government] is being paid to protect, not bureaucratic turf, past policies, or other abstractions of power." Our goal should always be to make Government more responsive and protective of the public regarding toxic wastes and their adverse health and environmental effects.

Senator Cohen?

Senator COHEN. Thank you, Mr. Chairman.

OPENING STATEMENT OF SENATOR COHEN

Senator COHEN. I'll take first just a few moments to commend you for convening these hearings to investigate what I think is one of the most critically important issues facing this country today. That is the story of Hemlock, Mich. I'm sure that the historical irony of the cup of poison that Socrates had to drink has been referred to in many articles that have been written about this particular story.

But as the chairman has suggested, he might just as easily have sought out the story of Gray, Maine, in my own State; that of Rockford, Ill.; or any of a dozen other American communities that have experienced the imminent danger of uncontrolled toxic wastes.

Today, we happen to be focusing upon Michigan, but I think it's with the understanding that the horror of Hemlock is but one episode in the tragedy of man's efforts to harness the benefits of nature without destroying himself in the process. The questions that we are going to try to address don't require an esoteric knowledge of toxicology. They don't require a doctoral degree in geophysiology or in chemical engineering. They are questions for every man and woman who is capable of sound judgment. In short, they are very basic questions about responsibility.

This doesn't mean they are going to be easy questions. Just as we can't afford to cavalierly throw away our toxic wastes, we also have to refrain from, I think, a slipshod disposition of the moral issues that are going to present themselves today. We need to find a fair and enforceable method for apportioning responsibility for safe toxic waste management.

To do so, we have to transcend the buzzwords and the ever present urge to find a scapegoat, rather than an effective remedy that requires some sacrifice.

At the time of its passage, the Resource Conservation and Recovery Act, which I voted for as a Member of the House of Representatives, was thought to be such a remedy. As the House report rather proudly noted, and I'm quoting: "The approach taken by this legislation eliminates the last remaining loophole in environmental law." Un-

fortunately, pride often goes before the fall; and as things turned out, we may have acted with less than perfect foresight.

For example, the current law fails to provide a remedy to the health hazards posed by dumpsites that have no identifiable owners. Although the President and the Congress are now working closely on legislation to close this gap, I don't think that we in Congress can avoid the responsibility for the hardship imposed on all Americans during the time the problem remains.

Even so, I think just as there's room in this universe, there is room as well in these hearings for distinguishing between honest, unwitting mistakes and clear violations of ethical responsibility.

It's been more than a year since the statutory deadline for the Environmental Protection Agency's promulgation of rules which define hazardous wastes and govern their disposal; we still have no regulations. We may not have them until mid-1980, notwithstanding a court order which mandated the promulgation by the end of this year. We have no firm commitment that the 1980 deadline will even be met.

Now the cost of the delay in dollars and harm to the public is immense. Without regulations, no private firm is going to build a toxic-waste facility and thus risk losing huge investment if the facility does not comply with the yet-to-be-issued criteria. And many States, including my own State of Maine, cannot afford to enact their own waste treatment laws, so long as other States remain free to subsidize the pollution created by local industry. Honest businessmen are forced to choose between disposing of their wastes in an unsafe manner or paying exorbitant and possibly bankrupting fees to have their wastes transported to safe facilities. In the meantime, the public suffers both the economic uncertainty and the threat of cancer and toxic poisoning.

The law we passed in 1976 provided a so-called cradle-to-grave monitoring for the location of toxic wastes.

The problem here is that there aren't enough safe graves to contain the toxic wastes generated by American industry. In fact, in my own region in New England, there is not a single disposal site that is considered by engineering experts to be safe for the storage of hazardous wastes.

I am not concerned, Mr. Chairman, so much with the legality of delays as I am with the social irresponsibility that they imply. I am willing to tolerate delay, but there have to be some reasons and good ones. The public responses provided so far, in my judgment, by the EPA Administrators have been contradictory and, I think, have weakened the public's faith in our Government's ability to rationally alleviate a major health hazard. Congress created the EPA to make tough decisions and not necessarily popular ones. If we must stop producing some chemicals, then so be it. But at least let us decide the question.

The maxim that justice delayed is justice denied rings true in the field of environmental protection, just as well as in the realm of jurisprudence. So during our hearings, Mr. Chairman, we are going to have an opportunity to question the administrators of our environmental law. I look forward to their responses. I think we need some candor, not for its own sake but for the sake of the Nation's health.

Once again, I want to take this opportunity of commending you for showing leadership in this quite important area.

Senator LEVIN. Thank you very much, Senator Cohen.

We will at this time introduce for the record a number of exhibits and documents.

First is exhibit A, which is a December 15, 1977, letter to EPA Region V from Carol Jean Kruger. Exhibit B is a January 24, 1978, letter to Dr. Harold Price, State Department of Health, Lansing, Mich., from Carol Jean Kruger. Exhibits C–1 and C–2 are the February 14, 1978, letters to Mr. John Isbister, Department of Public Health in Lansing, from Carol Jean Kruger and the response of Mr. Isbister. Exhibit D is the December 5, 1978, letter to Mr. Michael Busch, State Capitol, Lansing, Mich., from Carol Jean Kruger. Exhibits E–1 and E–2 are the letters from Mrs. Jungnitsch to the Department of Natural Resources in Lansing and the response dated January 10, 1979, from James W. Bedford of that department. Exhibits F and G have been deleted. Exhibit H is the June 13, 1979, memorandum to Robert Courchine of DNR from James Truchan of the Environmental Enforcement Division of DNR regarding Hemlock, Mich. Exhibit I is a July 3, 1979, letter to Mr. Charles Sutfin, Director of the Water Division of EPA Region V from the Water quality planning section of DNR. Exhibit J is the Dow Chemical news release of November 15, 1978. Exhibit K is the June 29, 1979, letter to Mr. Schwartz, who is a reporter for a radio station in Flint, Mich., from Mrs. Linda Braley. Exhibit L is the July 16, 1979, letter to this Subcommittee from Dr. Irving Selikoff of the Mount Sinai Medical Center in New York.

[The information referred to follows:]

EXHIBIT A

2880 Pretzer Road
Hemlock, Michigan 48626
Phone: 517-642-5962

December 15, 1977

U.S. Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, Illinois 60604

Dear Sir:

PCB - polychlorinated biphenyls - (calculated as Aroclor 1254) has been detected at .15 ppm in the sample and .7 ppm in the fat in my 9 (nine) month old Holstein heifer. This determination was made at the diagnostic lab at Michigan State University by the Michigan Dept. of Agriculture.

Problems have been occurring on my Holstein dairy farm for four years; since Fall of 1973 to the present time. Resulting in disposal of 70 head of mature cattle, over a 50% disposal rate. At present my herd totals 70 head. All animals are affected in varying degrees. Symptoms observed are: death, weight loss, lameness, swellings, enlarged joints, mastitis, hair loss, low milk production (present average 18 pounds per cow), abortions, stunted growth, cuts don't heal, teeth-brown and black stains crooked-deformed, eyes brown and bulging, abnormal feet, abnormal white blood cell counts, and inability to breed. I do not at present have an exact figure on calf mortality and disposal; estimated over 150.

Under quantative analysis 2 ppm copper was detected in the kidney and 42 ppm in the liver. When trace minerals are fed, some of the animals refuse to eat the grain. There acute swellings under jaws and in the legs of some of the cattle. I feel there is an interaction between what is in the cows system and normal trace element level feeding.

During 1976 some of my upper teeth turned brown and broke away at the gum line. Fillings would not adhere for any length of time. I wear an upper denture. I feel this is related to my livestock problems.

I do not have conclusive proof as yet that our water supply is contaminated. Let me suggest to you that I am not an isolated case. Just that after four years of trying to solve problems I am finally learning the truth. I am observing things in my immediate neighborhood that are truly frightening. We have been living experimental research. We don't have to wait the 10 or 20 years for researchers to learn how to deal with PCB.

Does the EPA have established levels for this chemical? I hesitate to use the words "safe level" because of the effects of long term ingestion. We cannot continue to live in a chemically altered environment upsetting the delicate balance that nature once provided.

What are the allowable levels in milk? The levels in meat? Do you have any actual data pertaining to animals and humans done to date? Are there people considered experts that I could contact? Are there any treatments? Any ways to filter our water wells?

I am at present working with the county environmentalist, the Michigan Dept. of

Agriculture and Dept. of Public Health; progress is very slow. My family doctor is now arranging for fat biopsys for me.

Michigan's concern with PPB is overshadowing all other contaminates. I cannot overstate the urgency of this matter. I would appreciate any assistance that you could offer.

Sincerely,

Carol Jean Kruger

cc: Governor Milliken

(Retyped by Subcommittee Staff; original copy in Subcommittee files.)

EXHIBIT B

2880 Pretzer Road
Hemlock, Michigan 48626
Phone 517-642-5962

January 24, 1978

Dr. Harold Price
State Dept. of Public Health
Lansing, Michigan

Dear Dr. Price:

PCB has been detected in my cattle. I know the effects of contamination on the animals.

I request to be tested for PCB as soon as possible. My son is 3½ years old and has been exposed to my milk and meat. I asked for tests through the local physician with no response. My son and I would come to Lansing or wherever these tests can be run.

I am weary of governments inability to respond to inquiries for help. It is becoming more apparant the State doesn't care what happens to its constituents.

Expecting to hear from you.

Sincerely,

Carol Jean Kruger

(Retyped by Subcommittee staff; original copy in Subcommittee files.)

EXHIBIT C1

2880 Pretzer Road
Hemlock, Michigan 48525
Phone 517-642-5962

February 14, 1978

Mr. John L. Isbister, M.D.
Dept. of Public Health
3500 N. Logan, P.O. Box 30035
Lansing, Michigan 48909

Dear Dr. Isbister:

You asked for family health problems. I will attempt to give a list of these as best I can. We are a populated area with extensive residential building. I do not know all the residents but I am well acquainted with many of the long time residents surrounding my area. You must treat this as a study performed by an investigator without the participants knowledge. Not all the residents go to the same doctor or consult the same veterinarian about their animals. I am a lay person but will attempt to give you the occurrences, as were in some cases told directly to me, in other cases by another party asking for me. I am acutely aware of the sensitivity and risks I am undertaking by attempting this. Because so far, the belief of most of the people is that my problems are isolated from the rest of the community. I do not wish to panic the area. Because of my son and the other children here; we cannot wait 20 years or any longer. 7 years into this experiment is long enough. The results to date are truly frightening.

In many of the cases there is a direct correlation between what has been observed in the animals and the humans. The following subjects are all within a two (2) mile radius of me. Many are being sent to Mayo Clinic, Ford hospital, Ann Arbor and Cleveland with no cause detected. We must find out what these people are contaminated with. My animals can be disected; but not the people.

1. Male, 40 Hair loss. Adopted children observed by teacher not as energetic as other youngsters.

2. Male, 50 Dog bite. Tired, extra sleep, hunger, inability to gain weight.

3. Male, 40 Throat operation (cancer) dairy herd. Father, very ill 1977 extended hospitalization.

4. Female, 70 Passess out, sleeplessness, surgery 1977, excessive perspiration, pale, hands red, knuckles enlarged.

5. Male, 18 Tired, continued fatigue, muscle cramps, recurrent sore throats, excess perspiration, bone tumor surgery leg, 1975 dizziness, chest pains, elevated blood sugar, pale.

6. Male, 40 Elevated sugar, normal next checkup; dizziness, unable to drive summer 1977. Cattle indicate swellings, lameness, increased cattle losses.

7. Female, 8 Low white blood cell count, tired, listless, colds.

8. Male, 50 Severe industrial accident, leg sores don't heal. Dog poor, moans.

9. Female, 30 Mayo Clinic Diagnosis -- drug fever, initially sick from water.

10. Male, 30 Bone growth on arm, removed 1976.

11. Female, 30 Rash, summer 1977, allergic to perspiration, three dogs died abruptly, present young dog poor, houseplants die.

12. Male, 50 Leg operation, slow healing, fatigue, extended periods of illness.

13. Female, 18 Stomach problem undiagnosed, pale, attitude change.

14. Female, 40 Hysterectomy.

15. Male, 30 Severe skin rash, farmer spraying chemicals.

16. Male, 30 Continued fatigue, hearing impaired, backaches, no children.

17. Male, 4 Low white blood cells, spleen removed, pale.

18. Male, 60 Impaired health, farmer spraying chemicals.

19. Critical family, Female 36, lymph glands removed, spleen now enlarged, extensive medical no cause determined, always cold, advised not to drink water, no followup: Husband, 38 Off work two years, swollen legs, weight loss, now improved: Children under 10 bladder infection, urologist, drink excessive water: Mother, Benign brain tumer, 1977, rapid development: Father, 1978, prostrate operation. Small animals affected exactly like mine. Adjacent neighbors cattle died, believed to be buried on property.

20. Children under 10. three individuals run high temperatures stop breathing. Personally removed dead horse similar condition as my animals.

21. Female, 30 Mayo Clinic Feb. 20, 1978.

22. Female, Mayo Clinic, Feb. 14, 1978, cancer.

23. My son, Chris 3, 4 times bowel movement green. Stool otherwise reddish brown, strong odor, similar to cattle odor. Facial blush when playing is blotchy, cheek bones remain white.
Mother, 74, Hearing impairment, backaches
Father, 76 Growth removed from ear 1977
Myself, Nail discoloration on feet, change in skin pigment, don't tan anymore -- used to get deep tan. Fatigued, a laborious task to do the physical labor I have always done. Sensations primarily left arm. Left heel sore in past. Some eye discoloration similar to cows. Teeth deteriorated, fillings would not hold, teeth broke off at gum line, excessive facial swelling during 75-76, now have upper denture. Always loose bowel movement. No milk to breast feed baby, could be related to depressed flow in cattle. In past cold, now perspire doing any physical labor.

In addition, I believe there were and are human lives given as a result of this. I will not elaborate, because of additional heartbreak for loved ones, and my concern is for the living. I will talk about this matter privately and confidentially, however. The incidence of cancer has escalated dramatically and the death rate in people 50 and below has increased markedly. I will do a statistical survey to substantiate this if it becomes necessary.

The symptoms are as varied in my animals as in humans. It is apparent to me that resistance is lowered and the most vulunerable areas are affected due to each individuals body chemistry. Something has happened to our natural immunity.

Animals symptoms include: chronic pneumonia, mattery eyes, enlarged joints, boney growth on legs, 3 tumers found in 10 rabbits butchered, cattle mastitis not responding to normal drug treatments, skin pigment loss around eyes of horse, open sores on horses, extreme swelling of horses legs usually 1 or 2 hind legs, all 4 legs of cattle. Extreme weight loss with death following rapidly in all animals. Fluid retention swellings all areas of cattle bodies. Cattle and horses listless, have to shove out of stalls -- as though they forgot how to back out. Stunted growth. Animals do not mature to normal stature and weight. Dieurretic. Brown stained tails will not wash out. Cows may be passing same material that causes their brown and black discoloration, improper tooth development. Odor in barn not normal. Cattle excretment always brown. Sterility. Abortions. Hair loss.

One other area, houseplants died using well water; which would again substantiate water contamination. Plants received no other food or fiber. Plants flourish on rain water.

I do wish I could supply with the answer of the contaminates. If I knew the answer I wouldn't need the State's assistance. My understanding phenyls were pumped down until 2 years ago. One theory I have developed is there is seepage made toxic by the interaction of chemicals injected. Another theory is that we may be on Dow's monitered water system somehow because of the Bromine in the water. One of the state veterinarians mentioned when PCB was detected in the calf that some of the tests cost $700 to $800 each to run and the state cannot do them. I have since learned he may be referring to dichlorofurans and dibenzofurans. Another possibility may be the trihalomethanes or a version of them which are being exposed in cities due to interaction of PBT, chloroform, carbon tetrachloride, and benzene. Some of these including lead, copper, cadmium, DDE dieldrin, chlorinated pesticides are in my cows milk. I understand some of the above measured in parts per trillion will kill a fish.

Some of the calves that died never had any carcus deterioration. Dogs would not touch. Appeared as though they were pickled or preserved suggestive of formeldahyde. Perhaps the people becoming dizzy and passing out could suggest chloroform. Copper deposits were in the livers and kidneys of the four animals biopsied. Suggestive of a chemical or acid that reacts with copper. I would appreciate some of these things being told to a chemist to aid in a possible analysis.

Whatever toxic substances are involved are lethal; because when they can kill my plants, dogs, cats, fowl, rabbits, horses and cattle, they can kill me.

I have written everything I can inform you of to date. I will do whatever I can to assist you. I must ask that you give this priority. I again request the procedure for a biopsy on myself if this is the only sure method of determination. I understand the blood doesn't necessarily provide the answers. In some cases the blood platelets are coated. No determination was made as to the nature or content of this coating.

Expecting your earliest reply, so that we may proceed rapidly in this investigation to aid all involved.

Sincerely,

Carol Jean Kruger

(~~Copy~~ typed by Subcommittee staff; original copy in Subcommittee files.)

EXHIBIT C2

WILLIAM G. MILLIKEN, Governor

MAURICE S. REIZEN, M.D., Director

STATE OF MICHIGAN
DEPARTMENT OF PUBLIC HEALTH
3500 N. LOGAN, P.O. BOX 30035, LANSING, MICHIGAN 48909

February 23, 1978

Carol Kruger
2880 Pretzer Road
Hemlock, MI 48626

Dear Mrs. Kruger:

In response to your letter of February 14, I am sorry to advise you that we are not in a position to conduct any type of analytical screening for toxic substances in individuals except on an exceedingly limited basis. Part of the problem is the lack of facilities to do this type of work on a large group basis.

In relation to PBB contamination and associated illnesses, we have looked extensively at approximately 50 individuals, using a battery of tests, examinations and diagnostic procedures in two of the medical centers in the state and, to date, have not been able to develop objective findings of abnormality which can be related to the presence of PBB. In the instance of any single individual, we will be glad to run PBB determinations if simultaneously obtained blood and fat specimens are sent to us. In this program, we send a specimen collection kit to the physician. He obtains the specimens, sends them to us and we send the report of the analysis back to him. Of course, there is no charge for the analytical work done by our laboratory.

Sincerely,

John L. Isbister, M.D.
Disease Control Officer

JLI:ac

EXHIBIT D

2880 Pretzer Road
Hemlock, Michigan 48626
Phone 517 642-5962

December 5, 1978

Mr. Michael Busch
100th District
State Capitol
Lansing, Michigan 48909

Dear Representative Busch:

As you may be aware from the media exposure, regarding our water quality problems around Hemlock; the deeper the investigation, the more inconsistencies and inefficiencies are exposed.

The DNR has a mass Spectometer in their labortory. They have no technician to run this machine. Also I don't know whether it is operative. With a budget in excess of $85 million it would appear there are monies available even though each branch maintains they are operating ona shoe-string budget. They are severely handicapped in their analytical findings by only using the chromograph; by which they can quantify findings but cannot qualify them or specifically identify them. For example: they cannot identify the type of aromatic amines, the freon, or the hydrocarbons found here. Also they rely on industrial findings and accept their results by so called "looking over industry's shoulders". Could you inguire into the status of this machine?

Under Statute 245 of the Public Acts of 1929 as amended, being Section 323.2 and 323.5 of Michigan Complied Laws; a set of groundwater quality standards have been devised. It is my understanding this material may be in legislative sub-committee. Is it necessary for these rules to be acted upon by the legislature to be effective or are they just to be used as a guideline? It is my firm belief that the rules must be laid down before our underground aquifers are no longer usable for any purpose during our lifetime.

Mr. Andrew Hogarth, Chief of the Groundwater Quality Division of the DNR, has confirmed the validity of both these areas when confronted privately by me.

It would, I believe, be advantageous to have a central core laboratory used by all the departments, Health, Agriculture, and DNR, instead of each individually requesting monies for equipment to do the chemical analysis required because we do live with these compounds.

Would you inquire into these problem areas on my behalf; so that government can function more effectively in tasks it has assigned itself? Also what further steps should I take as an involved citizen in these matters?

Thanking you in advance for the time you will spend in this endeavor.

Sincerely,

Carol Jean Kruger

EXHIBIT E1

December 18, 1979

Dr. Howard A. Tanner, Director
Department of Natural Resources
Stevens T. Mason Building
Box 30028
Lansing, Michigan 48909

Dear Dr. Tanner:

It was recently brought to our attention that there is a mass spectrometer sitting unused somewhere in the D.N.R. laboratory. I asked Mr. Andrew Hogarth about this and he stated that they did have a mass spectrometer but that it needed repairs. He also mentioned that with the "tight budget" funds were not available to get the machine back into working condition.

We are rural residents near Hemlock, Michigan. The D.N.R. has been in our area several times taking water samples. In our well they found aromatic amines and a volatile hydrocarbon. Because of their limited laboratory equipment they are not able to identify the aromatic amine or the hydrocarbon. If the mass spectrometer were operatable this job could be done. Also involved here is a Freon extractable oil and grease.

Because your laboratory can't identify the individual substances they can't correlate the findings of our Private laboratory.

With a budget in excess of $85 million it would seem there is money available to have this machine repaired and for a technician to operate it. Or, maybe it would be better to purchase a new piece of equipment.

We would appreciate you giving this matter your immediate attention.

Sincerely,

Mr. & Mrs. Edwin Jungnitsch
13584 Ederer Road
Hemlock, Michigan 48626

cc: Mr. Andrew Hogarth

kdj

EXHIBIT E2

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING, LANSING, MICHIGAN 48926
HOWARD A. TANNER, Director

January 10, 1979

Mr. and Mrs. Edwin Jungnitsch
13584 Ederer Road
Hemlock, MI 48626

Dear Mr. and Mrs. Jungnitsch:

Thank you for your letter and concern over our non-functioning gas chromatograph-mass spectrometer (GC-MS). An operable GC-MS with a data system would indeed be a useful instrument for many environmental situations.

However, in the case of your well water, the quantities of organic compounds present are probably too small for the GC-MS to aid in the identification, as somewhat larger quantities are needed for the GC-MS than the gas chromatograph alone. That is, enough would be present for the GC to give a response, but not enough for a mass spectra.

The trace amount of an unknown volatile hydrocarbon does not match any of the usual ones found, including all those reported by your private laboratory. The aromatic amine test we run is general for all aromatic amines and the level reported is near the detection limit for the analysis.

The lack of any gas chromatographic evidence in combination with the very low total organic carbon (TOC) values indicate that there is no significant organic contamination of the well.

We continue to strive to improve our analytical capabilities and your concern is appreciated. If you have any questions, please feel free to contact us.

Very truly yours,

ENVIRONMENTAL SERVICES DIVISION

James W. Bedford

James W. Bedford
Asst. Laboratory Director

JWB:bm

cc: Andrew Hogarth
T. K. Wu

MICHIGAN
THE GREAT LAKE STATE

R1026 1/75

EXHIBIT H*

June 13, 1979

TO: Robert J. Courchaine, Chief, Water Quality Division

FROM: Jim Truchan, Environmental Enforcement Division

SUBJECT: Hemlock Michigan Water Quality Report

Thank you for providing copies of your Division's and the Health Department's reports on this problem. It is apparent from the amount of sampling performed that your staff did a thorough job investigating the water supply aspects of this problem. There is, however, one problem with the report that you should bring to your staff's attention. On page 50 under Dow Analysis, chlorine is shown at concentrations in the thousands of parts per million. I understand that these determinations are really a neutron-activation determination of chlorine atoms not residual chlorine. This aspect should be clarified either at the bottom of the table or in the report since someone reading the report indicating that there were no apparent chemical problems, then looking at the chlorine data, might not understand what the analysis was for.

It would seem appropriate that before you close your file on this matter that the possibility of air borne pollutants causing the citizens increased level of health concerns be investigated. Since the area is downwind from both the Michigan Chemical facility and a refinery the mixture of air emissions from these facilities should be investigated. It apparently was Michigan Chemical Company's practice to release their excess bromine gas at night which could have formed brominated hydrocarbons when mixed with the refinery emissions.

JGT:ml
cc: D. Rector

(*NOTE: EXHIBITS F AND G WERE NOT INTRODUCED.)

EXHIBIT I

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING, BOX 30028, LANSING, MICHIGAN 48909
HOWARD A. TANNER, Director

July 3, 1979

Mr. Charles H. Sutfin, Director
Water Division
U.S. EPA-Region V
230 South Dearborn
Chicago, IL 60604

Dear Mr. Sutfin:

Per 40 CFR 35.1513-4(C), the State of Michigan certifies that those elements of the areawide work programs ranked higher than zero(0) in the attached 208 Project Priority List are adequate and compatible with the State strategy and work program.

The following conditions are imposed upon this certification:

(1) That appropriate changes in final work programs be made in response to review comments on areawide work programs by state technical staff.

(2) That funding decisions on the work program for the West Michigan Shoreline Regional Planning and Development Commission be made in response to the enclosed materials. Region 14 came in with last minute revisions to their work program. The "Comprehensive Investigation of Water Quality and Toxic Contamination of Selected Western Michigan Groundwaters has been scoped down to a Procedural Strategy for the Comprehensive Investigation of Water Quality and Toxic Contamination of Selected Western Michigan Groundwaters" for approximately $34,000. Essentially this will encompass the first five elements of the original project and will result in a strategy for identifying and dealing with groundwater toxics problems in the region.

The region also submitted a work element for development of self-financing mechanisms which totaled $16,111. This would result in a financing strategy and efforts at putting it in place.

The region will be formally submitting a revision to their work program in the near future; however, for use in the interim, draft work elements are attached.

MICHIGAN

R1026 10/76

(3) That Activity 102,000, titled Comparative Analysis between Agricultural Runoff and the Implementation of Agricultural Best Management Practices, submitted by the East Central Michigan Planning and Development Commission be reviewed with the following consideration. The undertaking of this task as proposed relies upon the participation of an institution in the monitoring essential to determining changes in loadings due to the implementation of BMP's. If this participation cannot be obtained a scaled down proposal would be necessary. In this event, it is also recommended that Activity 402,000 relating to the Saginaw River Stormwater Water Quality Response Model be considered for funding. This task was not submitted in time to receive a priority ranking from the state.

(4) Should any of the Regions have pretreatment tasks funded, the State will coordinate these task(s) with the State Regional Laboratory task to assure that duplication of effort will not occur.

(5) Two regions have transferred the self-financing portion of their work plan. Region 3 has placed Task #1, Update the Plan and Five-year Strategy etc., within Task #7 Investigate Self-Financing Mechanisms for a total cost of $26,190, and Region 8 has placed Element #1, Program Administration within Element #5, Development of Financing Alternatives for Continued Water Quality Management Planning for a total cost of $7,813.

An updated version of Michigan's prioritization process is also included.

Very truly yours,

WATER QUALITY DIVISION

Ronald B. Willson

Ronald B. Willson, Chief
Water Quality Management Planning Sec.

RBW/elv

cc: J. Filippini, U. S. EPA
Regional Agencies

Michigan FY 79
208 Project Priority List

#Points	Region	Project	Total Cost	Sub-Totals
	2	FY 78 Work Plan	56,666	56,666
35	3	Self Financing	26,190	
	5	Self Financing	32,000	
	6	Self Financing	3,572	
	7	Self Financing	33,000	
	8	Self Financing	7,813	
	9	Self Financing	6,500	
	10	Self Financing	7,726	
	12	Self Financing	3,895	177,362
34	4	Self Financing	14,500	191,862
33	1	DMA - Self Financing	53,443	
	13	Self Financing	12,166	
	14	Self Financing	16,111	273,582
31	14	Public Participation	12,547	
	State	Segment Classification & TMDL	93,000	379,129
29	3	Sewer Authority	2,780	
	3	Communications	7,125	389,034
28	1	Nonpoint Source Standards	5,811	
	1	Environmental Education	31,625	426,470
27	1	Fringe Area Handbook	13,142	
	1	River Basin management	55,100	
	4	Inland Lakes Handbook	3,400	498,112
26	3	Water Quality Standards	2,527	
	8	On-Site Wastewater Management	13,758	514,397
25	1	Detroit 201 Work	25,801	
	State	Gasoline Storage	20,000	
	7	Agricultural Nonpoint	30,000	
	9	Near Shore Impacts	18,000	
	11	Inland Lakes Management	8,000	
	14	Groundwater	34,733	650,931
24	12	Lake Management	33,080	
	3	Urban Stormwater	2,403	
	4	Watershed Analysis-Ag & storm	24,865	
	6	Combined Sewer Overflow	27,118	
	7	Agricultural BMP Analysis	90,000	
	9	Inland Lake Assessment	22,300	
	10	Agricultural Nonpoint ID	9,660	
	11	Zoning Ordinances	9,000	
	State	Local Governments Study	60,000	
	5	Urban Stormwater	102,204	
	6	Landfill Corrections	9,061	
	8	Metro Sewerage Policy	28,194	
	9	Inland Lake Assistance	10,000	1,078,816

23	1	Economic/Social Impacts	51,160	
	3	Nutrient Budget	4,190	
	9	Environmental Assessment	1,600	
	10	Inland Lake Nonpoint	13,519	
	12	Wastewater Treatment Needs	8,985	
	State	Regional Lab Feasibility	84,000	
	9	Nonpoint Source	34,200	
	13	Inland Lake Mgnt. & Sampling	15,000	
	4	Ag. NPS Analysis	18,335	
	12	On-Site Disposal	18,895	1,328,700
*22	10	Peninsula Township GW	30,000	
	6	Water Quality Sampling	36,179	
	13	Septic Problems	12,167	
	3	Groundwater Impact Assessment	30,890	
	4	GW Assessment	35,300	
	9	Pretreatment	21,500	1,494,736
*21	6	NPS Assessment	35,179	
	8	Closed Dump Inventory	11,166	
	6	Groundwater Recommendations	9,061	
	6	Land Use Guidelines	9,061	
	13	Agricultural NPS	7,000	
	1	Landfill Review	9,802	1,576,005
*20	3	Small Treatment Plants	4,855	
	1	Septic System Mgnt. Districts	29,022	
	1	Pretreatment Impacts	26,956	
	7	Landfill Leachate	18,000	
	9	On-Site Options	13,800	1,668,638
*19	14	Plan Update	4,092	
	10	Landfill Leachate	13,529	
	3	Land Use Ordinances	5,570	
	4	On-Site Options	2,310	
	1	Sewer Service Area Map	29,001	
	1	Septic System Constraints	15,087	
	1	Stormwater Coordination	10,590	
	1	Atmospheric Impacts	24,431	
	1	W.Q. Constraints	52,292	1,825,540
18	9	Land Use & Pop. Update	4,500	
	9	Inland Lake Monitoring	8,000	
	9	G.W. Problems	20,500	1,858,540
17	7	Minimum Tillage	27,000	
	10	Oil and Gas Storage	11,595	1,897,135
16	4	G.W. Sampling Analysis	28,630	
	1	Hazardous Waste Leg. Review	20,465	
	13	Solid Waste Management	7,000	1,953,230
15	9	Intern Program	23,500	
	12	G.W. Investigation	10,645	1,987,375

14	3	Urban Stormwater - Portage	59,465		
	5	Agricultural NPS	24,500		
	6	Agricultural Regulation	9,061		
	10	Septage Disposal	13,519		
	12	W.Q. Monitoring	1,870		2,095,790
13	9	Watershed Zoning	27,600		
	9	G.W./Lake Hydrogeology	30,500		2,153,890
11	1	Aerial Photo	4,885		
	1	Rain Gage	38,753		
	8	201 Review	5,471		
	9	G.W. Supply	14,900		2,217,899
10	1	Underused Infrastructure	7,767		2,225,666
0	1	Amend Plan	36,189		
	1	A-95 Review	20,491		
	1	# State Strategies	17,127	(pass through)	
	1	Coordinate Env. Progress	12,300		
	1	Assist State in Pub. Part.	12,543	(pass through)	
	1	Plan Monitoring	95,946		
	1	Assess WQMP	46,132		
	1	Conflict Resolution	76,097		
	4	Rural Clean Water Appl.	5,775		
	5	Facility Plan Review	6,100		
	6	Facilities Plan Review	7,208		
	7	Hemlock G.W. Sampling	15,000		
	7	AWT on Cass River	16,500		
	9	Municipal Wastewater DMA's	18,500		
	9	Wetland Education	22,500		
	10	Dredge & Fill Impacts	9,660		
	10	Stormwater Management	5,792		
	11	Solid Waste Management	7,000		
	14	Review DMA Compliance	5,008		
	14	Revise Recommended Control Meas.	12,448		
	14	Revise 5-Year Strategy	2,033		
	14	Direct & Manage Program	2,029		
	14	Coordinate with other agencies	5,578		
	14	Evaluate implications of toxic studies	1,502		
	14	Revise Assessments	12,763		
	7	Saginaw Stormwater Response	14,500		2,712,387

*projects listed in priority order within the point scale

Process for Prioritization of Funding for Water Quality Management Planning Work Program Tasks

In view of the expected continued decline in federal money available to support water quality management planning acitivities in Michigan, it is necessary to develop a process by which the state can prioritize and guide funding decisions for work program tasks. The proposed process can be broken-down into three parts.

I. Minimal Requirements - Those requirements which all proposed work program tasks must meet to be considered for funding. The MDNR Water Quality Management Planning Section will review proposals to determine if they meet the following requirements:

   A. The proposed task must be identified in the state strategy as a high statewide problem priority, or a high regional problem priority agreed upon by the state.

   B. The proposed task must comply with federal funding constraints.

   C. The proposed task is not duplicative of other efforts.

   D. The applicant must have the capability to perform the activity.

II. Evaluation Factors - Since qualified proposals are likely to exceed available funds, a set of criteria are necessary by which the proposals can be evaluated to form a basis for prioritization. Evaluations will be made by the MDNR's Water Quality Management Planning Section staff based upon the following factors:

   A. Magnitude of the problem
   B. Severity of the problem
   C. Fulfills a condition for plan approval
   D. Implement ability of the end product
   E. Fulfills a commitment in an initial plan which has not yet been performed
   F. Extent to which the proposed activity reinforces or complements activities of other regions or the state
   G. Cost-benefit relationship
   H. Probability of success

III. Prioritization - Water Quality Division staff in consultation with the regions will propose the funding priorities using the evaluations from part II. A meeting will be held with the regions to discuss the proposed funding priorities and provide for their comment. Staff will make modification to the funding priorities as may be appropriate and present to the Michigan Water Resources Commission and/or the Michigan Natural Resources Commission for final determination.

A. Magnitude of the problem

0 - very localized impact - i.e. - one small lake, one subwatershed, etc.

1 - countywide impacts

2 - regional impacts

3 - multi-regional impacts

4 - statewide impacts

B. Severity of the problem

0 - minimal - impacts are not causing standards violation

1 - no standards violations - possible public health hazard
minor standards violations are occurring, no public health hazard

2 - minor standards violations are occurring, possible public health hazard
major standards violations are occurring, no public health hazard

3 - major standards violations - possible public health hazard

4 - definite public health hazard

C. End product implementability

0 - no implementable product - i.e.: project is data gathering, no control program proposed

1 - low implementability - i.e.: control program will be proposed, however funding, implementing agencies, schedule, costs, etc. will not be determined

2 - moderate implementability - i.e.: control program is proposed and detailed to some extent, however, more work will be needed before programs could be implemented.

3 - good implementability - i.e.: product proposes control program and details all steps to follow in implementation

4 - very implementable - all of the details of implementing the control program will be spelled out so the implementing agency only needs to follow the recommendations. Implementing agency involved in program development thus more willing to participate

D. Project's relationship to other activities in the region, other regions or the state

0 - conflicts with other projects 0

1 - has no effect on other activities or projects 1

2 - may enhance other activities or projects 2

3 - will aid or enhance other activities or projects 3

4 - is essential for the success of other activities 4

E. Cost or project benefit relationship

a) definitions

1) Cost (for section 208 projects)

a) Extremely high - greater than 10% of state allotment

b) High - over $100,000

c) Medium - between $20,000 and $100,000

d) Low - under $20,000

2) Benefit

a) High

1) will abate a pollutant source causing a water quality violation

2) will develop a fully implementable program to abate or significantly control a pollutant source

3) will develop a control or abatement program which would be of benefit to many regions and/or the state

4) other projects with widespread or very significant beneficial results

5) will result in the eventual savings of significant amounts of dollars

b) Medium - those that fall somewhere in between

c) Low

1) no implementable product

2) simple data gathering - no control program developed

3) control program will benefit only a very limited area (i.e.: one small lake, etc.)

4) shows no cost savings potential

5) simply administrative activity which cannot be tied to pollution abatement

b) Rating

high cost/low benefit med. cost/low benefit high cost/high benefit low cost/med. bene

Extremely high cost high cost/med. benefit med. cost/med. benefit med. cost/high ben

low cost/low benefit

0 1 2 3

low cost/high benefit

4

F. Probability of success - considering::

a) number of governmental units involved - relationships between them

b) citizen support or provision to develop it

c) capability of the agency involved, past track record, etc.

d) complexity of the project

e) potential costs of implementation

f) DMA status of implementing governmental units

0	1	2	3	4
very low (?)	low	medium	high	very high (?)

C. Classification of impacted waters

0 - effluent limited stream, oligotrophic or high mesotrophic lake, or high quality groundwater

2 - potential water quality limited stream, designated trout stream, designated natural rivers, low mesotrophic lake, or potentially degraded groundwater

4 - water quality limited stream, eutrophic lake, or degraded groundwater

The following are yes—no type considerations

	0	1	2	3	4	10
h) High State priority	no				yes	
i) Self-Supporting mechanism	no					yes
j) Public Participation & Education project	no				yes	
k) Condition for plan approval	no				yes	
l) Commitment of initial plan	no		yes			

DOW News Release

FOR FURTHER INFORMATION
Contact: Tom Sinclair or Bob Bumb
Phone: (517) 636-5781
Midland, Michigan 48640

EXHIBIT J

FOR IMMEDIATE RELEASE

November 15, 1978

DOW REPORTS DIOXINS OCCUR EVERYWHERE
AS RESULT OF NORMAL COMBUSTION PROCESSES

The family of toxic chemicals known as chlorinated dioxins are formed in minute amounts by normal combustion processes that occur everywhere, Dow Chemical scientists reported today. The dioxins include the compounds known as TCDD which are said to be among the most toxic chemicals known to man.

Dow said its research to date has verified the following sources for chlorinated dioxins: refuse incinerators, fossil-fueled powerhouses, gasoline and diesel powered automobiles and trucks, fireplaces, charcoal grills and cigarettes. The company has detected the dioxins in soil samples taken from several cities.

Until now, the dioxins have been viewed as impurities that occur during the manufacture of such chemical products as pesticides and herbicides. The company said there is no need for concern or alarm over the new findings, which Dow considers a key scientific breakthrough.

The discovery and claim that dioxins are ubiquitous, and therefore can be found everywhere, comes after a four month search to explain the presence of 2,3,7,8-TCDD in fish taken from the Tittabawassee River which flows by the Dow plant in Midland. Dow reported finding the TCDD in fish last June and has been on a crash research program to find the source ever since.

- more -

Robert R. Bumb, research director of Dow's Michigan Division and head of the task force concerned with the study, explained that new capabilities in analytical chemistry account for the discovery.

"We now think dioxins have been with us since the advent of fire," he reported. "The only thing that's different is our new found ability to detect them in the environment."

Bumb spoke of the "trace chemistries of fire" which produce the dioxins. He said this chemistry, now being understood for the first time, consists of numerous reactions which occur during combustion at very low concentrations in the range of parts per million and lower.

The Dow report said one principal route by which dioxins enter the environment is by way of airborne particulate matter and a second route is by way of waterborne particulate matter. The particulates can come from a wide variety of combustion sources.

"Some thought our pesticide production facilities might be the source of the TCDD. Contrary to that easy assumption, we found the Dow pesticide manufacturing facilities are not measurable sources of the trace levels of dioxins found in the fish taken from the river," Bumb commented.

"It's really been a startling experience for us," Bumb said, "including the fact that much evidence which supports our conclusions is now emerging world wide."

Dow made a report on the findings to state officials this morning and was also sharing its data with the Environmental Protection Agency in Washington.

The need to make an interim report to the State of Michigan prompted today's disclosures. # # #

EXHIBIT K

June 29, 1979

Dear Mr. Schwartz,

I applaud you on your show "Is Hemlock Poison?"

I am a new resident of Hemlock and in fact Mrs Ader & Mr. Morse are neighbors, but I have never met them sociably.

The impression I got from your attitude while watching your show, is that you feel there is something definately wrong out here and officials are keeping something from the residents. But, I must admit you equally gave Dow and Mich Dept of Health credit for investigating the problem.

I feel there is something wrong! My children, ages 2yr & 5mo. have had colds every month lymph gland problems, nausea & diarrehea. I took a sample of tap water to my children's doctor after receiving the enclosed letter from the Richland Twp Water Dept. I received the letter March 31, 1979. I took a water samble about 1 week later which would be around April 7, 1979 and I still haven't received the results. The doctors office said I would have the results 1 week to 10 days later.

We moved into Hemlock 8 mo. ago. My 2 yr. old has had only 1 cold in 18 mo. until we moved to Hemlock. Since then, he & my 5 month

old are always getting something.

I really think it could have something to do with the water, but I will put it to my own test. After seeing your show I will only use distilled water and if my children have less illness, I will know its the water & move out of Hemlock.

I hope you don't lose interest in us, because we need your help. I am sure if you are interested, the residents would help you in any way they can. At least I will! I also know a few people who feel the same way I do.

If you have any questions feel free to contact me.

Thank You.

Mrs Linda Braley
397 Sandridge Dr.
Hemlock, Mi.
48626
Phone: 1-517-6422144

Dear Water Customer:

The Richland Township Water Department wishes to notify its water customers of a recent problem in meeting the state drinking water standard for coliform bacteria.

During the months of January and February, the analyses performed on drinking water samples collected from certain locations in the village showed the presence of coliform bacteria. The state standard does not allow any coliform bacteria to be present in drinking water. Coliform bacteria are an indicator that disease causing organisms may be present. Since the state drinking water standard for coliform bacteria has been exceeded, we are required by state law to notify you of the situation by mail and to let you know that steps have been taken to eliminate the problem.

City officials, along with state health department personnel, have installed emergency chlorination facilities at one of the city's well supplies. This was done at the request of the Michigan Department of Public Health on March 2, 1979 to disinfect the system and protect against further possible contamination problems. Following the initial disinfection of the system, the chlorine dosage was reduced to a point where a trace of free residual chlorine was recorded throughout the system. An investigation has shown the cause of the problem to be birds gaining access to the elevated tank. The elevated tank has since been repaired, disinfected and placed back into service. Samples collected recently from the city system show no coliform since correction of the problem.

The city is continuing its routine monitoring program for drinking water quality and will notify you again if any problems develop in the future. Please write or call us if you have any questions. (Phone number) 642-2097.

Respectfully,

Richland Township
Water Department

EXHIBIT L

THE MOUNT SINAI MEDICAL CENTER
ONE GUSTAVE L. LEVY PLACE • NEW YORK, N.Y. 10029

OF THE CITY UNIVERSITY OF NEW YORK

Mount Sinai School of Medicine • The Mount Sinai Hospital

July 16, 1979

Environmental Sciences Laboratory
Cummings Basic Sciences Building
10 East 102 Street
New York, New York 10029
(212) 650-6173

Mr. Richard L. Tallman
United States Senate - 3308 Dirksen Building
Subcommittee on Oversight of Government Management
Senate Committee on Governmental Affairs
Washington, DC 20510

Dear Mr. Tallman:

Thank you (and please thank Mr. Klitzman) for allowing us to see the various records concerning the Hemlock material. It is replete with the kinds of frustration felt by many as the result of inadequate data, incomplete scientific understanding, inability to go back in time, the variable findings in different periods and with different measures.

The frustrations are not lessened when our investigative and analytical constraints fail to convince us that there is much we don't know in any situation of this type (yet, observations which do not exist can not be "forced.").

Scientists are often accused as perpetually complaining that "we don't have enough data." I expect that they will again be so censured since, despite the extensive and useful studies commissioned by Dow and those undertaken by the Department of Natural Resources, we are tantalized by the fact that the spent brine discharges suffered 24 losses in 17 months, with some evidence that they do have other chemicals (organic carbon was present at 7 ppm). One could wish for information from radioactive tracer studies, but any now be done would not tell us very much about what happened in the past. (They might, however, tell us what could happen.) There was also the curious statement that no "routine discharges" would be likely to occur that could cause widespread chemical contamination. The question naturally comes to mind about discharges that are not "routine" and that would be "unlikely" to cause than less than "widespread" contamination.

I believe Dow is a careful company. They may have a list of all chemicals they discharge. I perhaps overlooked it in the voluminous reports. Were these sought? Accidents sometimes happen, in the most peculiar ways.

I'm afraid that Dr. Waldbott is not far off the mark in his complaint that clinical studies might be preferable to "epidemiological studies," but I am not at all sure that there isn't a semantic problem here. Thus appropriate epidemiological investigations concerning human health in situations such as this could very well include essential clinical facets, as well. Simply recording symptoms is not necessarily satisfactory, and the prevalence of a very high percentage of people with adverse symptoms in the Hemlock area is no guarantee that they reflect adverse environmental exposures, although they are consistent with it. Other parameters might well be looked to, including specific biochemical and clinical examinations.

I must be away this week and essentially all of next week. I'm confident that Dr. Henry A. Anderson of our Laboratory will be able to be of assistance to you in clarifying some of these problems.

With all best wishes.

Sincerely yours,

Irving J. Selikoff, M.D.
Professor

IJS:ss
cc: Dr. H. A. Anderson

P.S.: I am reminded of a similar question being raised by the House's Subcommittee on Oversight and Investigations concerned with ground water pollution at the Hooker Chemical Company's Montague, Michigan plant where in 1968 Hooker was notified that ground water under its plant was contaminated with salt from two wells, with the possibility raised that admixture of other chemicals "on the ground" could move with the saline ground water.

Senator LEVIN. Our first witnesses this morning are Mrs. Carol Jean Kruger and Mrs. Kathryn Jungnitsch.

Welcome to Washington, and in your quest for answers, we're delighted to have you with us this morning. I'm not at all delighted with the circumstances that bring you here.

We will first call upon Mrs. Kruger. Let me first swear you in, as is the custom of the Subcommittee. Mrs. Jungnitsch, I will swear you in at the same time. You needn't stand.

[Witnesses sworn.]

TESTIMONY OF CAROL JEAN KRUGER AND KATHRYN JUNGNITSCH, CITIZENS, HEMLOCK, MICH.

Mrs. KRUGER. Thank you, Senator, and members of the Committee.

My name is Carol Jean Kruger, and I am a resident of Hemlock, Mich. I have submitted written testimony to the Subcommittee and rather than orally summarizing that testimony, I would prefer to give a brief presentation on the extent of the Hemlock area health problems and my efforts to remedy these problems to date.

To focus on these health problems, I have developed a map of the area, showing the location of the brine line traversing the area and the old oil well diggings. I have grouped the various ailments on eight plastic overlays, and I have loosely used the term "neighborhood syndrome." I didn't realize the implications of this term until I completed my graphic material which I will now present to you.

This is the map of our area: Fremont, lying to the south of this line and Richmond Township lying to the north, and the village of Hemlock represented here. This is the brine line system, both injection and oval brine pumping wells, that go through the area. The blue dots identify the old oil well drilling holes that were done in the 1940's.

These are the thyroid problems in the area. We have four thyroids and five thyroid removals.

Senator LEVIN. That was the first overlay you put up?

Mrs. KRUGER. Right.

Senator LEVIN. Perhaps that could be marked as "Overlay A."

Mrs. KRUGER. Now then Overlay 2 consists of a living case of diagnosed lupus, 10 miscellaneous items, 18 tumorous cysts and lumps, and one brain tumor. Many of these things are, indeed, hard to categorize. A young woman, aged 20, has had a type of bone deformity removed from the hip area, so in some instances, we're not quite sure how these were specifically produced. One family with children are constantly on phenobarbital because of a convulsion type of spasm that they have. But they cannot specifically identify it. They know what it isn't, but they don't know what it is, and there are many of these, I hate to say, strange things that do continually occur.

Senator LEVIN. We will mark that as Overlay B. I understand you've already marked these overlays. You've numbered them one, two, and three, and so forth?

Mrs. KRUGER. No, I haven't. I'm sorry.

Senator LEVIN. It's all right. There's no problem. Will you mark them so the reporter can identify them? You can mark that as Overlay C.

Mrs. KRUGER. All right. And here we have 25 cases of bone problems, joint problems, bone spurs, and I should say that we are concentrating within 12 sections of land, 3 miles by 4 miles.

And we're talking about 50 homes that we know of, out of a total grouping of homes of less than 150. Now, these are the cancers that again go along in the area. We have 3 children living with cancer, 11 people living with cancer, and 11 cancer patients that no longer are here.

And I would like to produce this Saginaw newspaper article. This is one of the children from our area that I believe met with you, Senator, as he was here visiting the capital.

Senator LEVIN. We will mark that as exhibit M, and it will be made part of the record.

Mrs. KRUGER. There is a 15-year-old girl with cancer of the back, a 12-year-old child with cancer. And as these things get into the children, then it does become truly frightening.

Now, this is the blood pressure and heart attack chart, with 10 diagnosed high blood pressures, two living heart attacks, and 15 people that have succumbed from heart attacks.

The next overlay, we have 14 gall bladder cases, three enlarged spleens—I am sorry—one enlarged spleen, three spleens that have been removed, four enlarged livers, and one liver case that is no longer living.

And this has to do with the women's problems. We have 18 hysterectomies, 10 D. & C.'s, 6 miscarriages of one or more, 6 still births, and 4 babies that were not born normal at birth.

And we have one kidney death, two people living with kidneys removed—one is a 14-year boy—four with diagnosed kidney problems, and 12 with various bladder problems.

Now, these—I don't attempt to put them all back up, but as you get them all in focus one on top of the other, then these areas begin to jump right out in how they follow along this specific line.

Senator LEVIN. Those overlays will be made part of the record at the conclusion of your testimony.

Mrs. KRUGER. Now to continue on. Some of the area residents are very reluctant to discuss their problems for fear of losing their disability income. The Government doesn't recognize environmental disability. Kathryn and her husband, Ed, are continually communicating with Social Security about their prior disabilities. Social Security would like some refund of their money.

I have used this book by Irving M. Sax, "Dangerous Properties of Industrial Materials," as a regular reference in my search. I am finding that many of the things that are itemized here are certainly appropriate in our area. Some of the findings to date show a variety of suspect materials and chronic long-term exposures.

One of the women in the area had the highest PPB and PCB rating of any mother's milk tested in the Saginaw clinic, and I hand-delivered the specimen to ERG at Ann Arbor. Blood analysis, a test for arsenic, showed 8.5 UD per DL. Three to seven is the normal range. The tests were run at Willow Run, Pa.

My son, Chris, at the age of 2, had 26 parts of blood lead, the normal range being 2 to 50. In a liver analysis of my animals we had 226 milligrams per kilogram of copper, and 539½ milligrams per kilo-

gram of zinc in the liver, plus traces of cadmium and lead. We are now pursuing urine analysis for fluoride, and that is being run in Montana. The various water tests indicate the same elements with many more as yet untested.

The common denominator is the ground water wells. My variety of animals in their separate locations provided ample background. The nonfarm and farm residents also have only one thing in common: natures most precious resource, the water, the only outside factor being the Dow well system. DNR, in the Geology Division records, shows many millions of gallons of waste brine deposited in the subsurface strata, also toxic compounds, including butyl alcohol, chlorinated benzene compounds, phenolitic compounds, and 2,4,5-T at specified locations. The oilwell drillings could act as drinking straws, allowing these compounds to commingle and move upward due to the many degrees of underground pressures.

There is also speculation about putting the radioactive wastes down the brine wells from the nuclear plant under construction at Midland. This must be prohibited.

Yesterday, while coming to Washington, I read a copy of the Detroit Free Press of testing to be done at Oscoda, 47 wells at a cost of over $100,000 to do an 18-month study. Now, studies are meaningless if they do nothing more than cost money, compile additional data, and remain in Government offices. Monies would be better applied by aiding the people involved through proper testing and diagnosis and methods of treatment and by developing methods to remove the contaminants from our water supplies, rather than by treating them with additional chemicals.

I realize it is necessary for those of us involved in extreme environmental problems to solve our own case. To quote Dr. Truchan, "If they don't give up, they'll find the answer." Each approach I have made to government, I have brought additional proof and information. We have worked with the general attitude of cooperation, but always the end result being noncommittal or "We don't know." If we must continue to seek the private sector for doctors and qualified laboratories at our own expense, then our tax-paying dollars are not being utilized to respond to citizens' needs.

The proposed groundwater regulations at both the State and Federal levels need to be addressed by the Congress if it indeed is necessary to have an enforceable law. We are citizens of the most affluent society in the world, with the greatest technological expertise and development. We must be responsible to ourselves and to each other. lest history repeat itself, like the great Roman Empire, who, with her advanced civilization, initiated her own demise through the extreme use of lead. We live in a chemical world and must deal with that reality now.

I will persevere in the search for truth and good water and medical diagnosis and perhaps treatment for my neighbors and friends in my community. By my appearance before you, it may make it easier for those who are yet to follow in other discoveries and other unsolved problems. But I do refuse to become a statistic.

Thank you for allowing me this privilege to testify before you. And I would be happy to answer any questions that you may have.

Senator LEVIN. Before we proceed to Mrs. Jungnitsch, I wonder if you would describe the problems that you had with your animals.

Mrs. KRUGER. I am sure you are all aware that this has been repeatedly brought up, and for the first 5 years of this experiment I did indeed blame myself and I did make improvements in buildings, et cetera. The harder I tried to improve my own confined environment, the more disastrous things became, particularly those animals that I purchased to replace those of my own that could no longer produce properly. And lameness, various ailments, sterility——

Senator LEVIN. Could you describe the ailments and the problems you had with your animals?

Mrs. KRUGER. Well, weight loss, lameness, lumps, swellings, hair loss, constant bouts of mastitis. We would go through and totally treat the entire herd, and in another month's time we would be doing the same thing. The medical costs were fantastic. There were the same indications of problems in the horses and in the various other animals, because when you have a herd of animals, they have a same look. Their feed, their care—and we would have some fat ones and by the same feeding there would be some who would be very thin, and there would be no reason. Something was happening. They couldn't digest the food properly; their growth was retarded; very high calf mortality rates; curled hoofs; even, in some cases, I would say, the animals' temperaments would change—they wouldn't come in the barn, we would absolutely have to drive the animals in the barn as though they became stupid.

Senator LEVIN. What were the deformities?

Mrs. KRUGER. The only thing specifically were in the fowl area, with the wings and the eggs that would not hatch. But as far as the large-animal deformities, there were none, thank goodness, that I observed.

Senator COHEN. Mr. Chairman, prior to turning to the next witness, perhaps we could just, by unanimous consent, insert in the record this article that appeared in the New York Times magazine section this past week, by Michael H. Brown, that gives some detailed explanation on the deformities and the difficulties.

Senator LEVIN. Without objection, all of your exhibits will be made part of the record at this point.

[The prepared statement and material referred to by Mrs. Kruger follows:]

STATEMENT OF

CAROL JEAN KRUGER

HEMLOCK, MICHIGAN

BEFORE THE

SUBCOMMITTEE ON OVERSIGHT OF GOVERNMENT MANAGEMENT

COMMITTEE ON GOVERNMENTAL AFFAIRS

UNITED STATES SENATE

July 19, 1979

I am Carol Jean Kruger. I present this testimony this morning on behalf of myself and the residents within and surrounding the village of Hemlock, Michigan, in the Fremont and Richland townships of Saginaw County. The testimony summarizes my investigation into the animal and human health problems we've experienced in Hemlock and their possible cause by chemical contamination of our area's groundwater.

My background includes Hemlock High School valedictorian, graduating 1953; Michigan State University, bachelors degree in retailing, 1956; Saginaw County Dairy Princess and Cherry Pie Queen and 4-H achievement winner. I am a life-long resident of the area except for a four-year period of work and living in Illinois. A fourth-generation descendant of German immigrants to this property, I returned to full time dairy and general cash crop farming in 1966.

The focal point began in October, 1977, when after purchasing five top-quality producing Holstein dairy cows in July, 1977, I found they all had developed symptoms similar to those occurring previously. I contacted Dr. Thomas Naples, my veterinarian, and told him something was killing my new animals. We called in Dave Bollingbaugh of Coleman, Michigan, a feed nutritionist, to assist us. The pertinent questions he

asked, including culling rate - 50%, staining on teeth, and milk production led to developing a history of the animals and calling in veterinarians of the Michigan Department of Agriculture.[A1*] Dr. Carter, Dr. Davis and Dr. Mellenberger came for an on-farm investigation on October 25, 1977. Diagnosis of a ten-month-old Holstein heifer revealed PCB (calculated as Aroclor 1254) 0.15 ppm in the sample and 0.17 ppm in the fat. The liver contained 42 ppm copper and the kidney 2 ppm copper.[A1a]

I knew that similar problems were occurring with the Belgian draft horses which my father, Walter Beyersdorf, had bred and raised for 40 years; and with the hogs, ornamental fowl, and peacocks which were kept on two additional properties. The only common denominator between the three farms was the water.

In November 1977, I called Dr. Ectyl Blair, head of the Environmental section at Dow Chemical, Midland, Michigan, and told him my animals were sick and some had died. Could they test my water? I delivered a gallon of water to Dr. George J. MacLean, DVM, Agricultural Products Department. Results were confirmed by letter December 16, 1977. The values reported were:[A2]

chlorine	340 ppm
bromine	0.8 ppm
iodine	<0.03 ppm
sodium	340 ppm
magnesium	9 ppm
calcium	28 ppm
sulfates	123 ppm
total organic carbon	<1 ppm

Upon receipt of the PCB analysis of the calf, I wrote to the EPA Region V office in Chicago, on December 15, 1977.[A3] I sent a copy with a letter to Governor Milliken, the same date.[A4] No response ever came from the EPA. Governor Milliken's acknowledgement was received April 6, 1978.[A4a]

*Attachments are available in the Subcommittee's files.

State veterinarians returned with Dr. Ellis, December 22, 1977, and again in February, 1978, when three animals were selected for slaughter and specimens collected. I mentioned what I suspected was happening in the community and they thought it would be wise to contact the Michigan Health Department. Dr. Carter mentions in his special report that Dr. Ellis talked to Mr. Ellison about the water wells, and sending someone from the DNR to investigate. No one came. A4b

Stan Cherry, Michigan State Dairy Inspector, tested several milk samples. He suggested we not drink the milk because of the heavy metal and pesticide residues, but it was all right to sell to the public. I stopped selling milk January 25, 1978, because I could not morally sell a product I should not drink myself. A5

Dr. Harold Price, a name I picked from the Saginaw News, was my first attempt to reach the Michigan Health Department. A6

Dr. Isbister responded to my letter to Dr. Price. A7 Saginaw county health officials came February 8, 1978. The county health nurse collected blood samples for the state. Dr. Gotay and Dr. Asuan, the county health director and assistant, discussed medical problems. James Cleland and Fred Scarello collected water samples for the state. Ben Woodard, Saginaw county environmentalist also attended. Reporters from the Saginaw News came.

I called Edwin and Kathryn Jungnitsch to attend because I knew about their serious family illnesses, even though we had no social or business contact other than bowling twelve years previous. Dr. Gotay expressed the opinion, after hearing their illnesses, that water could be a factor. I felt if I could help them, my suspicions would be validated. Kathryn was scheduled for spleen surgery and swollen lymph

glands, several lymph glands having previously been removed. I purchased a water distiller, thanks to Mr. Severance of Bridgeport, Michigan, calling in reply to the newspaper article. I insisted that the Jungnitsches try distilled water and furnishing same, the improvements soon became apparent. The surgery was not necessary, lymph glands became normal, constant headaches vanished, low body temperatures returned to normal, urinary problems gradually abated. Ritalin was no longer necessary for the son. Only after gathering their medical record for this investigation, did they learn that a consulting physician, on December 9, 1976 suggested that Edwin temporarily drink distilled water because of the high sodium content in the well water.[A7a] Edwin was afflicted with what was diagnosed as Guillain-Barre syndrome, the same condition which struck some persons who received a swine flu inoculation. Ed, however, never had the swine flu shots. He was off work for 17 months. The daughter, it has been recently learned, has a heart condition.

In Dr. Isbister's letter of February 7, 1978, mention was made of no knowledge of family health problems. I composed a list of what I knew had occurred in the neighborhood, along with all the animal symptoms I had observed.[A8] and I noted that I had no idea of what to test for. His reply of February 23, 1978, was that they were not in a position to conduct any type of analytical screening for toxic substances in individuals except on an exceedingly limited basis. [A8a]

The results of our blood tests seemed very slow in coming. I have since learned to be very patient. I called Dr. Keith Long, whose name and work in environmental problems appeared in a farm publication, to inquire if they could assist us.[A9] He called Dr. Humphrey, who stated

our case was under active consideration. Several inquiries led to Mr. Art Bloomer from whom we asked to receive information of water and blood analysis. Blood analysis, received March 17, 1978, listed PCB, PBB, DDT and DDE in my parents and myself.[A9a] The water analysis came in April, 1978, and is included in the Chemicals and Health Center Report.

The letters of February 8 and 16, 1978, from my state representative, J. Michael Busch, indicate his contact with the State Health Department and also with Dow Chemical's Mr. John Mier. [A10-11] I observed pipes being pulled from the brine well on Raucholz, No. 77, on February 17, 18, 1978. I began following these actions and every weekend pipes were pulled from additional brine wells in the area. The neighbors were aware that maintenance work and new piping were only done previously during summers. These pipes have never been replaced and many still lay on the adjacent well platforms.

Dr. Neill Varner, our local physician, requested through proper channels a field epidemiological study in the letter dated March 9, 1978. [A12]

Trying to assist the state in determining what chemicals to test for, I procured Dow's discharge waste list and an analysis of spent brine. [A-13-14] When the last cow abruptly died April 19, 1978, I made a listing of these materials for the Department of Agriculture to do toxicology on the animal. Dr. Carter made a telephone call to Dr. Cole, to whom I spoke. He said the state had no funds available for outside testing. No toxicology was done. The physicological analysis of the animal duplicated every symptom I had heard of in the neighbors. [A15]

I decided that I could better expose this matter and the difficulties encountered by additional media exposure. I hand delivered a letter to the Michigan Farmer with the corpse of the cow on an open trailer enroute to the diagnostic lab. [A16] The resulting article by Bonnie Pollard was published July, 1978. Very accurate and in-depth reporting of our area's problems was written. [A17]

I worried for five years that PBB was a part of my problem. I could no longer maintain the herd. The biopsies were done by Dr. Naples. I was assured by Dr. Carter the animals were OK for slaughter. I said it would be the state's responsibility because I believed that untested residues could be in the animals. The livers of cattle slaughtered for home use were so bitter we could not eat them nor would the cat or dog being smarter than we. The PBB biopsies showed no trace of PBB.[A18] The saddest days were when I loaded my dairy herd for slaughter. I kept and continue to maintain a representative sample of seven cows and their calves to test at whatever date in the future. There was PBB in the chickens, however, so no more eggs or chicken were consumed. The chickens just gradually died. The cattle were disposed of during May and June of 1978.

The State Health Department set up the questionnaire for the epidemiological study conducted in July, 1978. The County Board of Commissioners provided the $3,500 funding to hire interviewers. Ben Schrader was the doubting member.[A19] I furnished the names of the people I had listed only by number in the February 14, 1978, letter to Dr. Isbister to Ben Woodard. Several of these people were included in the study. I was not. Blumfield Township was used as control. I have just recently asked Ben Woodard for the chloride content of Blumfield

Township. The range is 9 ppm to 3325 ppm. Well depths are from 8-foot rock wells to 250-foot drilled wells. The deeper the wells, the higher the salt content. Blumfield residents are presently attempting to receive water from the Saginaw city system.

I had been told repeatedly by the private sector to be wary of the state stopping the investigation since the health department's analysis showed no organics other than DDT, DDD, and DDE. I had to keep one step ahead. I engaged the services of Advanced Analysis and Testing of Grand Rapids, Michigan. Several wells of varying depths were screened. Their method of testing indicated higher organic readings in some of the wells. Well No. 4 was chosen because it seemed consistent in Chemical Oxygen Demand. The bottles were prepared according to EPA specifications. The samples were collected by the lab personnel, maintained at constant temperature, driven through and hand delivered to Raltech Scientific Services, Inc., Madison, Wisconsin. The results were diethylether, 1,1,2-trichlorotrifluorethane (Freon 113 common name), trichloroethylene and toluene. [A21]

An appointment was made and a meeting occurred October 21, 1978, with the Water Quality Division of the DNR, at Lansing, Michigan. During the meeting we discussed Raltech's findings. I presented the material to Andrew Hogarth and Gary Klepper of the Water Quality Division. Representatives of the State Health Department, Jim Bedford of the testing laboratory and news reporters also attended. Kathryn Jungnitsch, Gerald Danin, my attorney, and Chris Harrington of AAT Labs were with me. The DNR agreed to begin testing immediately.

Gene Weingarten's article in the Detroit Free Press went out on the Knight Rider Service. [A22] The nationwide exposure brought correspondence

and reporters from across the country. Additional contamination exposures, areas and names of possible people that might assist were received in the correspondence that followed.

Mr. John Mier of Dow collected samples on Friday, October 27, 1978. Testing specifically for the Raltech findings, with detection limits of 2 to 10 ppb, none was detected. Lead, copper, silver, zinc, and TOC were found in well No. 4. A22a

The DNR began initial testing October 25, 1978. Results indicated aromatic amines, carbon tetrachloride, heavy metals, and excessive levels of conductance, chloride, sodium. All the wells had phenols in excess of 1 ppb which is the safe federal level for drinking water both in the U.S. and other countries such as Germany. A23

Retesting revealed no aromatic amine but an unknown volatile hydrocarbon, which was not identified. Then the DNR called in Dow and they simultaneously collected samples. A24 The DNR had Dow shut down the system while some of the tests were run. My observations indicate pumping resumed in January 1979. The DNR has not permitted further use of No.'s 50 and 81. A24a Standard Methods for the Examination of Water and Wastewater indicate the accuracy of the various analytical and sampling methods is in most cases much less than 100% detection. It is reasonable to assume higher levels actually present than indicated in the results. Method of detection is not known.

The state and county health departments held a news conference November 1, 1978. A25 They also held a closed meeting that morning. Involved in the news conference were Ben Woodard, County Environmentalist, Dr. Asuan, County Health Director, Mr. Art Bloomer, State Epidemiologist, George VanAmburg, Statistician and Dr. Neill Varner, Hemlock physician.

Health problems reported more frequently in the Fremont-Richland area included skin rashes, numbness, arthritis, pains in the arms, legs and lower back, dizziness, visual problems, nausea, injuries, urine sugar, thyroid problems and strokes.

It was not until March, 1979 that the official study was released.[A26] Values for each demographic group indicate more items with larger percentage for Fremont-Richland than would be expected by chance. I believe the statistical data would be more meaningful if rather then reporting the difference by subtracting the percentages of the two communities, the percentage of the people affected would have been used. For example: 32.6 Fremont-Richland, 15.8 Blumfield pain in arms, legs or lower back--difference 16.8; percentage of those affected 100 percent more in Fremont-Richland.

On November 27, 1978, I appeared on Channel 19, WUCM TV, Day by Day program with Dr. Isbister, Andy Hogarth and Gary Klepper. Private conversation revealed some shortcomings in the state's testing facilities.

On December 5, 1978, I sent a letter to Rep. J. Michael Busch concerning the non-use of the DNR mass spectrometer, and the need for that testing unit. I also inquired into the status of the proposed Michigan groundwater rules.[A27a-b] I received a phone call of acknowledgement from his secretary just before Christmas but nothing further developed. Further inquiries revealed the groundwater rules had been forwarded to the Attorney General's office and then returned to the DNR Groundwater Division for rewording. Status at present, I do not know. At the same time a letter written to Dr. Howard Tanner of the DNR by Kathryn Jungnitsch was answered by Jim Bedford, again pointing out the handicap in testing by the lack of adequate equipment.[A28]

On January 30, 1979, I sent U.S. Representative Donald Albosta my compiled documentation of the case to that point.[A29] There was no reply until the state officially closed the case. I received a telephone call from Gary Peters and sent additional material as stated in the enclosed letter.[A30]

I was invited to attend the hearings on the proposed toxic substances ombudsman legislation on February 14 and 21, 1979. I expressed support of the legislation to make it easier for state residents to have a direct route to the proper people in various state agencies. I stressed the need for a central core facility with qualified personnel used by all departments rather than each agency having its own facilities and thereby requiring duplicating monies.

I met many residents involved with PBB and PCP and heard of their struggles. I also learned of the existence of a deep injection well owned by Veliscol of St. Louis, Michigan, located on Olive Road, north of Breckenridge, Michigan. This may be a possible link with the reported hodgkins disease cases in that area. Breckenridge has contracted Williams & Works, Grand Rapids, Michigan, to do a water study, a four-month period of testing.[A31]

On March 29, 1979, I sent a letter to Dr. George L. Waldbott, M.D.[A32] He was repeatedly recommended to me from various areas of the U.S. I read many of his publications including: "Fluoridation, The Great Dilemma", "Struggle With Titans", and the Fluoride Society Journals. Our telephone conversation of April 4, 1979, led to the physical exams and blood tests of the area residents. Edwin and Kathryn Jungnitsch and myself were the first examined on April 13, 1979. Additional appointments have been scheduled for area residents. Personal interviews with residents were conducted in Hemlock, June 23, 1979, by Dr. Waldbott

to discuss the variety of health problems. To show the complex nature of the situation affecting the area residents, a representative sampling was scheduled to give him a better idea of the many and varied types of ailments occurring, rather than several people with one similar set of symptoms. Initial blood work was for copper and lead. Test results on two patients reveal high levels of arsenic. The accompanying medical records attest to the findings and health problems that have beset these people.[A33] These records are not to be released to anyone without the written consent of the patients involved.

In April, 1978, I attended a public hearing on the East Central Michigan Planning and Development Region's 208 Areawide Waste Treatment Program. The 208 program was established in 1972 by the Congress as a separate provision of the Federal Water Pollution Control Act Amendments (PL 92-500) for the express purpose of enhancing environmental water quality conditions. The selected regional plan includes a section addressed to the control of groundwater pollution. [A34] I felt it would be applicable in my situation. I supplied necessary documents to this agency pursuant to any agency doing more in-depth studies and well monitoring when the state officially stopped. Some monies were available through the Region 5, Chicago office of EPA. Additional monies were requested in the federal grant application totaling $15,000, as part of activity 302,000 included in the work plan for 1980 by ECMPDR.[A34a] The local advisory committee voted to eliminate any such study until it is firmly established that a problem exists. Ben Schrader, chief chemist at GM Steering Gear Division, Saginaw, Michigan, was instrumental in deleting the application from the 208 work program.[A35] Schrader was quoted in the Saginaw News, as follows: "We've got to put our foot down. Let's stop paying taxpayer money chasing ghosts around."[A36] Michigan DNR also has given low priority ratings for this study.

The letter from Dr. Waldbott to Jim Sygo of ECMPDR fully explains his evaluation of the Hemlock area situation.[A36]

Additional documentation gathered in this investigation provides more in-depth background on this case. Forty-two well and reservoir data files on the underground industrial waste disposal system operated by Dow, on record with Geological Survey Division of the Michigan DNR, show location of well, receiving formation, reservoir fluid data, disposal well data, injection data and fluid injection rate in gallons.[A37] Dow has a total of 83 wells licensed by the DNR Geology Division. Of this total, 73 are waste brine wells. Nine are toxic waste disposal wells, with supposedly only 5 operating today. The brine well system map identifies the location of those wells in the area.[A37a] Of particular importance is the fluid content of the toxic waste wells, consisting of: copper, butyl alcohol, chlorinated benzene compounds, phenolic compounds, Tordon, Pyridenes, and 2,4,5,-T being pumped into the Dundee formation. Most of these toxic waste wells are in or around the Dow complex in Midland, Michigan. The two oldest injection wells nearest my property, No.'s 50 and 81, are natural vacuum wells. No external pumps have ever been required to put down the disposal brine. In other observed areas external pumps are required, operating from 200 lbs to in excess of 800 lbs. valve pressure to put the material down, due possibly to hydrostatic or underground head pressures. There are also many natural artesian flowing water wells and springs throughout the area, supporting the underground pressures. Inhibited hydrochloric acid is used to fracture the rock in the subterranean when the injection wells are being readied for service. I personally observed the Dowell tanker trucks, Mt. Pleasant, Michigan, at the site on Orr Rd. and Swan Creek Rd. I called Mr. Nagle and he corroborated this observation. The interaction

of pumping in and out and the external pressures applied in the movement of these materials could have resulted in a co-mingling or leaching action in the Dundee formation.

Many oil exploration holes were drilled throughout the area in the thirties and forties, at least twelve in the immediate area. There are no records by the state. Some are not capped, some are not plugged and some may be leaking. The oil drilling log, permit 12783, 34-12N-2E, Richland Township, gives a complete drilling core record and indicates water coming from the base of the hole.[A38] The map gives location of the many drillings perforating the area.[A38a]

The residential well logs of the immediate area show the varying depths and drilling core strata, but no water quality records.[A39] Well depths range from 54 to 300 feet. There are some known in the area at depths to 600 feet.

Records from the Geology Division, Michigan DNR, show Dundee brine composition from Bay, Clare, and Arenac counties. [A40]

The Report to the Dow Chemical Company on Environmental Vulnerability Assessment of Potential Brineline or Near-Surface Level Brine Well Spillage in the Midland, Michigan Area, August, 1978, was prepared by Williams & Works, 611 Cascade West Parkway, S.E., Grand Rapids, Michigan, 49506. [A41] I believe this study was undertaken due to complaints by the residents of Ingersoll Township, Midland County, Michigan, of lateral line breakage and spills, and damage to the natural environment. Dow contracted the study with the DNR looking over their shoulder, so to speak.

Water in the area is termed "brackish" due to the sodium chloride content. Dr. Ellis, MSU Veterinary Professor, suggested not supplementing the animals' diet with any additional salt. No salt has been fed the

animals since April, 1978. The horse hair analysis done for me by Albion Clinical Labs., Clearfield, Utah, illustrates the mineral imbalance in the animal.[A42] Low computer readings in phosphorus, sodium, iron and manganese and high readings in magnesium and potassium are the analytical findings. The water in well No. 8 has 700 mg/l of iron, highest of the test wells, sodium 170 mg/l and chloride 169 mg/l,lowest of the test wells. The horse then cannot assimilate these minerals as they occur in the water.

Soil test analysis was conducted on all my farmland 11/9/78 by Chemical Service Laboratory, Jeffersonville, Indiana.[A43] Two sites were selected for mineral content: B, a heavy soil and J, a sandy soil. Readings were as follows:

	B		J	
Zinc ppm	104	vh	123	vh
Manganese	66	m	17	l
Sulfate	45	m	203	vh
Boron	.4	l	.2	l
Copper	3	m	2	m
Iron	125	h	105	h

I have not as yet completed plant tissue analysis to demonstrate plant mineral content. But again there is not the correlation of body function indicated by the soil and water and the hair analysis of the horse. There must be additional factors involved to unbalance the body function for proper mineral absorption.

A topographical map shows site locations for soil samples. Farms are identified by well No.'s 1,4,7,8.[A44]

Static daphnia toxicity tests were conducted by the Michigan DNR, November 1-20, 1978.[A45] Mortality in all the wells occurred at varying rates. The sodium chloride levels, PH and conductivity were the only factors considered. The range of test wells were 169-1580 mg/l for chloride. According to Water Quality Criteria, threshold concentrations

are from 3700 to 4600 mg/l.[A46] The tolerance limits for domestic animals and livestock range from 1025 to 25,000 mg/l. On the basis of these lmits, there must be additional parameters to produce the toxicity and mortality indicated in the testing. No effort was made to investigate further.

Two analytical reports by Dow of the #6 spent brine pond dated 8/21/74 and 11/10/78 are identical except for the reduction in organic carbon from 43 ppm, 1974 to 7 ppm, 1978.[A47-48] The chemical analysis by the DNR of the spent brine spill, October 31, 1978, shows a somewhat different analysis. Total organic carbon was 120 mg/l plus several other parameters not recorded in Dow's records.[A49] The critical materials report data sheet lists critical materials reported by Dow.[A50] The discharge method of these products is not known.

Faith, Keyes and Clarks, Industrial Chemicals, Fourth Edition, by Frederick A. Lowenheim and Marguerite K. Moran lists many of Dow's Midland Plant manufactured chemicals.[A51] In the manufacturing processes of compounds, various metals are used as catalysts and are lost in the process, and certainly could explain the presence of cadmium, boron, nickel, silver, antimony, manganese, etc. in our aquifers. Phenols are manufactured with about a 90% recovery rate, also accounting for the presence of phenols. Amines, hydroxdiphenol and copper salts are used in this process. The brine is neutralized with sodium bicarbonate.

A novice study conducted by Biology students at Hemlock High School, May 21, 1979, used gerbils in their experiment. No. 3 gerbil died ten days after being shifted from the use of distilled water to test water. There was no way in the experiment to determine cause of death.[A52]

Dangerous Properties of Industrial Materials, by N. Irving Sax has been my regular reference for toxicology related to chronic exposure. Along with arsenic which produces a great variety of symptoms, boron, lead and manganese belong to a group of chemicals which affect the central nervous system. Boron produces a sub-normal temperature and has been one of the symptoms in the residents' finger nails. Fluorides are indicated by the mottled teeth, the bone spur removal and tumors of the bone. Phenols are obvious by the occurrence in all the test wells. Phenols have been known to lead to headaches, fainting, skin eruptions, ringing in the ears and excessive salivation. Several children from the area have been hospitalized with so-called false appendicitis attacks--nausea and vomiting, severe stomach cramps. After a 2 or 3 day hospital stay, they return home.

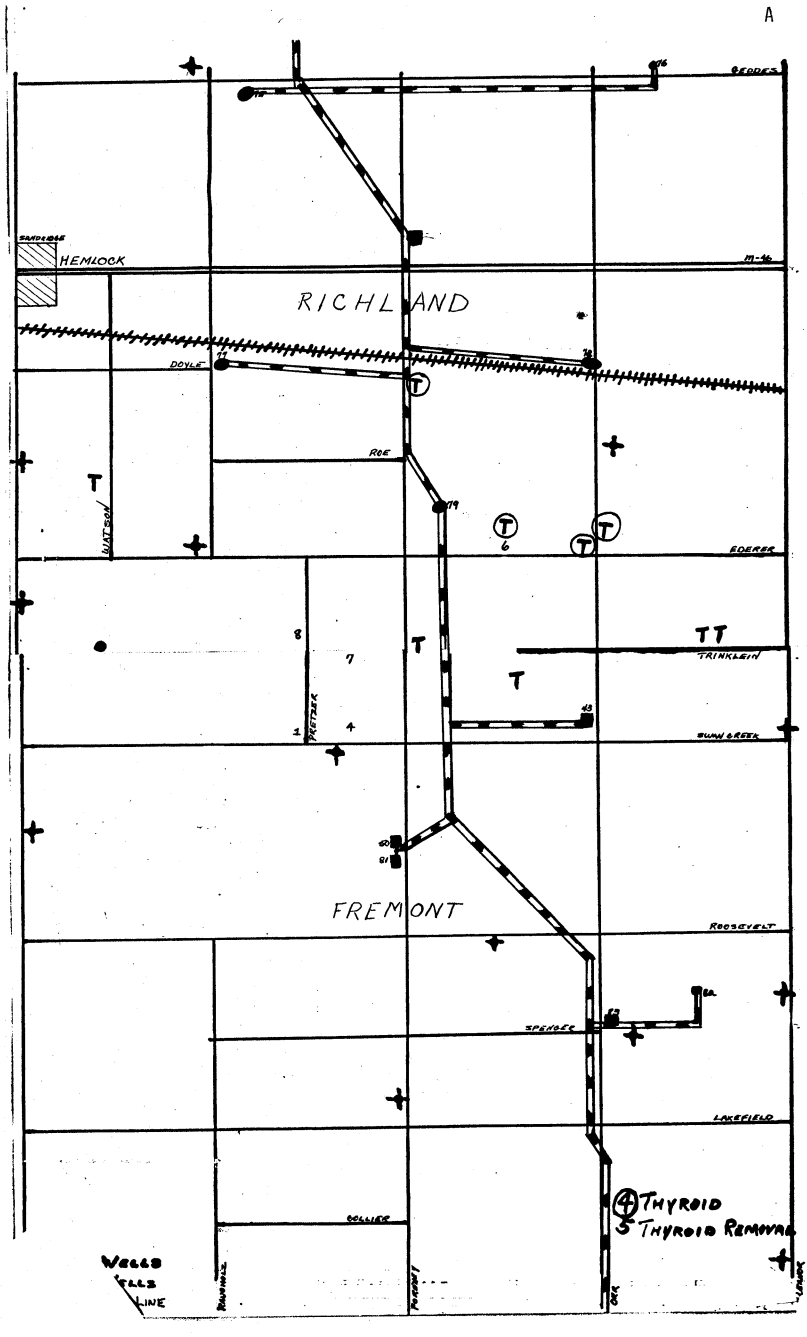
The D & C and the hysterectomies in the women, I cannot classify anywhere. Loss of toe and finger nails and hair loss and regular occurrences of rashes and boil-like eruptions are common. I believe toxic substances produce similar symptoms for the most part. Because of our individual genetic makeup and physical condition, the weakest areas are attacked differently, as the body attempts to rid itself of the foreign materials. The cancers, tumors, kidney removals, spleen operations, enlarged livers and heart conditions are all too common. Most residents that move away from the area have a general health improvement.

Two specified locations were selected in the area in an additional attempt to show what health problems are occurring. Out of a total of 127 homes, the residents are known in 50. Of those 50 homes, the listed ailments have been noted on the accompanying chart.[A53] The same procedure was followed on Sandridge Drive, a street in the village totaling 19 homes with 11 residents or families known.[A54]

The analytical data by the various state agencies, the ECMPDR material and application for funding, the additional research material and the health records and ailments of the area residents reveal my investigation to the present date, July 1, 1979.

In addition, I believe I should inform the Subcommittee of the importance of studies of groundwater migration patterns. Analytical study methods are available to monitor fluctuations in mineral content in groundwater sources, and these methods must be used consistently on a national scale to establish the connection between environmental conditions of the groundwater and their ultimate effects on human and animal health.

I am pleased to be here to testify today, and I will be glad to answer any questions the Subcommittee may have.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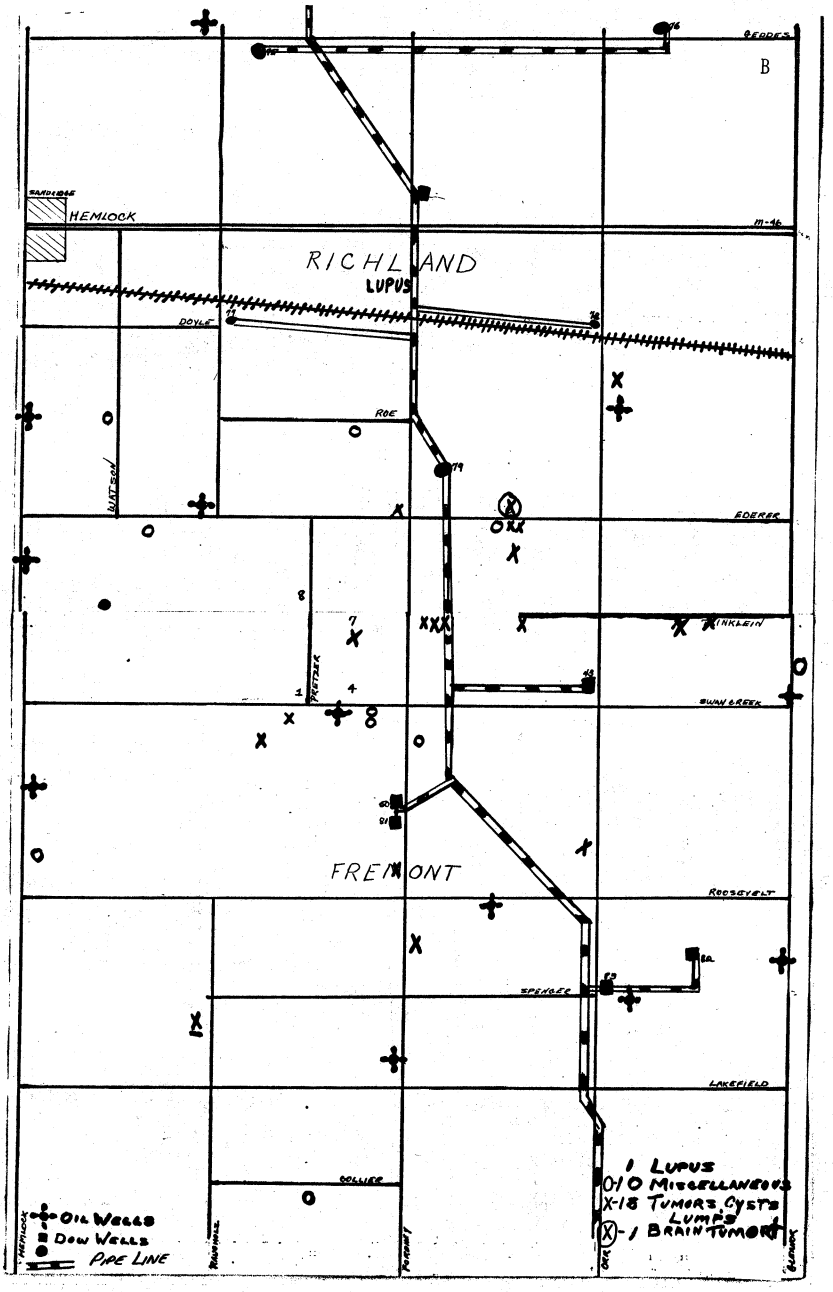
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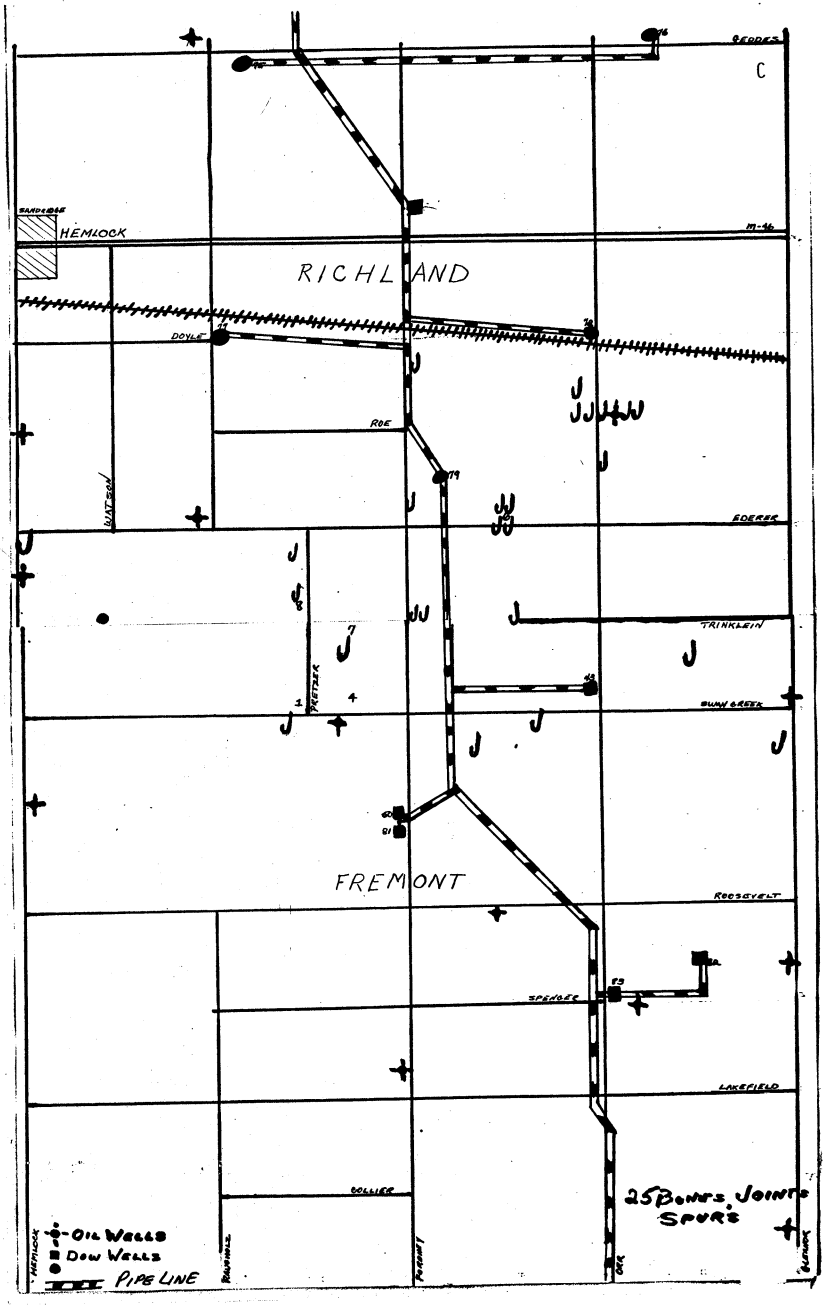
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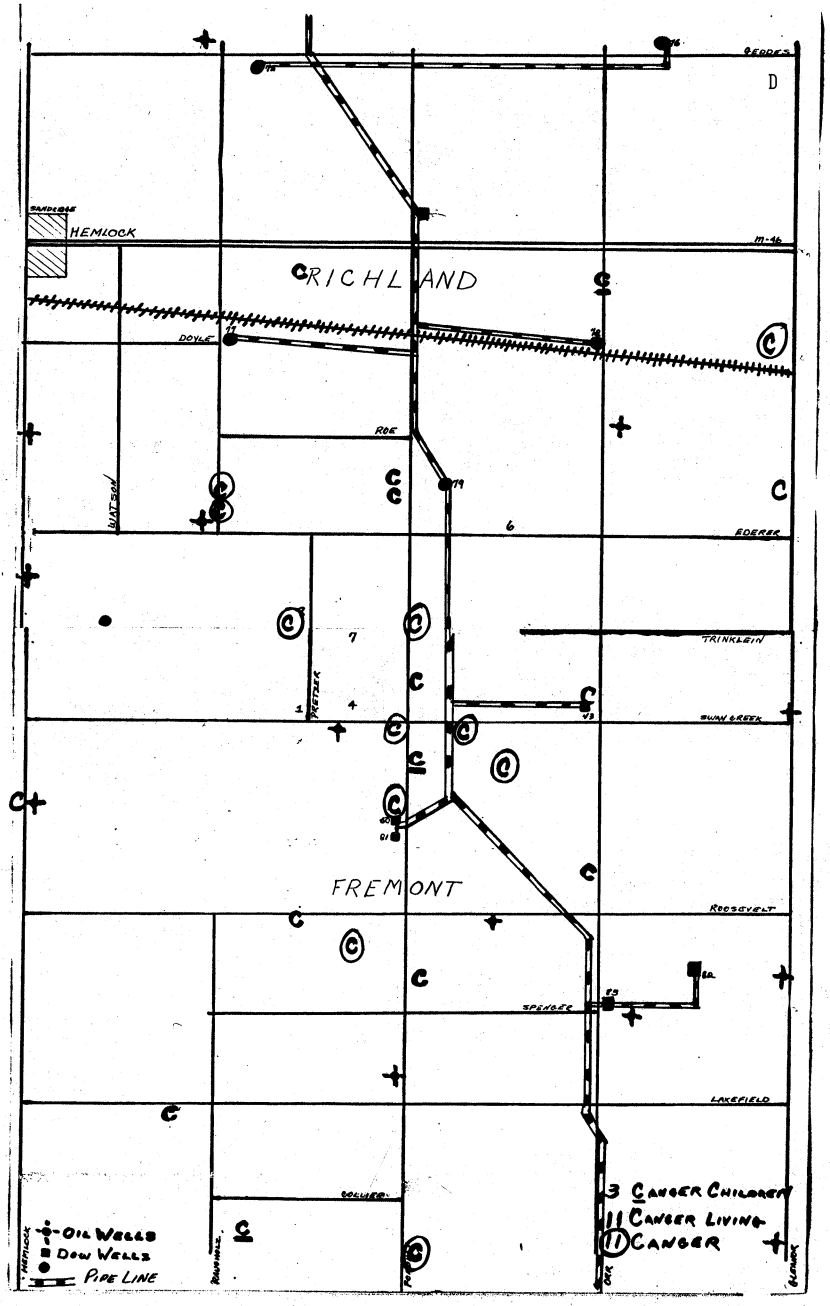
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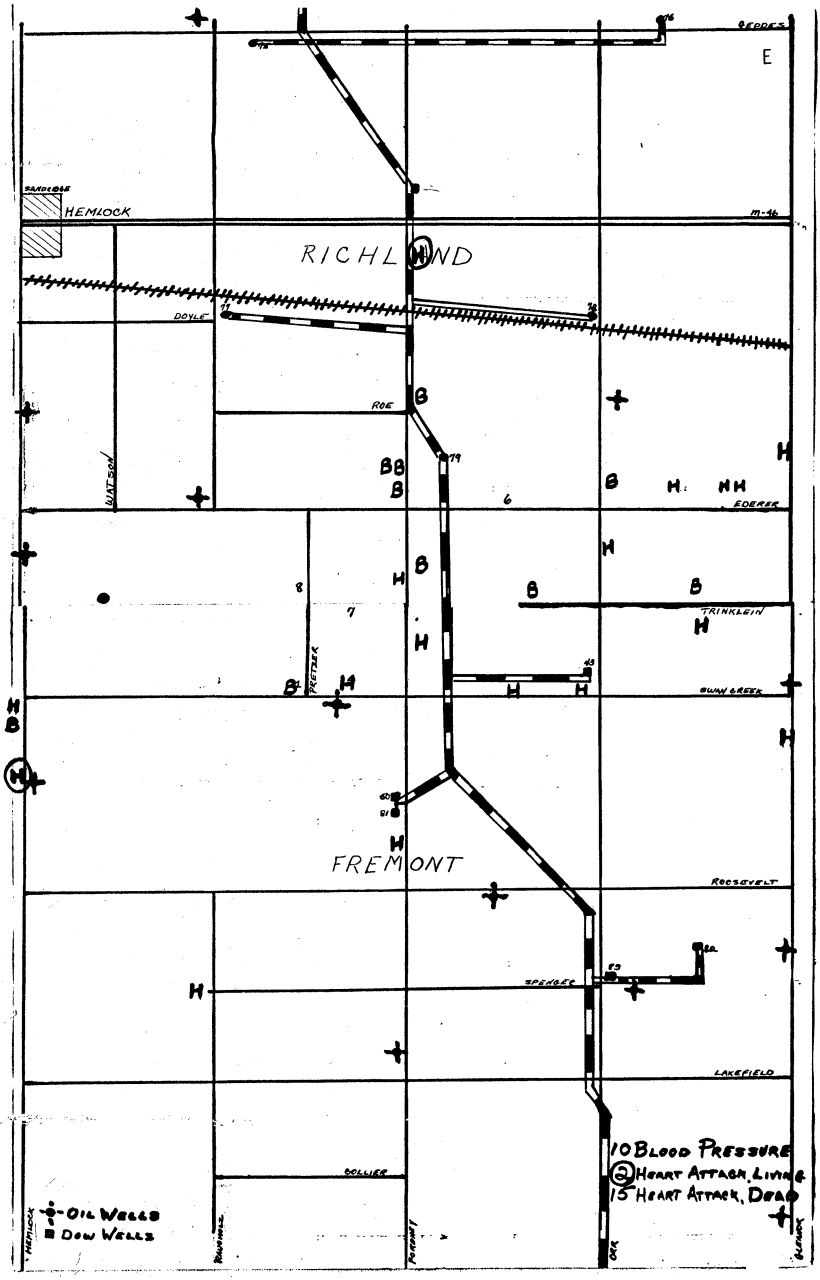
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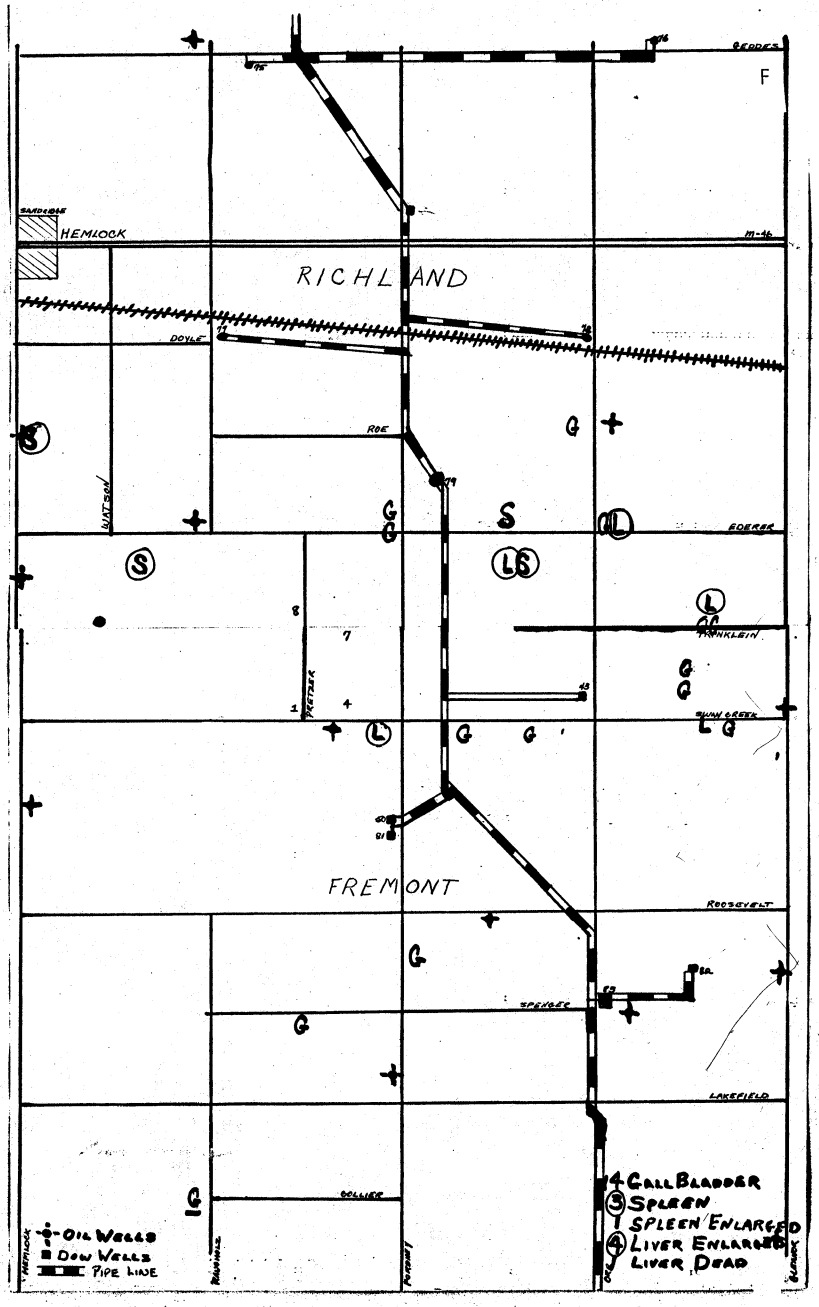
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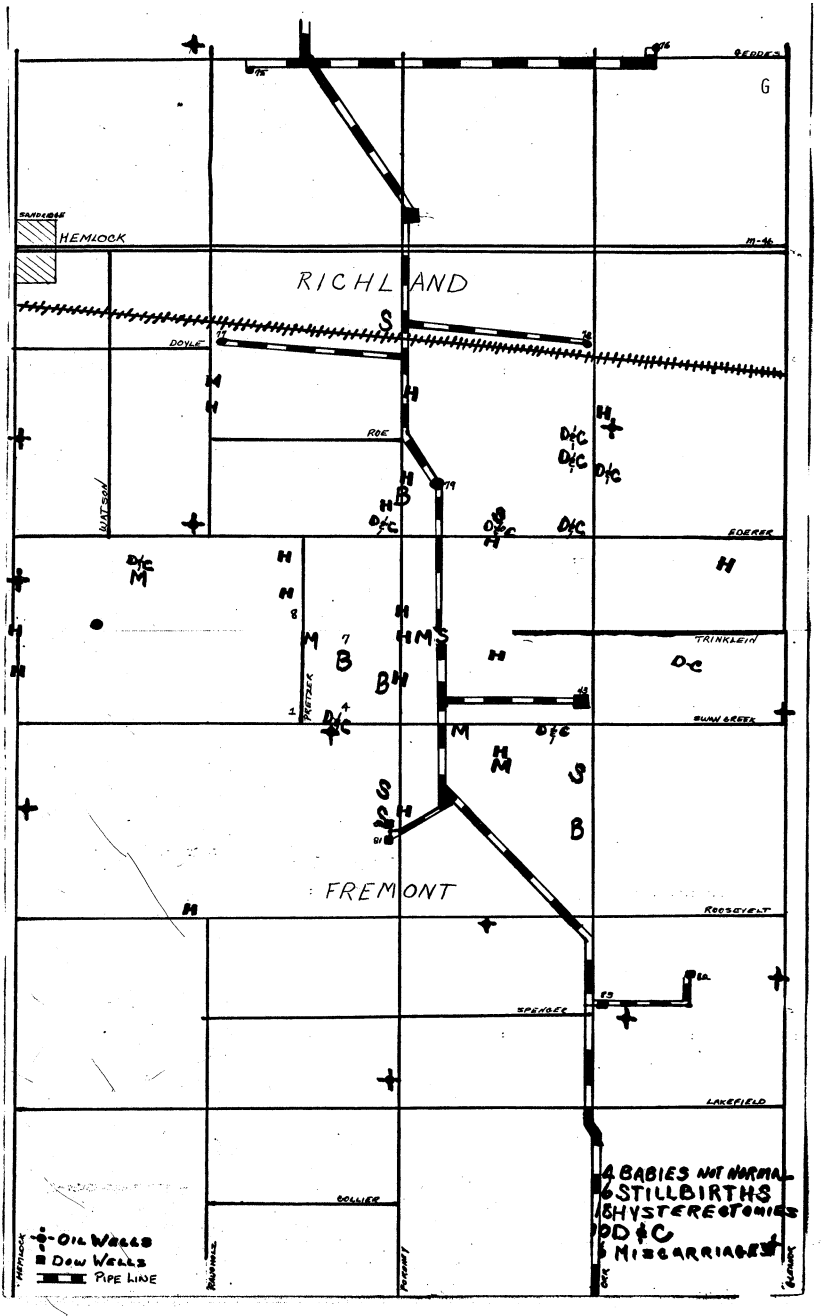
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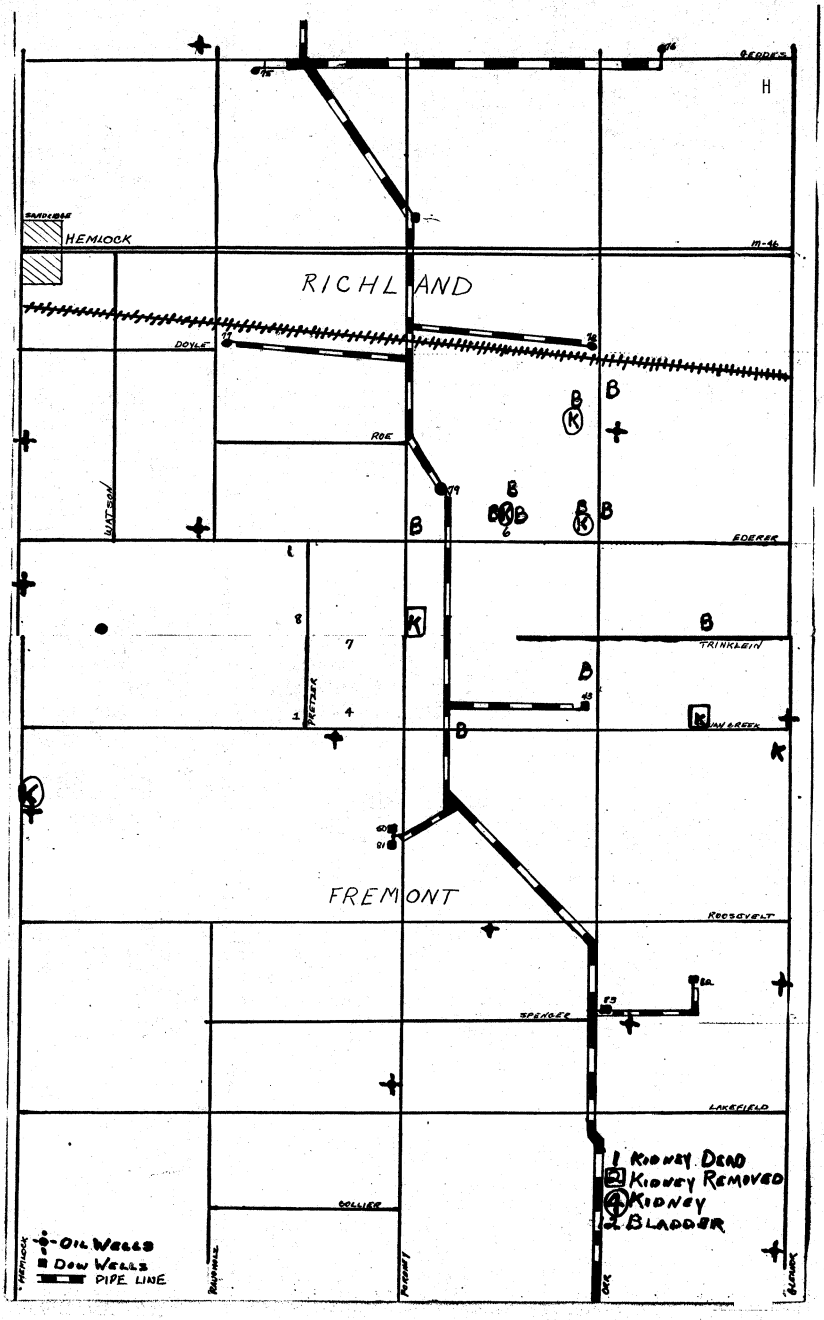
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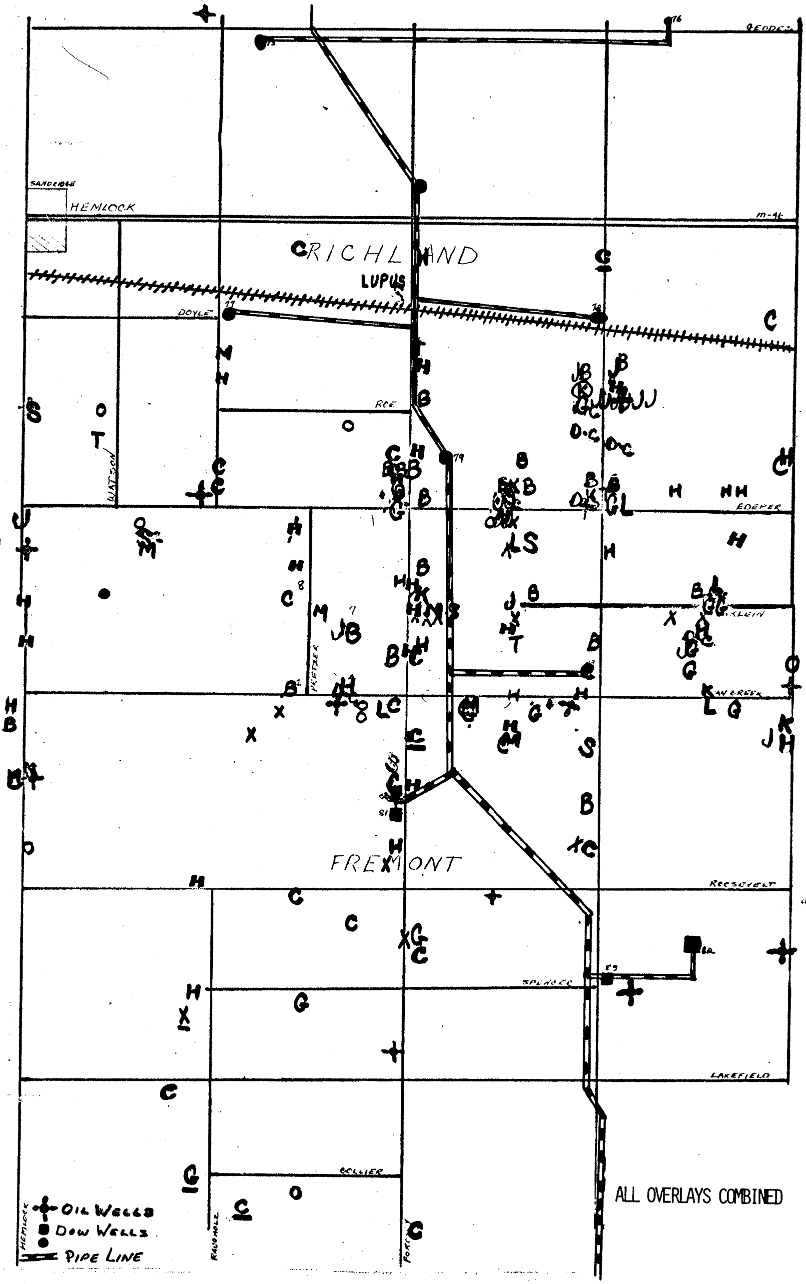
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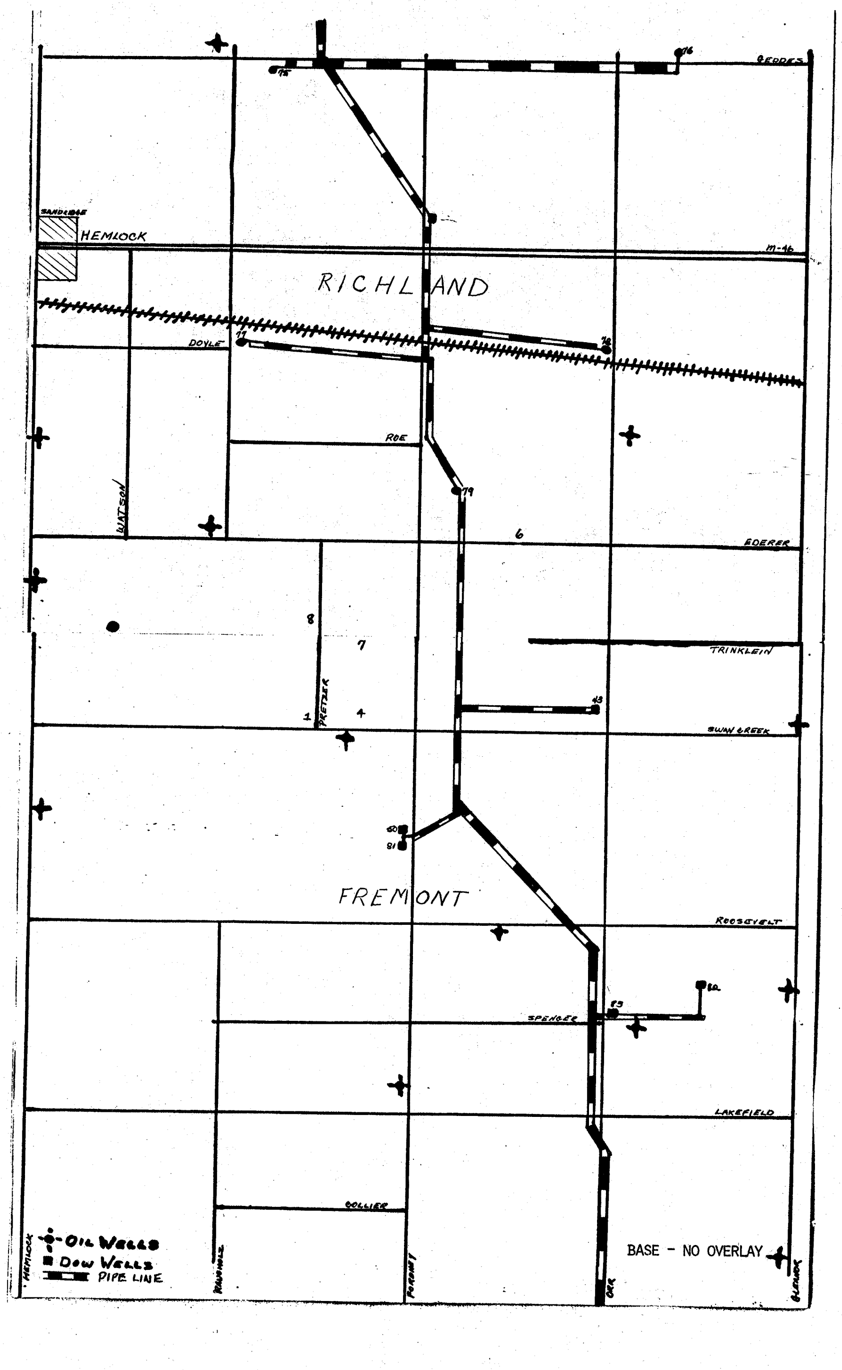
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PEOPLE in the news

6-6-1979

Capitol visit

On the nation's Capitol steps are (from left) Sen. Donald Riegle, D-Mich., Leonard Butko, and Mr. and Mrs. Butko of Hemlock. (UPI Photo)

Saginaw boy climbs steps on artificial leg

BY JACQUELINE TEARE
News Washington Bureau

WASHINGTON — On his fourth day with an artificial leg, 11-year-old Leonard "Coke" Butko of Saginaw walked up the steps of the Capitol.

The leg, which takes the place of a leg amputated at the hip in January because of cancer, "works good," Coke said.

"It does the job for me."

In Washington with his parents, Louis and Leona Butko, and family friend, Charles McNally of Bloomfield, Coke spent a busy first day.

He'd been told that if he walked up the Capitol steps, he'd get a chance to see the Senate, and see the Senate so he did. "The neatest thing was meeting a bunch of senators," Coke said.

Among them were Michigan Sen. Donald Riegle, whose office arranged activities in Washington, and who lunched with the family. Coke had steak and French fries and a hot fudge sundae in the Senate dining room.

Also on the agenda was a meeting with Massachusetts Sen. Edward M. Kennedy, whose son Teddy Jr. also had a leg amputated because of cancer.

Kennedy suggested that Coke's doctors and Teddy Jr.'s might consult on the Saginaw boy's situation.

And there was Sen. Carl Levin of Michigan and George McGovern of South Dakota and some others whose names he didn't remember.

That excitement over for the day, Coke was looking forward to a trip through Washington's Wax Museum, a special VIP tour of the White House and a trek through the FBI headquarters.

McNally, a real estate developer and old friend of Coke's father, expressed amazement at how well and how quickly the boy began working with the artificial leg.

"He walked immediately — without crutches or a cane," McNally said of the scene earlier this week when Coke first tried the leg. "And his doctors want him to demonstrate for other doctors how well he does because it's been so amazing."

Riegle, who spent 2½ hours with Coke, the Butkos and McNally, said the boy was "really doing spectacularly."

IS HEMLOCK BEING SLOWLY POISONED?

Are the people around this tiny Michigan town the unknowing victims of industrial pollution?

Photographs by Andrew Sacks

Mr. and Mrs. Jungnitsch at a reinjection well near their farm.

By Michael H. Brown

That something might possibly be askew in the old German farming community of Hemlock, a small Michigan town just southwest of Saginaw Bay, first occurred to Carol Jean Kruger. She lived on one of the area's largest dairy farms in a region of flatlands known for its cider mills and its bluegrass. "In 1974, things kind of started," she says. "But it took until 1977 for me to put it together. When we did, we could go back to 1969 and see the problem."

It was in 1974 that she bought 10 Holstein cows — only to watch, during the next six months, as two of them rapidly lost weight for unknown reasons, and died. Not long afterward, large clusters of calves began to succumb mysteriously. Forty of the animals died one year alone — and in a somewhat grisly fashion. Their teeth were stained lavender and brown. Their hind legs were grossly swollen while the bodies were rail thin. Open sores persisted on bald areas where the bristly hairs had fallen out in clumps.

Michael H. Brown, a freelance writer who lives in Niagara Falls, N.Y., is writing a book about toxic wastes.

Although many of the cattle had arrived at the farm boasting a healthy production record of up to 25,000 pounds of milk a year, their milk flow, once the animals settled down on the Kruger farm, was all but a trickle. Carol Jean began piling the revealing carcasses behind the central barn, to disprove the agricultural inspectors' first claims that parasites and poor maintenance must have been to blame. The display did little to sway the officials, but for Mrs. Kruger the exercise was an interesting one. She observed that the dogs would not eat the carcasses as they normally had. Occasionally, said Mrs. Kruger, the odor of "burnt brake linings, or spent carbolics" permeated the milking area, and the iridescent sheen of an oily substance coated small puddles of water outside, leading to jokes that the neighborhood was about to become rich from an oil strike.

Other animals fared no better. Rabbits had large tumors on their ribs and innards. Cats wandered away and disappeared. On the barnyard floor, in the meantime, several mice were seen dashing in concentric circles, then suddenly collapsing. Fancy pheasants, peacocks and chickens would not hatch from their eggs. Among the birds that did survive, two geese were born with their wings on backward. Two newborn Shetland ponies

developed hooves that curved upward like elf shoes. It all could have been a quirk of the genes, but to Carol it was unnerving.

Among those neighbors living in the 50 homes nearest to her, Mrs. Kruger said she counted 22 cases of bone and joint problems, 17 kidney and bladder difficulties, and 16 instances of lumps and tumors. She claimed that skin rashes and "teeth that crumbled like tissue paper" were also prevalent. After months of complaints, state and county health authorities sent a medical questionnaire to a sample group of 100 homes. The survey was not accompanied by physical examinations, and so it did not provide objective proof of the existence of the disturbances, or suggest their cause. Officials said that the survey uncovered more health complaints of rashes, dizziness, urine sugar, visual problems, limb numbness and other maladies in Hemlock than in a control group chosen in the nearby Michigan town of Blumfield. "It is apparent from the analysis that, for health problems as a whole, sex and age do not explain the differences between Blumfield and [the Hemlock] area," said state health director Dr. Maurice S. Reizen. He did not venture a theory about possible causes.

Because the problems were common to both animals and humans, Mrs. Kruger came to her own conclusion on the common denominator: Life around the area, she speculated, was being slowly and secretly poisoned from the water that was pumped from their wells.

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This week, the Senate Subcommittee on Oversight of Government Management is expected to consider the mystery of Hemlock during the hearings it will hold on hazardous waste disposal, and one of the witnesses will be Carol Jean Kruger.

The focus of the hearings will concern the problems at landfills, such as the one at Love Canal in Niagara Falls, N.Y., where 247 families were permanently evacuated from their homes when toxicants seeped into their basements from an abandoned chemical dumpsite. The Senate subcommittee is trying to learn why the environmental protection agencies in state governments have not responded more quickly to problems associated with chemical byproducts. Certainly, a major difficulty is funding. Indeed, on June 13, President Carter asked Congress to create legislation that would impose fees on industries to build up a $1.6-billion "superfund" over the next four years; the fund would be used to pay for cleaning up hazardous wastes and oil spills, and for recovering the costs from those responsible. But another problem for the investigators to consider is the sheer complexity involved in examining the perverse effects and identifying the problematic causes of what may be hazardous situations. Perhaps the Senators may not need to search much further for evidence than to consider the medical mystery at Hemlock, a town that is appropriately named.

Carol Jean Kruger's water well: she believes it to be tainted.

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Virtually all of the thousand or more people in and immediately around Hemlock drew their drinking water from several wells only a short distance from the Kruger farm. Many of them had noticed, during the past several years, a difference in its taste. It had always been brackish in nature, but the saltiness seemed to be increasing all the time, and once in a while, it tasted a bit like cleaning fluid. In their sinks and bathtubs were darkening stains where the water most frequently splashed against the porcelain. For these reasons, Mrs. Kruger began distilling her well water and passing it through charcoal. She believed that as a result, her complexion, which had recently turned yellowish and scaly, was markedly freshened. She recommended the same process to her ailing neighbors, who soon experienced fewer headaches and fainting spells, and felt less nauseated.

By the time one family subscribed to the method it was almost too late. Ed Jungnitsch, a thin man with a folksy smile and an unquenchable thirst, was picking up stones in his yard one Saturday in September of 1976 when he began to ache all over his body. Returning to the kitchen, he quaffed two quarts of water. That night, at a gathering with friends, his mood turned uncharacteristically irritable. "Ever[illegible] everyone in [illegible] was against him," in his wife Kathryn's words. The following Sunday morning, Ed sprawled on the living-room sofa and stayed there all day, immobilized with pains in his extremities and the same splitting headache he had carried throughout the previous day. By nightfall, Kathryn felt the need to take him to St. Luke's Hospital in Saginaw.

One of Hemlock's deformed animals: a skew-winged goose on the Jungnitsch farm.

It would be 50 days before Ed left the hospital. His speech had turned progressively incoherent, and by the end of the first week he had become totally paralyzed. Eventually he improved to the point where he could use a walker.

Not long after Ed's inexplicable collapse, Mrs. Jungnitsch found a lump under one of her arms and watched, during the next six months, as lumps spread to her groin, neck and the base of her skull. Only after great difficulty did the doctors reach the diagnosis of hypoplasia of the lymph system – possibly cancer. Nor was the rest of the household without medical discomforts. The two children, Jennifer and John, had bouts with skin rashes, constant tonsillitis, lethargy and headaches. By two years of age, John's backbone had still not properly fused. "We talked with Carol Jean, and bought a distiller," Mrs. Jungnitsch recalls. "Ed got better. He's to work now. We all got better. My 'cancer' disappeared. After a while the doctors suspected the water." From the filter in the distiller, Mrs. Jungnitsch regularly removed a viscous residue and tossed it on one part of the lawn. Soon, no grass would grow there.

There were other unappealing parallels to what had happened on the Kruger farm. In the Jungnitsches' back lot was a pen with four geese that honked loudly. One of them appeared as if it had spikes piercing from the feathers where the wings should be. In actuality they were deformed wings, facing the wrong way. "You think that's something?" asks Mrs. Jungnitsch. "How about the chicks? We had chickens, and some geese, too, born with their guts on the outside. About 44, in all." Down the road, Gary Kricher told of a rabbit he had taken that had green meat throughout the edible parts. Another neighbor lost a small herd of cattle to a strange affliction similar to the symptoms Mrs. Kruger had witnessed.

On Feb. 8, 1979, the Michigan Department of Public Health sampled the Kruger wells, finding a high level of salinity but "no connection between the described health problems and the water supply." It was

not that the state was immediately discounting the bizarre reports. The technicians were well aware of the capricious nature of ground water — how its quality and composition could fluctuate from time to time. However, there was no laboratory result to account for the health difficulties — and so the problem has continued to be undefined.

The county's health officer, Dr Senen L. R. Asuan, was less inclined than state officials to say that there was a problem. Although he did not discount the anecdotal accounts of illness, he saw no need for extensive study beyond what had already been carried out. "We consulted a physician there [in Hemlock] and he didn't know the answer either," says Dr. Asuan. "There is nothing medically tangible there. We are sitting tight and seeing what else is in the area — looking for more reasons to go in and do more of a survey. So far, we don't have any plans."

Still suspicious of the water, and dissatisfied with the governmental response to their requests for an extensive investigation, Mrs. Kruger and the Jungnitsches took it upon themselves to have their wells tested by an independent laboratory, Raltech Scientific Services Inc. of Madison, Wis. This time, laboratory researchers found diethyl ether and low amounts of toluene, Freon-extractable oil and grease, and trichloroethylene — a substance that causes liver cancer in mice — in the water. While in theory the compounds were capable of wreaking many of the reported ailments, the quantities were not great enough to cause a noticeable impact. Nevertheless, an important question remained: What were these solvents and industrial substances doing 200 feet below the surface, in a farmland aquifer — the underlying rock, sand and clay deposits that formed the underground reservoir storing the water?

Only after the residents informed the state of their analyses did the Michigan Department of Natural Resources (D.N.R.) initiate its own well samplings. In some tests the department tracked toxic compounds such as carbon tetrachloride, aromatic amines, phthalates, PCB's (polychlorinated biphenyls, highly toxic substances used to insulate electrical equipment), and an unidentified halogenated chemical, but they were at mere trace levels. Secondary tests failed to even confirm their presence. "It's something that could be missed, I suppose," says Robert Courchaine, director of the D.N.R.'s water-quality division. "You may not find it today, and it may have been there yesterday or last year. But right now, we have no reason to believe there is widespread organic contamination of the aquifer." Having spent seven days testing some of the Hemlock wells, the water-quality division decided to halt its analyses in order "to spend more time on problems we know about," according to Andrew Hogarth, chief of ground-water compliance, who described Hemlock as a "quandary."

What the state, in its review of the situation, did *not* look for may be as important as what it did search out. No formal study was made of the exact ground-water patterns of the area. No regular surveillance program was instituted to check for sudden variations in contaminant levels. The technicians also had failed to sample well-bottom sediment, where any industrial compounds that may once have infiltrated the aquifer would have accumulated and lingered the longest.

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Dotting the entire Hemlock area is a cluster of industrial wells used through the decades to extract oil and brine from the limestone, shale and dolomite below. In the vicinity of the Kruger farm, there are at least 14 such borings, and more in localities nearby. Most important are the brine wells. It was because of them that, in 1897, Herbert Henry Dow took an interest in founding a chemical company 17 miles to the north, in Midland, where it was to grow into one of the 10 largest chemical concerns in the nation. From brine wells in the Hemlock area, the Dow Chemical Company extracted sodium, chlorides, bromine, magnesium and other ingredients vital to the chemical industry.

Once spent, it is necessary to dispose of the brine, and Dow decided that Hemlock would be a logical place for that operation too. Pipelines were installed to carry the salty wastes into reinjection wells, sending the useless and contaminated brine back into what is known as the Dundee Rock Formation, 2,500 feet or so below the potable water supply. There were at least four reinjection waste wells along the two roads parallel to the Krugers' street, two within a mile of the problem-plagued farm. In the two, Dow was reported to have pumped between three and seven billion gallons of spent brine. The discharges had stopped several years ago, except for sporadic usage, it was claimed. One well was operated in October of 1978, but was closed by the state's Geological Survey when con-

cerns arose over the troubled reports from Hemlock.

There was no evidence that Dow's waste wells were contaminating the drinking water. In fact, state geologists considered it unlikely that the spent brine, pressured below a thick partition of shale, could migrate upward to the point where it would taint the drinking wells. But no one knew if there were fissures in the shale, and the existence of the old oil wells — some of which may not have been properly capped — raised the possibility, according to the state's report, that waste liquid had risen up through them, bypassing the shale on the way to the surface.

The state of Michigan was unsure about exactly what was in the "spent brine," or whether other wastes had also been injected. While Dow maintained that nothing more than the spent saltwater had been sent into Hemlock, the state said only that "we have no information about the nature of substances injected previous to 1974 or of the nature of the production brines." To find out more about the Dow waste, the Senate subcommittee has sent the company a letter requesting specific information on its reinjection wells.

There was concern over what else may have found its way below, for Dow's Midland plant manufactured or used as intermediates dozens of highly toxic compounds, including tetra dioxin — widely described as one of the most dangerous substances ever synthesized by man — a byproduct in the manufacture of Agent Orange, the herbicide that was used in Vietnam. Tetra dioxin accompanied wastes from Dow's manufacture of trichlorophenol herbicides. State investigators say trichlorophenol waste was injected underground at Dow's Midland site itself. Dioxin had already been detected in fish in the Tittabawassee, the river not far from Hemlock, but state investigators had seen the need neither for testing for dioxin itself in the wells (the D.N.R. said such sampling was expensive) nor in coursing the flow of ground water from the Midland plant.

Disagreement has long festered over the safety of deep-well injection of hazardous wastes. It is considered by some governmental regulators and industrialists as the most responsible way of handling chemical or radioactive garbage, far better than the use of surface landfills and more economical than neutralizing the wastes. The critics decry the method as the equivalent to sweeping debris under a rug — sending material into a layer of land

'I'm convinced that these people sustained some environmental damage,' Dr. Walbott said. 'But it's hard to hang a hat on one substance.'

where no one can keep track of it.

There are now perhaps as many as 400 injection waste wells in 22 states. While the United States Geological Survey finds the disposal technique acceptable, the states of New York and New Jersey, among others, totally ban their use. There have been some problems with the wells. In Colorado, at the Defense Department's Rocky Mountain Arsenal near Denver, the pressure of materials in a 12,000-foot injection well caused small earthquakes; the well had to be capped. In Erie, Pa., an injection well suddenly backed up, to the point where wastes were spewing 20 feet above the surface, like a geyser; ultimately, four million gallons of wastes were spilled. Not long after the Erie episode, then Interior Secretary Walter J. Hickel described deep-well injection as a potential "Frankenstein monster."

Aside from the possibility that there was upward migration of Dow's spent brine, there was also the chance that pipelines transporting the wastes from Midland had leaked their contents near the surface and polluted the ground water. The brine pipelines had been known to leak in the past, and ran parallel along several of the roads where the loudest health complaints had been voiced. According to the state, there were 24 reported losses of brine from the Midland plant's pipelines between June 1977 and November 1978, including one spill of 24,000 liters. "We do not have complete records as to the numbers, locations and volumes of brine losses prior to May 1977," said the state report. "It is possible that significant losses may have occurred during that time period which are not documented." The pipes were buried about three feet below the surface. When the contents of one spill were analyzed, high levels of chloride and sodium were found, along with smaller amounts of Freon-extractable oil and grease, phenolics and fluoride.

Dow has sent technical experts to speak with Mrs. Kruger and they accompanied the state investigators during their 1978 well samplings. The company says the subsequent state study cleared the firm of any blame for the Hemlock problems and declines detailed comment on the matter. "There is no way we can win in a situation like this," says Dow spokesman Thomas Sinclair. "We've done everything humanly possible. There's nothing there."

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In June of 1979, a Warren, Mich., physician, Dr. George Waldbott, who specializes in health effects of the environment and has written two books on the subject, said he had examined eight people from Hemlock and believed they were being affected by chemical contamination. His "tentative diagnosis" was that some of them had been sickened by fluoride while others exhibited symptoms suggestive of PCB, phenol or bromide poisoning, or a combination thereof. "I'm convinced that every single one of them had sustained some environmental damage," he told me. "But it's hard to hang a hat on one substance. It's speculative. I'm reasonably sure Mrs. Kruger's condition is due to PCB's or PBB's because of the brown nails and skin pigmentation. ... I am really sure only that animals, especially one cow, with mottled teeth, were affected by fluoride exposure. But there are what appear to be clear-cut cases of fluoride poisoning in the people. On the other hand, more chemicals than fluoride appear to be involved. ... I would say that I wouldn't be at all surprised if these people had consumed a good deal of poisoned food."

It was Dr. Waldbott's concern that the fluoride content in the water, while not extraordinarily high, might be enhancing the toxicity of other compounds in the water; or the fluoride itself might be made more toxic because of the interactions of the compounds in the water. While the other substances he cited had been found at various times, the state did not think the levels could have been as damaging as Dr. Waldbott inferred.

Another possibility was that the people were suffering from toxic particulates in the air. "My main criticism with the state report was that, besides not testing for dioxin, there was no evaluation of the air," said Dr. James Truchan, of

(Continued on Page 100)

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the D.N.R.'s enforcement division. "I have no doubt the health concerns are real, but pinning it down is a very complex thing. . . . Hemlock is near an oil refinery in Alma, and the Michigan Chemical Company, which had to release bromides because it was manufacturing the PBB's."

Among those Dr. Waldbott examined was the Wiechec family, which lived near a brine pipeline about a half-mile from the Krugers. A combination of arthritis and bone growths, skin boils and other ailments had convinced the physician that illnesses out of the ordinary were occurring, possibly attributable to fluorides and bromides. The Wiechecs' property was along a stretch of unengaging fields crisscrossed by swales and drainage ditches that had a brownish appearance to them, and carried occasional flecks of oil. These and other ditches, claimed Mrs. Kruger, recently had refused to freeze over even in subzero temperature. In the spring, deep puddles of ground water flooded the Wiechecs' front lawn and driveway. "Carol Jean took a sample of our water and they said it was way too high in fluorides," she said. The state, however, had not checked her well.

Whether or not the Wiechecs had been poisoned by their water, it was clear the family had its problems. Irene Wiechec, at 40, found herself, like her children, continually plagued with rashes, sore throat and hard skin boils she called "corebuckles." She also related a history of six miscarriages and a partial hysterectomy. One of their children, Carl, had had a kidney removed; his other kidney was becoming sensitive, occasionally bleeding into his urine. A daughter, Rosemarie, missed much school because of kidney and bladder pains, and her mother said the child was embarrassed because her hair occasionally fell out in clumps. The other daughter, Becky, had an even more difficult time with teasing classmates. Several of her permanent teeth had been pulled because they were deformed — shaped like rabbit ears — and were made of black enamel. "The dentist just goes on shaking his head," Irene stressed. "It's something she can't help — and me, I can't help."

□

It may never be known what happened in Hemlock, or rather, what *is* happening there. There are fresh reports of similar distress among residents who live two miles west of the Kruger farm in the more populated section of town, including a stretch of several blocks on Sandridge Street where dizziness, limb numbness, skin rashes and internal aggravations have been reported. Perhaps all the cows had been smitten by parasites, and the people by a foreign virus, or maybe it was a simple case of bad chromosomes. Or perhaps a combination of coincidence and hypochondria had come into play. Or perhaps the air was fouled. Or, perhaps, these people were stung by a sudden slug of contaminated ground water that, during its subterranean caprices, infiltrated their pumps only to disappear soon after, without leaving much of a trace. The answers will be known only after months of intensive study.

But the state D.N.R. is busy with more tangible crises: there are the haphazardly disposed pesticidal residues in Montague; the drinking wells in Muskegon County that were contaminated by solvents from a defunct chemical warehouse; the cleanup in Livingston County, where a midnight hauler dumped 2,000 gallons of toxic paint thinners and defoliants; and there are many emergencies elsewhere. But in Hemlock, the county's health officer, Dr. Asuan, is still not convinced there is a massive problem. And while the state finds it all very odd, it is running out of new leads. "My experience is that I think there is something going on at Hemlock," says the D.N.R.'s Dr. Truchan. "Nine out of 10 times, when people complain like that, there's something to it. And they'll find it if they don't write it off." ■

Senator LEVIN. Mrs. Jungnitsch.

Mrs. JUNGNITSCH. Yes. My name is Kathryn Jungnitsch, and I am a resident of Hemlock, Mich.

Early in 1976 I began to experience flu-like symptoms. After repeated testing our doctor found that I was low in potassium. As the summer progressed our whole family became more irritable. You couldn't rest; you couldn't sleep. We began with the headaches. And in September my husband entered the hospital, and he was eventually diagnosed as Guillain-Barre syndrome. Later in the fall, as his condition worsened, I also began to feel sicker and sicker, and I attributed this to the terrific nervous tension that I was under. It began with a constant headache, numbness in the shoulders and the arms.

At Christmastime I found a lump under my arm. I immediately went in to the doctor, and he said it was an enlarged lymph gland and "Let's watch it."

During the course of the next 9 months, very slowly, I developed more enlarged lymph glands. I became more ill. And in the fall our doctor began again to run repeated tests, and in November of 1977 I was admitted to the hospital. During this hospitalization they removed some lymph tissue, and the diagnosis came back "probable lymphoma," or Hodgkins. This was sent to Ann Arbor for further diagnostic studies. Ann Arbor returned the same diagnosis. They at that time requested additional tissue.

So, in December of 1977 I again entered the hospital. This time the diagnosis came back as hypoplasia of the lymph system. But I continued to become more ill. They found that my spleen was enlarged, and it became very painful to ride in a car. At one point there was discussion of maybe spleen removal.

And as a last resort, Dr. Varner, who is our family physician in Hemlock, suggested, "Why don't we try distilled water?" And this is what we did. And it was about 10 days later, I got up one morning and I no longer had a headache, and very slowly the numbness and the prickliness left my shoulders, my arms, and my hands.

The next improvement that I could see was that you could rest at night when you went to bed, you could sleep. Very slowly, my lymph glands reduced in size and eventually disappeared. Very slowly, my spleen also reduced in size.

When we began, we could buy our distilled water, and after a very short period of time you could no longer go into the grocery store and buy your case of distilled water. It was at this point that we bought our own water distiller, and I thought, "We have it made now," however, the distilled water smelled; the water we were distilling was our own well water. This smell came through our distiller. We had this same sickening smell to the water.

The distilled water also tasted sweet, so a chemist from ERG in Ann Arbor suggested throwing away the first two cups that came out of the distiller and filter the remaining through activated charcoal. This eliminated the terrific odor in our distilled water.

At this point we privately had our distilled water tested, and it showed eight parts per million organics. At one point the DNR and the Dow people did a joint water testing, and one of the Dow men sat at our house waiting for our distiller to put out its first two cups be-

cause they wanted to check this. He told me that you could not distill out phenyl, and, hopefully, by running it through the activated carbon, it would, you know, remove the phenyl.

Also, during that summer, I threw the residue from our distiller out onto our lawn, and we killed the grass.

The DNR tested our water and found aromatic amines. At this point the DNR asked Dow to shut down their disposal system in our area until things cooled off. After the wells were shut down 1 month, the DNR and Dow tested the water jointly. After the report had been mailed to us, we received a letter from the State indicating they had found arsenic in our well.

The DNR stated on television during a local panel discussion that the second time they had tested the Jungnitsch well they had found no trace of the aromatic amines. They failed to mention that they had found a volatile hydrocarbon, instead.

When we asked the DNR, "What products are these," they said they could not identify either material.

At this point we wrote a letter to Dr. Tanner, inquiring about the mass spectrometer that was inoperable. We received an answer from James Bedford, indicating the levels found in our well were probably too low to be identified.

The DNR also did a Daphnia study. It showed that the Daphnia were unable to live and reproduce as expected. Why wasn't this pursued further?

Early this year Carol Jean and I hand-delivered a summary of the health problems in our neighborhood to Dr. Isbister, State public health officer. He was not in his office, but his secretary assured us he would call us. He never acknowledged receipt of this summary.

Dr. Bloomer, who is in the public health testing laboratory, told me on the phone in early spring of 1978 that our blood PCB level was due to our fishing the Great Lakes and eating our catch. We are neither fishermen nor fisheaters.

Our blood also showed DDT, DDE, and PPB.

He also told me during that phone conversation that if only four people out of every 1,000 died because of environmental contamination, it was considered safe. I don't want one of mine to be one of the four.

Thank you for this privilege.

[Material submitted by Mrs. Jungnitsch follows:]

SUMMARY OF FAMILY HEALTH PROBLEMS IN THE HEMLOCK, MICHIGAN AREA

by Kathryn Jungnitsch

July 19, 1979

July 19, 1979

Mr. Chairman:

I have attached a brief summary of my family's health problems, both past and present. Due to the severity of our problems, as well as many of the other residents of the Hemlock area, I feel we are at a point where we need effective help. We have not been able to obtain satisfactory answers to our questions at both our local and state levels.

I would be happy to answer any questions you might have on this material.

1963 - Birth of baby boy - died (see post mortem report).

Jennifer 1968 - Birth of baby girl. Heart murmur. Formula did not agree with child. Put on soy-bean milk. Helped the vomiting. Colic continued.

About age 1-1/2 years, she was hospitalized - possible cystic fibrosis - enzyme lacking in stool. Tests negative. Loose bowels continued. Eventually cleared up.

About age 4 - Tonsillitis began. High temperature - sores in mouth.

Flu-like symptoms continued. Rashes that came and went.

About age 6 - permanent teeth came in behind baby teeth.

About Age 7 urine irritation began. (Still has problem - has gotten progressively worse - sores on bottom.)

About age 8 headaches begin - severe enough to cause vomiting. Headaches eventually became daily. Pains in stomach - come and go.

Age 10 - hospitalized with suspected appendix - negative.

Allergy tests - Doctor disregarded results (allergic to lamb as an example).

Tonsillitis worsened. Had her tonsils removed Fall, 1978. (We have the tissue saved.) Long recuperation. Hemorrhaged about 10 days after surgery. During this hospitalization they investigated the heart murmur. Found it was a valve problem.

Summary: Jennifer has had head-aches, skin rashes, flu-like symptoms most of her life. Since she changed water, all of her problems except the urine irritation and lack of stamina have improved significantly.

John 1970 - Birth of baby boy. Appeared normal and healthy. Very active.

About age 2 bladder infection. Hospitalized - urologist could find nothing wrong with bladder. Skeletal X-ray showed the spine had not fused yet.

About age 3 - extremely active (put on ritalin). Still could not control bladder - wait.

Skin rashes begin. Tonsil and ear problems. Had tonsils removed. Ear problems were corrected.

Taken off ritalin.

Age 5 - enters school. Had to be put back on ritalin. Went to bathroom many times during day (urinated small amounts many times).

Teacher asked if John had seen a doctor about problem.

Many rashes (worse on bottom).

Age 7 - put back on Tofranil to try and improve bladder capacity. Severe reaction to medication.

Age 8 - allergy to bee stings - currently on allergy shots for same.

Complained of leg and joint pains (I put it to growing pains).

Hit knee. It swelled up and became very red within 24 hours. Took him to emergency room. X-ray found he had bone growth in right knee (see X-ray report for John).

Had to take John off ritalin because it began making him worse.

Summary - John has had a short attention span and all problems associated with it, skin rashes and bladder problems his entire life

Edwin Jungnitsch

Always in good health until early summer of 1976 - flu-like symptoms, muscle weakness, up-set stomach, head-ache, back and joint pain. Went on vacation to Colorado late July - symptoms disappeared. Returned home - symptoms re-appeared. Had to lay on floor to put his shoes on; could not bend. No appetite - didn't want to eat.
Sept. 12, 1976 - severe head-ache and joint pain.

Sept. 13, 1976 - severe head-ache, joint pain and center toe on each foot numb - entered hospital. (Mono screen positive.)

Paralysis began. By end of first week he was completely paralyzed. Diagnosed Guillian Barre'. After a couple of weeks his breathing became affected although he was never on a respirator. He lost his memory, much weight and muscle, lost lots of hair. Paralysis continued about 3 months. Finger and toe nails developed cross-wise ridges. Bothered by severe sweating.

He was released from hospital day after Thanksgiving walking with a walker. Still no appetite. Still had problems sleeping.

After he returned home swelling of feet and legs began. Doctor told him not to drink well water for awhile. Hauled Saginaw City water for about 3 months - quit when he seemed to improve. Joint pain continued. Summer of 1977 his improvement slowed. Doctor told him he would have to eat better if he ever expected to get better. There was nothing wrong with his diet - well balanced.

It seemed like he would improve and then back-slide. This went on for over 2 years.

Developed bladder trouble - the medication made him sick to his stomach.

During his recuperation he suffered with severe constipation, sores on tongue, sweating, loosing hair, severe back aches, leg cramps, etc.

He returned to work February, 1978. He was drinking a combination of city and distilled water - fingers went numb. June, 1978 he developed some sort of throat abscess - lost 3 weeks work getting over that one. After that he began carrying distilled water to work.

He has been on distilled water for just over a year. His back and joint pains are significantly improved, as are the sores on tongue (less frequent). His feet remain numb, he continues to lose hair, he has constant constipation (never had any problem before he became ill). For some reason the nerves are not regenerating. We believe too much nerve damage had been done.

He has gained extra weight and lost the bloat in his stomach.

Kathryn Jungnitsch

History of allergies (ragweeds, pollens, yeasts, molds). Some gall-bladder trouble. Always considered myself a healthy person.

1973-74, bladder and kidney problems. Eventually had bladder surgery (urethra closed). Reaction to anesthesia.

Bleeding problems - hysteroctomy (no tumor) - 1974-75.

1975 - bowel problems - bleeding from bowel. Pocket formed in bowel. Pocket burst.

1975-76 - Extreme fatigue, head-ache, flu-like symptoms. Problems with eyes, especially at night (driving). Blood test showed low in potassium. Slow K helped the fatigue. Fall of 1976 - plain sick. Blamed it on nerves as husband was extremely ill during this time. Could not get restful sleep. My double teeth fractured during this time.

January, 1977 - Lump appeared under left arm. Doctor observed lump during next several months. More lumps appeared under other arm groin area, neck and scalp. Headaches and extreme fatigue continued. Tingling and numbness in the shoulders and arms.

Hospitalized November, 1977. Slight temperature and sore throat (mono screen negative). Rash on stomach. (Blood tests erratic.)

Surgeon removed lymph glands under left arm. Local pathologists said lymphoma, Hodgkins. Tissue sent to Ann Arbor. Ann Arbor tests came back with suspected lymphoma, Hodgkins. Wanted more tissue. Re-entered hospital. Surgeon removed lymph tissue from under right arm and right groin. Tissue sent to Ann Arbor. Diagnosed hyperplasia of the lymph system.

During this time my spleen was found to be enlarged. Became very sore during the next few weeks. Very uncomfortable to ride in a car. Possible surgery discussed. Took temperature at 12 hour intervals - somewhat low. My health continued to deteriorate. Doctors simply didn't know what was wrong with me.

As a result of Mrs. Kruger's discussions, local doctor suggested trying distilled water. This was about February, 1978.

About 10 days later the tingling and numbness began to go away. I got up one morning and my dull head-ache was gone. It took several weeks before the fear of the head-ache returning left me. During the next several months my lymph glands and spleen slowly reduced in size (the lymph glands actually disappeared except for one under left arm and it softened). I began sleeping and resting at night. My hair thickened. My health slowly improved. I actually could say I felt good after years of plainly not feeling well.

I still have an occasional day when I don't feel just right, but it is gone the next day. I no longer have to go to my local doctor and say "I just don't feel good."

Summary - We as a family went through periods of extreme (mood changes) irritability (1975 - 1978). We had no problems to justify this irritability except we didn't feel well.
We, as a family, also have problems with antibiotics and anti-histimines. We experience the side effects. Very few our bodies can tolerate.

Richard & Adeline Dommer (my parents - live right behind us)

Adeline Dommer - 4 to 5 years ago began problems of degenerating bone in hip. August of 1977 she had slight stroke. After much testing they found she had a brain tumor. It was removed - not malignant. She had many problems (reaction to medicine, bone infection) during her recuperation.

Richard Dommer - 1978 had prostate surgery. Recuperation was rapid.

Both parents are bothered with arthritis.

Dated July 11, 1979.

Kathryn Jungnitsch

Kathryn Jungnitsch

ST. LUKE'S HOSPITAL
SAGINAW, MICHIGAN
POST MORTEM REPORT

Patient Male Infant Jungnitsch Age SB LAB. No. A-1181
Physician Dr. Gaisterer
Exam. by John Young, M.D. Hosp. No. 78882 T.O.A. 7/11/63 10:55 p.m.
T.O.D. 10:55 p.m. 7/11/63 T.O.P.M. 8:30 a.m. 7/12/63

PROVISIONAL AUTOPSY DIAGNOSES

CONGENITAL HEART DISEASE - HEART FAILURE

1. Massive edema of subcutaneous tissues.
2. Ascites, (bile stained).
3. Hepatomegaly and splenomegaly.
4. Congenital malformation of heart:

   simple ventricle,
   simple atrium, (cor biloculare).
   absence of interventricular septum.

Photography: whole body,
liver, spleen,
heart.

NOTE

Postmortem examination of blood:

direct coombs - negative
blood group A
C- c+
D- e-
E+

probable genotype CDE/cde
bilirubin - to be determined.

The appearance of the heart and results of the laboratory examination of the blood indicate a cardiac origin for the edema rather than inter-group incompatibility.

John Young, M.D.
Pathologist.

Rose Wiechec

Feb. 1973	Operation on her big toe.
Aug. 1973	Operation on one foot.
July 1974	Operation on both feet.
Aug. 1975	Operation on both feet.
June 1976	Operation on one foot
Nov. 1976	Operation on one foot
Oct. 6, 1977	Operated on left foot and toe.

She has had a sore throat so long I can't begin to tell you about it. She is going to the hospital in August to have her foot operated on again. She has a skin rash that we just can't get to go away.

Carl Wiechec

He had to have his right kidney removed in Oct. 1977. He got big sore, and we get cores out of them that you wouldn't believe and you can't break them up. Since May of 1979, he has been on Tegopen 250 mg. 4 times a day, and he is still on them because we had to take him to the hospital because he had to have a shot of penicillin because his eyes were swelled shut from these sores.

Leonard Wiechec

He got these sores also in his nose, and he couldn't breathe so we had to taken him to the hospital also in April 29, 1979.

Becky Wiechec

She has sore throat all the time and she has black teeth and her last teeth are also turning black.

Irene Wiechec

Nov. 1973	Had big toes operated on.
April 1974	Blood clot out of my right heel.
May 1975	Operated on left big toe to remove nail.
Nov. 1975	Operated on right big toe to remove the nail.
Dec. 1976	Had an operation to remove cartlige in my right knee.
April 25, 1979	Operated on my right foot which is not all right yet and big toe.
Feb. 20, 1974	Had a hysterectomy and didn't get all better for 6 weeks.

I also get these sores and they made my sugar go high. Sore throat also. I have arthritis very bad.

By Irene Wiechec, July 19, 1979

Patient,

Madeline Oeder

350 Sandridge
Hemlock, Michigan

Age: 34
Resident of Hemlock since 1974;
Health excellent prior to 1974.

1975 Two D&C, 1 miscarriage, bowel trouble, skin rashes

1976 Bladder infections, skin rashes, swelling of knee, numbness of arm, vision problems, dizziness, heart palpitations, respiratory distress, low blood pressure, anemia.

1977 Hospitalized for 5 days; total weakness in muscles, swollen joints, paint below left rib cage, bloating, weight gain, back pain, heart palpitations, low blood pressure, breathing problems, dizziness, vomiting, tiredness.

1978 Above conditions worsened; developed allergies. Taken to emergency. (That summer I moved up north for 3 months and conditions started improving. Fall of 1978, went on distilled water.

1979 Experiencing hair loss, but condition is still improving slowly.

Results

A low serum calcium level with a high tissue calcium was found. Off balance with the zinc, copper, and iron. This calcium contamination produced a condition unfavorable to bone stability.

Patient has a sensitivity to race molds.
Deterioration of the lower spine and neck area.
White blood count at 3,600.
Minimal brain waves.
June of 1979 - Blood test showed arsenic found in patient blood stream at a level of 8.07 miograms.

Patient,

Kenneth Oeder

350 Sandridge
Hemlock, Michigan

Age: 35
Health Excellent to 1974

1976 Pain in leg, extending up side.
Growth on back of neck.

Patient

Bridgett Oeder

350 Sandridge
Hemlock, Michigan

Health Excellent to 1974
Age: 14

1975 to 1979	Numbness in arm, swollen knee, skin rashes, enlarged lymph nodes, headaches, sore throat, discoloration of skin, flu symptoms, general fatigue, unstable condition of bones, sores in mouth, vision problems.

Patient

Kendra Oeder

350 Sandridge
Hemlock, Michigan

Age: 10
Health excellent to 1974.

1975 to 1979	Skin rashes, sore throat, swollen glands

Doctors records are available.

Madeline Oeder

Senator LEVIN. Thank you, Mrs. Jungnitsch.

I believe, Mrs. Kruger, you referred to a Department of Public Health study of the Hemlock area. Is that correct?

Mrs. KRUGER. Yes.

Senator LEVIN. One of the conclusions of that study, which we will make a part of the record, is that the Michigan Department of Public Health, in cooperation with the Saginaw County health authorities, were struck by the greater number of health complaints from the Fremont-Richland Township area than from comparable township areas.

The Fremont-Richland Townships area is your area, is that right?

Mrs. KRUGER. That's right.

Senator LEVIN. The Department of Health indicated they were unable to establish a link between the complaints and the private well water. The critical finding, at the moment at least, is that they did find a greater number of health complaints in your area.

Do you know whether they made laboratory studies as part of their survey?

Mrs. KRUGER. There were no laboratory studies or no physical examinations. Just a personal interview that was orally presented.

[The document referred to follows:]

The Hemlock Area Study

AN INVESTIGATION INTO REPORTED HEALTH PROBLEMS AND POSSIBLE WATER CONTAMINATION

MARCH 1979

CHEMICALS & HEALTH CENTER

MICHIGAN DEPARTMENT OF PUBLIC HEALTH

THE HEMLOCK AREA STUDY

AN INVESTIGATION INTO REPORTED HEALTH PROBLEMS AND POSSIBLE WATER CONTAMINATION

MARCH, 1979

Chemicals and Health Center

Michigan Department of Public Health

SUMMARY

In late 1977, a veterinarian from the Hemlock area in Fremont and Richland Townships in Saginaw County was experiencing difficulty in treating some residents' animals for various problems, including low milk production. He requested the assistance of veterinarians at the Michigan Department of Agriculture and Michigan State University who conducted numerous tests on the animals. They concluded that the animals' conditions and low milk production were the result of infection and problems relating to treatment and management, and made recommendations to the residents for improvement. The residents were not completely satisfied with the veterinarians' conclusions, and were concerned also with what appeared to be an unusual number of human health problems which they associated with their private well water. They then consulted representatives of the Saginaw County Health Department, who in turn, called the Michigan Department of Public Health.

Engineers from the State Health Department visited the farms to examine the construction of the private wells and to collect water samples to test for possible contamination due to inorganic chemicals, pesticides or bacteria. Test results indicated that none of these contaminants were present at levels known to cause health problems. Following the water investigation, the State Health Department and the Saginaw County Health Department conducted an epidemiological study to determine whether perceived human health problems and concerns were more frequent in the Fremont-Richland area than in a comparison area, and, if so, whether they could be attributed to private well water. The study concluded that health complaints were more frequent in the Fremont-Richland Townships area but that there was no apparent relationship linking the health complaints to individual private well water.

During the course of the epidemiological study, the residents grew increasingly concerned about the possibility of water contamination, perhaps associated with

reinjection brine wells operated by Dow Chemical Company of Midland, Michigan. They submitted samples of their well water to be tested by Advanced Analysis and Testing, a private laboratory in Grand Rapids.

The private laboratory tested the water samples for inorganic chemicals, detected elevated salt concentrations in some wells, but was unable to test for organic chemicals, so forwarded one water sample to Raltech, a private laboratory, in Wisconsin. Results from these tests indicated the presence of a number of organic chemicals not usually associated with ground water. The residents, with an attorney, then met with the Department of Natural Resources. Representatives from the Department of Public Health and from Advanced Analysis and Testing were also present.

Following the meeting, Department of Natural Resources personnel tested private well water samples for chemicals found by the private laboratory, analyzed the samples for a wide array of organic and inorganic chemicals, and evaluated the Hemlock area for potential discharges of pollutants into the groundwater. The Department of Natural Resources personnel did not confirm the Raltech Laboratory's findings, and did not find evidence of widespread groundwater pollution. To date, the state agencies have been unable to develop evidence to account for the greater number of health complaints in the Fremont-Richland Township area.

INTRODUCTION

In the fall, 1977, citizens living in the Fremont and Richland Townships area, near the village of Hemlock in Saginaw County, complained of animal and human health problems which they believed might be attributed to private well water. They suspected problems with their water because of their proximity to brine (water saturated with salt) wells in the area and speculated that chemicals other than salts were invading their private well water supplies.

Because of the citizens' concerns, the Michigan Department of Agriculture, Michigan State University, the Michigan Department of Public Health, and the Michigan Department of Natural Resources became involved in conducting studies relating to animal health, human health and the private well water supply. The following is a report on the agencies' investigative activities in the Fremont-Richland Townships area to date.

THE MICHIGAN DEPARTMENT OF AGRICULTURE'S ROLE

In October, 1977, diagnostic veterinarians from the Department of Agriculture, working cooperatively with the residents' veterinarian and specialists from Michigan State University, inspected the animals of the affected farms.

A review of the animal health problems; the results of diagnostic workups and various chemical analyses led to the conclusion that the herd health problems were the result of numerous factors including the following: mastitis, and resulting economic difficulties from low milk production; animal problems at the time of purchase; sanitation problems; and ventilation problems. Recommendations for improving the existing problems were made. To date, no evidence has been developed to support a relationship between animal health problems and chemical contaminants.

MICHIGAN DEPARTMENT OF PUBLIC HEALTH'S ROLE

Water Analyses:

At the request of the Saginaw County Health Department, personnel from the Division of Water Supply of the Michigan Department of Public Health and the Saginaw County Health Department visited the Fremont-Richland Townships area in

early 1978 to examine the private well water and the construction of the four private wells of most concern to the residents. They determined that the wells were constructed according to State Health Department standards. They also collected samples of water from these wells for analysis in the State Health Department's laboratory to determine whether potential contaminants, which might have an effect on animal and human health, including inorganic chemicals, pesticides and bacteria, were present in the samples.

The Michigan Department of Public Health tested the water for the inorganic chemicals which are routinely monitored in municipal water systems. Results of the tests (TABLE 1) indicated that the levels of chemicals found did not exceed the federal standards as set by the Environmental Protection Agency (EPA) with regard to health effects.

The wells did contain an excessive load of total solids which might affect the taste of the water and contribute to plumbing problems, but are not known to affect people's health at the levels observed, except perhaps for those people who must limit their intake of salt.* However, it should be noted that it is common knowledge that many wells in the area produce water that is 'brackish' or salty in nature.

Since the water samples came from farms, the State Health Department laboratories also tested for various forms of DDT. Water analysts detected DDT in some of its forms at extremely low levels (TABLE 2). However, DDT is prevalent in our environment, and research data fail to substantiate any detrimental health effects attributed to exposure to such levels in a water supply.

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* The Environmental Protection Agency (EPA) and the American Heart Association have recommended the following: people on a moderate salt-free diet use water containing less than 270 mg/l of sodium; people on a strict salt-free diet use water containing less than 20 mg/l.

It is also noteworthy that during the pesticide analysis of water specimens, additional sample time was allowed on the gas chromatograph (an instrument which separates various organic components of a sample and draws a graphic representation of each one) to determine if other such compounds were present at detectable levels. None were detected.

The State Health Department personnel also checked for bacteria in the water. In order to do so, they looked for coliform organisms which are "indicator" organisms. ("Coliform organisms" are generally found in warm blooded animals or in soil and, if found, suggest that the water is contaminated and may contain other potentially harmful bacteria). Water analysts did not detect any coliform organisms, and therefore concluded that the wells were not contaminated.

In October, 1978, Health Department personnel revisited the Fremont-Richland area and gathered samples from three municipal wells in the village of Hemlock and performed the same type of tests which they conducted on the private wells in the area and which they had done in previous years on the municipal water. Water analysts did not find any chemicals at levels exceeding EPA standards and did not detect anything which would suggest the necessity to examine the water further. (TABLE 3). A comparison of these results with previous tests from the same municipal water system dating back to 1953 failed to show any significant changes in the water quality.

Later in 1978,tests conducted by the Department of Natural Resources on the Hemlock municipal wells indicated the presence of polychlorinated biphenyls (PCB) and phthalates. Health Department personnel immediately resampled the municipal wells. They split the samples and sent part of them to the Department of Natural Resources. Both Departments checked for PCB again and detected none. Health Department personnel also checked again for phthalates and detected none.

After completing these water tests, the Michigan Department of Public Health concluded that using the tools, tests and procedures which are widely accepted in studying possible toxic situations, it was not possible to show either a significant contamination of the water supplies tested or a connection between the described health complaints and the water supply.

Health Study:

Since the analyses of water samples from the private well water detected no unusual chemical contamination, the Michigan Department of Public Health and the Saginaw County Health Department decided to conduct a joint epidemiological study. The investigation was designed to determine whether perceived health problems and concerns were more frequent in the townships where contamination exposure had been suspected than in a comparison township on the opposite side of the county where no unusual water or health complaints had been received.

The Michigan Department of Public Health was responsible for designing the study, developing the questionnaires and analyzing the data. The State Health Department trained people who were hired by the Saginaw County Health Department to conduct the interviews. The Saginaw County Board of Health authorized and provided some of the funds for the study; the State Health Department provided consulting epidemiological services, field personnel training and data processing and analysis.

The study area consisted of the northern half of Fremont Township and the southern half of Richland Township (1308 households); and the comparison area consisted of all of Blumfield Township (621 households) (See Map 1). A sampling scheme utilizing a probability sample of 100 households was selected for each area. In the Fremont-Richland area 88 of the sample of 100 households provided completed interviews from 303 respondents. In the Blumfield area, 74 of the 100 sampled households provided completed interviews from 263 respondents.

Five Saginaw County Health Department representatives visited people in their homes to conduct interviews in July and August, 1978. They administered two questionnaires: one, to all individuals in selected households, about health problems and concerns; and another, to individuals sixteen years of age or older, about demographic factors and potential exposure to toxic substances.

Analysis of the responses to the health questionnaire revealed that a greater proportion of individuals reported health complaints or problems in the study area than in the comparison area (TABLE 4). The overall conclusion was not explainable on the basis of different sex or age factors between the study areas (TABLE 5). The types of health problems that individuals reported most frequently in the Fremont-Richland Townships area included skin rashes; numbness; arthritis; pains in the arms, legs and lower backs; dizziness; visual problems; nausea; injuries; urine sugar; thyroid problems and strokes.

Further analysis revealed that there was no apparent relationship between health complaints and the use of private well water in the Fremont-Richland area. It was found that persons using private well water in Fremont-Richland Townships reported approximately the same frequency and kind of health complaints as persons using private well water in the Blumfield Township (TABLE 6).

These health problems cannot be attributed to reported exposure to agricultural and industrial chemicals since people reporting the use of such chemicals in each area reported approximately the same kind and number of health complaints as those who did not use them (TABLE 7,8, and 9).

At the end of the health interview, participants were asked about additional health problems or hospitalizations not included in the interview. The types of other health problems which were described were similar in the two areas, with only a few more respiratory problems mentioned by the residents of the Fremont-Richland Townships area. (TABLE 10). The nature of hospitalizations were similar in the two

areas but residents in the Fremont-Richland area had almost three times the number of surgical procedures. The greater number of surgical procedures may be due to differences in medical practices between the areas. There also appear to be more hospitalizations among study participants from Fremont-Richland for respiratory problems and infections (TABLE 11).

No statistical differences were found between the areas for proportions of women pregnant; total number of pregnancies per woman; total number of livebirths; and total number of stillbirths, miscarriages, or abortions. (TABLE 12 & 13).

Although people in the Fremont-Richland area reported more health problems than in Blumfield Township area, the problems cannot be attributed to sex, age or chemical exposure. Furthermore, differences are not apparent among people using private wells as their regular source of water, since in both areas people using private well water reported a similar frequency of conditions.

MICHIGAN DEPARTMENT OF NATURAL RESOURCES' ROLE

At the request of residents in the Hemlock area, in late 1978 the Department of Natural Resources became involved in the investigation of possible water contamination. Department personnel decided to analyze the water for possible chemical contamination and to look for and investigate any potential source of groundwater contamination.

On October 24, 1978, residents from the Hemlock area met with representatives from the Michigan Departments of Natural Resources and Public Health, and a private laboratory, Advanced Analysis and Testing in Grand Rapids, Michigan. Prior to the meeting, residents had submitted water samples from eight wells to be analyzed by Advanced Analysis and Testing for inorganic chemicals. This laboratory did not have the capability to test for specific organic chemicals so they sent a sample from one well (Number 4, See Map 2) to Raltech Scientific Services, Inc., in Wisconsin for organic analysis. Raltech reported the presence of four organic chemicals: diethyl ether, toluene, freon, and trichloroethylene. This data was presented to participants at the meeting. Residents also expressed concern about spent

brine reinjection wells operated by the Dow Chemical Company, of nearby Midland.

As a result of the meeting, the Department of Natural Resources staff collected water samples from five of the residents' wells (Numbers 1,4,6,7,8) the next day (See Map 2). These water samples were tested for the following:

1. The four organic chemicals which the Raltech Laboratory had reported;
2. Several inorganic metals and salts;
3. Several chemicals listed on the Critical Materials Register* which are used by the Dow Chemical Company;
4. Bacteria (total coliform and fecal coliform);
5. General water chemistry.

The results of the tests are shown in Table 14 and can be summarized as follows;

1. The four chemicals reported by Raltech were not detected in any of the water well samples;
2. The concentrations of salts in the well waters varied greatly, with some of the wells having chloride concentrations greater than that recommended by the EPA. As noted previously, well water with high concentrations of salts (brackish water) is a common occurrence in this part of the state;
3. Of seventeen chemicals on the Critical Materials Register that were tested for, none were detected in any of the wells sampled;
4. High bacterial contamination (coliform) was detected in one well (Number 4), a well not tested previously by the Department of Public Health;
5. Aromatic amines in one well sample, carbon tetrachloride in a second well sample, and oil or grease type compounds in a third sample were found at barely detectable levels.

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* This register is a list of potentially hazardous substances compiled by the Critical Materials Advisory Committee. (This Committee consists of representatives from the Department of Natural Resources, other state departments, the academic community and private industry.) It is by no means a complete list of potential toxic chemicals, as thousands of them exist. It is a list of those chemicals that the Critical Materials Advisory Committee recognizes as having the greatest potential for causing environmental problems.

The Department of Natural Resources did not feel that their findings were sufficient to conclude that organic chemical contamination of the groundwater in this area had occurred. The sampling did show that one well was bacterially contaminated, that three wells had brackish (salty) water, and three wells needed further testing for verification.

The Department of Natural Resources, at the request of the Department of Public Health, retested the municipal water from the Hemlock municipal system. On October 31, 1978 the Department of Natural Resources collected water samples from the municipal wells and conducted the same tests as for the private wells (TABLE 15). The Department of Natural Resources laboratory found trace amounts of polychlorinated biphenyl (PCB) and of a group of compounds called phthalates in these samples. The wells were resampled and analyses of the second samples of the municipal wells for PCB were performed by both the Health Department and Department of Natural Resources Labs; neither laboratory found any evidence of PCB's. Additional analyses for phthalates by the Health Department also proved negative.

On October 31, 1978, the Department of Natural Resources staff gathered additional water samples from the private wells for "Static Daphnia Screening Tests". This set of tests,which measures the survival and reproduction of daphnia, an aquatic invertebrate, is intended to provide general information on the toxic characteristics of a water sample. The results could indicate whether a chemical is present in sufficient quality to harm the test organism but would not indicate the identity of the toxic factor; they would also indicate whether it was advisable to continue further investigation.

The results from these tests were the following:

1. Water from one well was harmful to Daphnia. The high concentration of chlorides in this well is suspected to be the cause. It is not known whether any other sustances, such as chemical contaminants contributed to

the harmful effects, as none have been measured.

2. Water from the other four wells contained no substance which was significantly toxic to Daphnia. Some adverse affects were shown by the Daphnia in waters from these wells but it could not be determined if the harmful effects were due to the moderate levels of chlorides in the water, to stress from handling the organisms during the tests, or low concentration of a toxic chemical contaminant, or combination of these factors.

In summary, the Static Daphnia Screening Tests were inconclusive as to whether chemical contaminants were present in the groundwater.

On November 28, 1978 the Department of Natural Resources personnel returned to the Hemlock area to sample the private well water again because:

1. The Hemlock area residents expressed the opinion that the quality of their well water seemed to change from good to bad at different times; data from the Advanced Analysis and Testing Laboratory appeared to support this opinion. A second set of samples by the Department of Natural Resources was requested to verify this contention and to determine if a contaminant had been missed by the first sampling;
2. The Department needed to know if aromatic amines, carbon tetrachloride, and oil and grease, were really present in the groundwaters as had been indicated by the October 25 sampling;
3. A second analysis was desired to verify the October 25 sample results which did not show that the chemicals found by Raltech were present in any of the well waters;
4. The Department wanted to test for additional chemicals on the Critical Materials Register which are used by Dow but had not yet been looked for in the groundwaters.

The Dow Chemical Company participated in this sampling in an effort to help resolve the question of groundwater contamination. They performed analyses similar

to those by the Department of Natural Resources and made additional analyses which that laboratory did not have the capability to perform.

The results of the two laboratories' testing (See TABLE 16) were as follows:

1. The quality of the water from each of the wells on November 28 was very similar to what was found on October 25;
2. Aromatic amines and carbon tetrachloride were not found in any of the wells sampled;
3. Oil or grease type compounds were detected in one well for the second time. This well is one of the shallowest tested. It appears to have trace amounts (up to 2 milligrams per liter) of a natural or artificially occurring oil type compound;
4. One well,(Number 4),of substandard construction according to State Health Department criteria, showed evidence of bacterial contamination for the second time and also oil and grease contamination. However, because of the limited capacity, the well does not produce enough water to collect a satisfactory sample. (Generally, it is desirable to allow the water to run several minutes before collecting a sample. It is not possible with this well.)
5. For the second time, the four organic chemicals originally found in one sample by the Raltech Lab were not detected in any of the wells tested;
6. None of the chemicals listed on the Critical Materials Register which were tested for were detected in any of the wells sampled.

Two additional analyses were performed on water from one of the wells in question. One test was performed on a sample obtained on a day when the resident said the water seemed particularly bad. Results of this test again showed no presence of any of the four compounds originally identified by the Raltech Lab. An organic compound was observed at a concentration of less than 10 micrograms per liter (parts per billion (ppb)) but could not be identified. This compound was not present the next time the well was sampled. The second special analysis was done by the

Department of Natural Resources staff and Dow Chemical Company on a sample of the well water which had been put through this resident's distillation apparatus. The first liquid produced by the still was analyzed; neither lab found any trace of the compounds identified by Raltech.

The Department of Natural Resources' analyses of well waters in the Hemlock area have not shown evidence of widespread organic chemical contamination of the groundwater. In order to be certain that the analyses did not overlook any chemical which could be causing a groundwater problem, the Department of Natural Resources is continuing to investigate possible sources or activities which could cause groundwater pollution in the area.

Since the Dow Chemical Company brine system does pipe concentrated salt solutions through buried pipe lines and wells to deep rock formations, this potential for causing groundwater pollution is being evaluated. At times the pipeline system breaks and spills brine to the ground; this, in fact, occurred while the Department of Natural Resources staff was in the Hemlock area in October and samples of the lost brine confirmed its high salt content. Spills of this type are generally cleaned up by Dow and as much of the brine as possible is recovered. A spill could cause some groundwater contamination immediately adjacent to a leak but is not expected to contaminate a large area.

The Dow system is designed to deposit brines, after extraction of useful minerals, back into underground rock formations similar to those from which they originated; this activity is regulated by the Department of Natural Resources' Geological Survey Division. However, past practices in coal and oil exploration, well drilling and brine production complicate the geology in this area of the state. For this reason no firm conclusions can be drawn at this time regarding the effects of current or past activities on the area's groundwater quality.

However, no evidence of widespread groundwater pollution or of activities which have caused groundwater pollution has been found by the Department of Natural Resources' investigation thusfar.

CONCLUSION

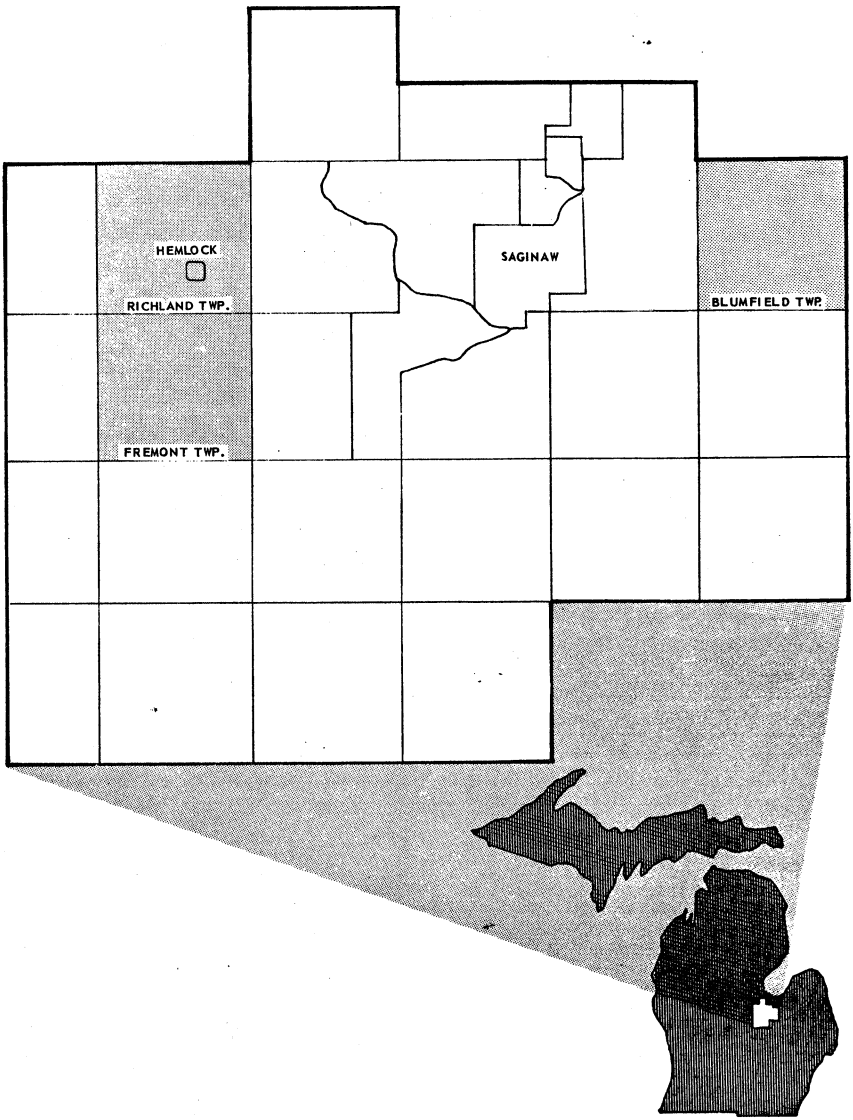
In conclusion, the Michigan Department of Agriculture, in conjunction with Michigan State University, identified animal health problems in some animals in the Fremont-Richland Townships area and attributed these problems to infection and problems relating to treatment and management. The Michigan Department of Public Health, in cooperation with the Saginaw County Health Department, discovered a greater number of health complaints in the Fremont-Richland Townships area than in a comparison township area but has been unable to establish a link between the complaints and private well water. Based on investigations to date, the Department of Natural Resources has insufficient evidence to conclude that the water in the Hemlock area is contaminated.

The three state agencies have not been able to identify a toxic chemical in the private well water supply in the Hemlock area which may be causing animal and human health problems. The concern for the quality of groundwater expressed by citizens in the area and the relationship of such water to human and animal health problems have not been substantiated by the large battery of environmental and health tests conducted to date.

FIGURES

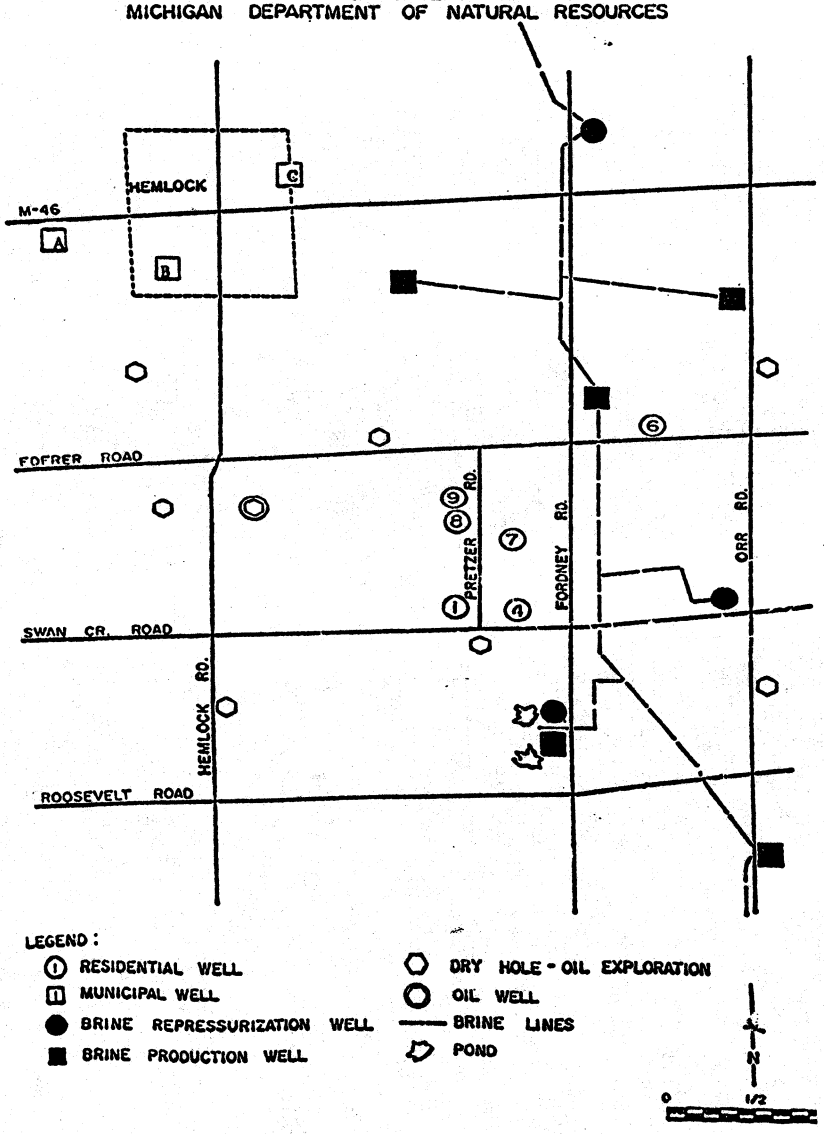
MAP 1

SAGINAW COUNTY: RICHLAND/FREMONT TOWNSHIPS AND BLUMFIELD TOWNSHIP



MAP 2

HEMLOCK AREA
GROUNDWATER INVESTIGATION
MICHIGAN DEPARTMENT OF NATURAL RESOURCES



TABLES

TABLE 1

MICHIGAN DEPARTMENT OF PUBLIC HEALTH

CHEMICAL ANALYSES FOR PRIVATE WELL WATER

PARAMETER TESTED	MCL	Well No.1	Well No.7	Well No.8	Well No.9
GENERAL CHEMISTRY					
Hardness-$CaCO_3$		110 mg/l**	37. mg/l	294. mg/l	225 mg/l
Fluoride-F	2.0*	0.7 mg/l	1.8 mg/l	0.6 mg/l	0.5 mg/l
Chloride-C_1		503 mg/l	557 mg/l	252 mg/l	204 mg/l
Nitrate-N	10.0	0.0 mg/l	0.0 mg/l	0.0 mg/l	0.0 mg/l
Sodium-Na		332.5 mg/l	461.5 mg/l	137.6 mg/l	136.8 mg/l
Potassium-K		6.3 mg/l	5.8 mg/l	3.4 mg/l	3.2 mg/l
Calcium-Ca		28.4 mg/l	10.0 mg/l	66.0 mg/l	55.8 mg/l
Magnesium-Mg		8.5 mg/l	2.9 mg/l	22.2 mg/l	18.2 mg/l
Silica-SiO_2		7.5 mg/l	6.0 mg/l	15.6 mg/l	14.4 mg/l
Bicarbonate-$CaCO_3$		214 mg/l	330 mg/l	206 mg/l	205 mg/l
Carbonate-$CaCO_3$		0 mg/l	0 mg/l	0 mg/l	0 mg/l
Sulfate-SO_4		160 mg/l	248 mg/l	148 mg/l	128 mg/l
Total Solids		1175 mg/l	1491 mg/l	769 mg/l	684 mg/l
Hydrogen Ion- pH		7.7	8.2	7.7	7.8
Conductance		1400. mmhos***	1700 mmhos	910 mmhos	840 mmhos
METALS					
Iron		230 ug/l****	80 ug/l	370 ug/l	880 ug/l
Manganese		60 ug/l	30 ug/l	50 ug/l	60 ug/l
Copper		20 ug/l	20 ug/l	10 ug/l	20 ug/l
Zinc		40 ug/l	130 ug/l	120 ug/l	50 ug/l
Cadmium	10	0 ug/l	0 ug/l	0 ug/l	0 ug/l
Lead	50	2 ug/l	0 ug/l	2 ug/l	0 ug/l
Silver	50	1 ug/l	2 ug/l	0 ug/l	0 ug/l
Arsenic	50	0 ug/l	0 ug/l	0 ug/l	1 ug/l
Barium	1000	12 ug/l	4 ug/l	27 ug/l	31 ug/l
Selenium	10	0 ug/l	0 ug/l	0 ug/l	0 ug/l
Mercury	2	0.0 ug/l	0.0 ug/l	0.0 ug/l	0.0 ug/l
Chromium	50	0 ug/l	0 ug/l	0 ug/l	0 ug/l

* Maximum contaminant Level-national interim primary drinking water regulations. Where these are not shown there are no established health related standards.

** Milligrams Per Liter

*** Micromhos Per Reciprocal Centimeter

**** Micrograms Per Liter

TABLE 2

PESTICIDE ANALYSES ON PRIVATE WELLS

CHEMICALS	Well No. 1	Well No. 7	Well No. 8
p,p' DDT	0.03 ug/1*	0.03 ug/1	0.04 ug/1
p,p' DDE	0.03 ug/1	0.02 ug/1	0.05 ug/1
o,p' DDT	0.03 ug/1	0.02 ug/1	0.02 ug/1

* Micrograms of substance per liter of water (parts per billion)

TABLE 3

MICHIGAN DEPARTMENT OF PUBLIC HEALTH

CHEMICAL ANALYSES FOR MUNICIPAL WELL WATER

PARAMETER TESTED	MCL	Well A.	Well B.	Well C.
GENERAL CHEMISTRY				
Hardness-$CaCO_3$		198 mg/l**	204. mg/l	166 mg/l
Fluoride-F	2.0*	0.6 mg/l	0.6 mg/l	0.5 mg/l
Chloride-C_1		44 mg/l	44 mg/l	69 mg/l
Nitrate-N	10.0*	0.2 mg/l	0. mg/l	0 mg/l
Sodium-Na		73 mg/l	73 mg/l	95 mg/l
Potassium-K		3.5 mg/l	3.5 mg/l	2.7 mg/l
Calcium-Ca		47.9 mg/l	49.5 mg/l	35.6 mg/l
Magnesium-Mg		18.5 mg/l	18.9 mg/l	16.5 mg/l
Silica-SiO_2		13.5 mg/l	14.1 mg/l	12.6 mg/l
Bicarbonate-$CaCO_3$		212 mg/l	216 mg/l	188 mg/l
Carbonate-$CaCO_3$		0 mg/l	0 mg/l	0 mg/l
Sulfate-SO_4		77.3 mg/l	81 mg/l	84.5 mg/l
Total Solids		406 mg/l	414 mg/l	429 mg/l
Hydrogen Ion-pH		7.7	7.8	7.6
Conductance		567 mmhos***	545 mmhos	632 mmhos
METALS				
Iron		1970 ug/l****	500 ug/l	350 ug/l
Manganese		60 ug/l	0 ug/l	0 ug/l
Copper		30 ug/l	50 ug/l	20 ug/l
Zinc		20 ug/l	30 ug/l	20 ug/l
Cadmium	10*	<0.5 ug/l	<0.5 ug/l	<0.5 ug/l
Lead	50*	<3 ug/l	<3 ug/l	<0.3 ug/l
Silver	50*	<1 ug/l	<1 ug/l	<1 ug/l
Arsenic	50*	11.0 ug/l	<5 ug/l	<5 ug/l
Barium	1000*	<99 ug/l	<99 ug/l	<99 ug/l
Selenium	10*	<2 ug/l	<2 ug/l	<2 ug/l
Mercury	2*	0 ug/l	0.0 ug/l	0 ug/l
Chromium	50*	<3 ug/l	<3 ug/l	<3 ug/l

* Maximum contaminant Level-national interim primary drinking water regulations. Where these are not shown there are no established health related standards.

** Milligrams Per Liter

*** Micromhos Per Reciprocal Centimeter

**** Micrograms Per Liter

< Less than

TABLE 4
Percent of Individuals from Fremont-Richland and Blumfield Samples Reporting Selected Health Problems and Complaints

	Health Complaint or Problem	Percent of Individuals Reporting the Condition		Differences
		Fremont-Richland	Blumfield	
Occurred During Previous Year*	Leg or Arm Numbness	23.4	12.9	10.5
	Experienced Frequent Dizziness	14.5	4.6	9.9
	Pain in Arms, Legs, or Lower Back	20.5	12.2	8.3
	Frequent Nausea	17.2	9.9	7.3
	Feelings of Unusual Tiredness	16.5	11.0	5.5
	Visual Problems	8.3	3.4	4.9
	Arthritis	21.8	20.2	1.6
	Skin Thickening	2.0	0.8	1.2
	Unusual Memory Loss	2.0	0.8	1.2
	Skin Rash	15.5	15.2	0.3
	Serious Infections	12.5	12.5	0.0
Occurred Only Prior To Previous Year	Skin Rash	12.9	6.8	6.1
	Arthritis	6.6	2.3	4.3
	Pain in Arms, Legs, or Lower Back	6.6	3.0	3.6
	Frequent Nausea	7.6	4.2	3.4
	Leg or Arm Numbness	5.3	2.3	3.0
	Frequent Dizziness	5.9	3.0	2.9
	Visual Problems	3.0	0.8	2.2
	Feelings of Unusual Tiredness	8.3	4.2	2.1
	Skin Thickening	2.3	0.8	1.5
	Unusual Memory Loss	1.0	1.1	-0.1
Occurred During or Prior to Previous Year	Broken Bones or Hospitalization for Injury	28.1	18.3	9.8
	Urine Sugar	6.6	2.3	4.3
	Tumor or Cyst	14.2	10.3	3.9
	Thyroid Trouble	5.6	2.3	3.3
	Liver Trouble	8.5	5.7	2.8
	Heart Trouble	7.6	5.7	1.9
	Strokes	1.3	0.0	1.3
	Convulsions	4.0	2.7	1.3
	Cancer	4.0	2.7	1.3

*The previous year referred to is approximately the year from July 20, 1977 to August 18, 1978.

TABLE 5
Number of Health Complaint Items for Which the Percentage of Persons Reporting Problems is Greater for the Area Indicated By Area, Sex, and Age

Demographic Group*	Fremont-Richland Percentage Greater Than Blumfield	Blumfield Percentage Greater Than Fremont-Richland	No Difference Between The Two Areas	Total
Under 45 Years Old	61	4	3	68
45 Years Old and Above	50	16	2	68
Males	57	8	3	68
Females	58	9	1	68

*Values for each demographic group indicate more items with larger percentage for Fremont-Richland than would be expected by chance.

TABLE 6
Percent of Individuals 16 Years or Older Using Private Water Supply Only Reporting Selected Health Complaints or Problems Fremont-Richland and Blumfield

	Health Complaints or Problems	Percent of Individuals Reporting the Conditions		Differences
		Fremont-Richland	Blumfield	
Occurred During Previous Year*	Experienced Frequent Dizziness	15.5	7.5	8.0
	Pain in Arms, Legs, or Lower Back	24.1	19.4	4.7
	Feelings of Unusual Tiredness	19.8	16.1	3.7
	Visual Problems	7.8	4.3	3.5
	Skin Rash	14.7	11.8	2.9
	Frequent Nausea	11.2	10.8	0.4
	Leg or Arm Numbness	23.3	23.7	-0.4
	Arthritis	30.2	31.2	-1.0
	Serious Infections	5.2	9.7	-4.5
Occurred Only Prior to Previous Year	Pain in Arms, Legs, or Lower Back	9.5	4.3	5.2
	Skin Rash	14.7	10.8	3.9
	Visual Problems	3.5	1.1	2.4
	Arthritis	6.9	5.8	1.1
Occurred During or Prior to Previous Year	Cancer	8.6	4.3	4.3
	Broken Bones or Hospitalization for Injury	30.2	26.9	3.3
	Strokes	2.6	0.0	2.6
	Liver Trouble	7.8	5.4	2.4
	Tumor or Cyst	18.1	18.3	-0.2
	Thyroid Trouble	6.0	6.5	-0.5
	Heart Trouble	6.9	8.6	-1.7

*The previous year referred to is approximately the year from July 20, 1977 to August 18, 1978.

TABLE 7

Respondents were asked if they had come in contact with the following potential toxic substances in order to determine potential toxic substance exposure:

1. Silo Sealant: Kumar
2. Other Material Preservatives and Sealants
3. Waste Oil
4. Insecticides
5. Weed Killers
6. Fumigants
7. Rodenticides
8. Any Other Agricultural Chemical
9. Any Industrial Chemical

TABLE 8
Percent of Individuals 16 Years of Age or Older with Potential Toxic Substance Exposure Reporting Selected Health Complaints or Problems Fremont-Richland and Blumfield

	Health Complaint or Problem	Percent of Individuals Reporting the Condition		Differences
		Fremont-Richland	Blumfield	
Occurred During Previous Year*	Pain in Arms, Legs, or Lower Back	32.6	15.8	16.8
	Experienced Frequent Dizziness	21.1	5.3	15.8
	Leg or Arm Numbness	32.6	18.4	14.2
	Visual Problems	14.7	6.7	8.0
	Skin Rash	12.6	6.6	6.0
	Serious Infections	10.5	5.3	5.2
	Frequent Nausea	15.8	13.2	2.6
	Feelings of Unusual Tiredness	17.9	21.1	-3.2
	Arthritis	31.6	40.8	-9.2
Occurred Only Prior to Previous Year	Arthritis	8.9	4.4	4.5
	Pain in Arms, Legs, or Lower Back	9.5	5.3	4.2
	Visual Problems	3.2	0.0	3.2
	Skin Rash	13.7	13.2	0.5
Occurred During or Prior to Previous Year	Broken Bones or Hospitalization for Injury	44.2	23.7	20.5
	Urine Sugar	11.6	5.3	6.3
	Thyroid Trouble	7.4	2.6	4.8
	Liver Trouble	7.4	6.6	0.8
	Heart Trouble	10.5	10.5	0.0
	Cancer	2.1	5.3	-3.2
	Tumor or Cyst	8.4	15.8	-7.4

*The previous year referred to is approximately the year from July 20, 1977 to August 18, 1978.

TABLE 9
Percent of Individuals 16 Years of Age or Older with No Reported Potential Toxic Substance Exposure Reporting Selected Health Complaints or Problems Fremont-Richland and Blumfield

	Health Complaint or Problem	Percent of Individuals Reporting the Condition		Differences
		Fremont-Richland	Blumfield	
Occurred During Previous Year*	Feelings of Unusual Tiredness	28.2	12.0	16.2
	Leg or Arm Numbness	30.9	17.6	13.3
	Arthritis	29.1	20.4	8.7
	Experienced Frequent Dizziness	14.6	7.4	7.2
	Frequent Nausea	16.4	11.1	5.3
	Pain in Arms, Legs, or Lower Back	21.8	16.7	5.1
	Skin Rash	16.4	12.8	3.6
	Visual Problems	6.4	3.7	2.7
	Serious Infections	8.2	11.1	-2.9
Occurred Only Prior To Previous Year	Skin Rash	13.6	4.6	9.0
	Pain in Arms, Legs, or Lower Back	10.0	3.7	6.3
	Arthritis	8.2	2.8	5.4
	Visual Problems	4.6	1.9	2.7
Occurred During or Prior to Previous Year	Tumor or Cyst	31.8	13.9	17.9
	Urine Sugar	8.2	1.9	6.3
	Cancer	8.2	2.8	5.4
	Thyroid Trouble	9.1	3.7	5.4
	Stroke	3.6	0.0	3.6
	Heart Trouble	9.1	5.6	3.5
	Broken Bones or Hospitalization for Injury	21.8	19.4	2.4
	Liver Trouble	6.4	5.6	0.8

*The previous year referred to is approximately the year from July 20, 1977 to August 18, 1978.

TABLE 10
Number and Percent of Other[1] Problems by Type of Problem
Fremont-Richland and Blumfield

Type of Problem	Fremont-Richland		Blumfield	
Total People	303		263	
Total People Mentioning Other Health Problems	53		30	
Total Problems	59		31	
	Number of Occurrences for Listed Conditions	Percent of Total Problems	Number of Occurrences for Listed Conditions	Percent of Total Problems
Respiratory System Pneumonia, Bronchitis, Flu, Tuberculosis, Colds	9	15.3	2	6.5
Digestive System (Stomach, Intestines, Gall Bladder, Liver)	5	8.5	6	19,4
Circulatory System	5	8.5	1	3.2
Heart Trouble	1	1.7	0	0.0
Hypertension	4	6.8	6	19.4
Genitourinary System	4	6.8	5	16.1
Ears or Eyes	3	5.1	3	9.7
Musculoskeletal System (Back or Bone)	3	5.1	1	3.2
Nervous or Mental	3	5.1	0	0.0
Allergies	6	10.2	3	9.7
Headaches	4	6.8	0	0.0
Childhood Diseases	2	3.4	0	0.0
Other	10	16.9	4	12.9

[1]These problems were volunteered in response to the next to the last question in the health questionnaire: "Have you been having any health problems which we have not discussed?"

TABLE 11
Number and Percent of Hospitalizations by Reason for Other[1] Hospitalizations
Fremont-Richland and Blumfield

Reason for Hospitalization	Fremont-Richland		Blumfield	
Total People	303		263	
Total People Reporting Other Hospitalizations	132		61	
Total Hospitalizations Mentioned	181		86	
	Number of Hospitalizations for Listed Condition	Percent of Total Hospitalizations	Number of Hospitalizations for Listed Condition	Percent of Total Hospitalizations
Tonsilectomy and/or Adenoidectomy	48	26.5	14	16.3
Appendectomy	18	9.9	8	9.3
Gall Bladder Removal	9	5.0	3	3.5
Hysterectomy	6	3.3	4	4.7
Hernia	10	5.5	3	3.5
Elective Surgery	11	6.1	6	7.0
Hemorrhoids	4	2.2	3	3.5
Accidents or Injuries	5	2.8	2	2.3
Lung and Bronchus (Including Pleurisy	10	5.5	3	3.5
Stomach and Intestine Problems	7	3.9	4	4.7
Kidney and Urogenital Tract Problems	3	1.7	3	3.5
Nervous and Mental Conditions	0	0.0	2	2.3
Infections	12	6.6	2	2.3
Pregnancy	4	2.2	6	7.0
Other	14	7.7	12	14.0
Not Specified	20	11.0	11	13.0

[1]These reasons were volunteered in responses to the last question in the health questionnaire: "Have you been hospitalized for any condition other than the hospitalization mentioned previously?"

TABLE 12
Number of Women, 16 to 55 Years of Age,
Never Pregnant and Pregnant at Least Once
By Area*

	Blumfield	Fremont-Richland	
Never Pregnant	11	21	32
Pregnant at Least Once	53	63	116
	64	84	148

*The proportions in each area are statistically equivalent.

TABLE 13
Total Live Birth Rates; Stillbirth, Miscarriage and Abortion Rates; and Currently Pregnant Rates by Area

Pregnancy Outcome	Rate Per 100 Women[1]	
	Fremont-Richland	Blumfield
Total Pregnancies[2]	233.3	243.8
Live Births	189.3	207.8
Stillbirths, Miscarriages, Abortions	28.6	18.8
Pregnant at Time of Interview	4.8	3.1

[1]There is no statistically significant difference in the rates between Fremont-Richland and Blumfield for any category.

[2]Since information on pregnancies beyond the fifth pregnancy were not recorded, the sum of rates for live births, stillbirths and current pregnancies will not equal that for total pregnancies.

TABLE # 14

WELL SAMPLES
HEMLOCK AREA
October 25, 1978
Michigan DNR

PARAMETER	WELL NUMBER				
	1	4	7	8	6
Chemical Oxygen Demand (mg/l)(C.O.D.)	Interference	Interfer.	8	5	6
Total Organic Carbon (mg/l) (T.O.C.)	0.2	0.8	0.1	1.0	0.6
pH (S.U.)	7.8	7.8	8.2	7.7	7.7
Nitrate-Nitrite (mg/l)	0.005	0.160	0.008	0.005	0.006
Ammonia (mg/l)	0.41	0.55	0.27	0.29	0.28
Organic Nitrogen (mg/l)	0.14	0.15	0.12	0.12	0.13
Total Phosphorus (mg/l)	0.012	0.015	0.010	0.102	0.008
Chloride (mg/l)	730	1580	340	169	270
Total Sulfates (mg/l)	130	180	160	120	140
Sodium (mg/l)	710	1400	490	170	270
Potassium (mg/l)	7.3	13.0	4.9	3.1	3.8
Calcium (mg/l)	29.	32.	12	70	65
Magnesium (mg/l)	9.6	12.0	3.1	25.0	17.0
Conductivity (µmhos/cm)	3060	5600	1925	1140	1485
Total Alkalinity (mg/l)	244	328	332	205	195

(continued)

TABLE # 14 (cont.)

PARAMETER	WELL NUMBER				
	1	4	7	8	6
Carbonate (mg/l)	0	0	0	0	0
Bicarbonate (mg/l)	296	400	406	250	238
Bromide (mg/l)	NA*	NA	NA	NA	NA
Iodide (mg/l)	0.007	0.017	0.003	0.002	0.002
Fluoride (mg/l)	1.3	1.4	2.3	1.1	0.92
Boron (mg/l)	2.9	4.6	4.0	0.5	0.6
Sulfide (mg/l)	<.05	<.05	<.05	0.15	<.05
Phenol (µg/l)	5.2	7.0	7.6	5.0	2.0
Total Cyanides (mg/l)	U	U	U	U	U
Total Cadmium (µg/l)	<1	<1	<1	<1	<1
Total Chromium (µg/l)	4	5	1	2	2
Hexavalent Chromium (µg/l)	<1	1	< 1	2	<1
Total Copper (µg/l)	7	29	4	4	4
Total Iron (µg/l)	130	610	74	700	410
Total Nickel (µg/l)	<5	<5	<5	<5	<5
Total Lead (µg/l)	<5	<5	<5	<5	<5
Total Zinc (µg/l)	<1	100	50	200	50
Manganese (µg/l)	22	16	5	12	11
Antimony (µg/l)	<5	<5	<5	<5	<5

* NA= Not Analyzed

(continued)

TABLE # 14(cont.)

PARAMETER	WELL NUMBER				
	1	4	7	8	6
Silver (µg/l)	4	6	2	2	4
Titanium (µg/l)	<25	<25	<25	<25	<25
Aroclor 1242 (PCB) (µg/l)	U	U	U	U	U
Aroclor 1254 (PCB) (µg/l)	U	U	U	U	U
Aroclor 1260 (PCB) (µg/l)	U	U	U	U	U
PBB (µg/l)	U	U	U	U	U
Freon Extractable Oil & Grease (mg/l)	U	U	U	2	U
MBAS (mg/l)	0.07	0.05	0.06	0.08	0.06
Aromatic Amines (mg/l)	U	U	U	U	0.3
Diethyl Ether (mg/l)	U	U	U	U	U
Benzene (mg/l)	U	U	U	U	U
Toluene (mg/l)	U	U	U	U	U
Trichloroethylene (mg/l)	U	U	U	U	U
1,1,2 - Trifluorotrichloroethane (mg/l)	U	U	U	U	U
Xylene (mg/l)	U	U	U	U	U
Diethyl Benzene (mg/l)	U	U	U	U	U
Cumene (mg/l)	U	U	U	U	U
Styrene (mg/l)	U	U	U	U	U

(continued)

TABLE # 14(cont.)

PARAMETER	WELL NUMBER				
	1	4	7	8	6
Vinyl Toluene (mg/l)	U	U	U	U	U
Chlorobenzene (mg/l)	U	U	U	U	U
phthalates (mg/l)	U	U	U	U	U
2,4,5-T (mg/l)	U	U	U	U	U
Hexachlorobenzene (HCB) (mg/l)	U	U	U	U	U
Nitrophenol (mg/l)	U	U	U	U	U
Butanol (mg/l)	U	U	U	U	U
Carbon Tetrachloride (mg/l)	U	U	.003	U	U
Fecal Coliform col/100 ml	<10	<10	<10	<10	<10
Total Coliform col/100 ml	<100	1900	<100	<100	<100

U means material analyzed for, but not detected.

< means actual value is known to be less than value given.

mg/l = Milligrams per liter

µg/l = Micrograms per liter

TABLE 15

WELL SAMPLES
RICHLAND TOWNSHIP WATER SUPPLY
OCTOBER 31, 1978

DEPARTMENT OF NATURAL RESOURCES

PARAMETER	WELL NUMBER A	B	C
Chemical Oxygen Demand (mg/l)	5	4	6
Total Organic Carbon (mg/l)	1.4	1.2	1.3
pH (S.U.)	7.7	7.7	7.7
Nitrate-Nitrite (mg/l)	0.005	0.003	0.005
Ammonia (mg/l)	0.22	0.25	0.38
Organic Nitrogen (mg/l)	0.15	0.21	0.19
Total Phosphorus (mg/l)	0.012	0.023	0.022
Chloride (mg/l)	45	45	66
Total Sulfates (mg/l)	60	60	65
Conductivity (umhos/cm)	675	675	705
Sodium (mg/l)	81	81	110
Potassium (mg/l)	2.6	2.7	1.9
Calcium (mg/l)	51	52	37
Magnesium (mg/l)	20	20	18
Carbonate (mg/l)	0	0	0
Bicarbonate (mg/l)	258	262	230
Bromide (mg/l)	NA*	NA	NA
Iodide (mg/l)	0.005	0.004	0.004
Fluoride (mg/l)	0.64	0.54	0.56
Boron (ug/l)	400	300	500
Sulfide (mg/l)	<0.05	<0.05	<0.05
Phenol (ug/l)	<0.1	<0.1	1.0
Total Cyanides (mg/l)	0.0002	0.0004	<0.0001
Total Cadmium (ug/l)	<1	<1	<1
Total Chromium (ug/l)	3	4	2
Total Copper (ug/l)	7	9	3
Total Iron (ug/l)	740	270	220
Total Nickel (ug/l)	<5	<5	<5
Total Lead (ug/l)	<5	<5	<5
Total Zinc (ug/l)	11	22	7
Manganese (ug/l)	22	6	4
Antimony (ug/l)	<5	<5	<5
Silver (ug/l)	3	4	4
Titanium (ug/l)	<25	<25	<25
Aroclor 1242 (PCB) (ug/l)	U	U	U
Aroclor 1254 (PCB) (ug/l)	U	U	U
Aroclor 1260 (PCB) (ug/l)	0.3	0.5	0.4
PBB (ug/l)	U	U	U
Freon Extractable Oil (mg/l)	U	U	2
MBAS (mg/l)	0.015	0.015	0.015
Aromatic Amines (mg/l)	U	U	U
Diethyl Ether (mg/l)	U	U	U
Benzene (mg/l)	U	U	U
Toluene (mg/l)	U	U	U
Xylene (mg/l)	U	U	U
Diethyl Benzene (mg/l)	U	U	U

*NA-- Not Analyzed

(continued)

TABLE 15 (cont.)

Cumene (mg/l)	U	U	U
Styrene (mg/l)	U	U	U
Vinyl Toluene (mg/l)	U	U	U
Chlorobenzene (mg/l)	U	U	U
Trichloroethylene (mg/l)	U	U	U
Freon (mg/l)	U	U	U
Butanol (mg/l)	U	U	U
Phthalates (DEHP) (mg/l)	0.024	0.032	0.024
Phthalates (DNBP) (mg/l)	U	U	U
2,4,5-T (mg/l)	U	U	U
Picloram (mg/l)	U	U	U
Hexachlorobenzene (mg/l)	U	U	U
Nitrophenol (mg/l)	U	U	U

U means material analyzed for, but not detected
< means actual value is known to be less than value given
mg/l = milligrams per liter
ug/l = micrograms per liter

TABLE 16

HEMLOCK AREA GROUNDWATER INVESTIGATION
WELLS SAMPLED BY MICHIGAN DNR
and
DOW CHEMICAL COMPANY
November 28, 1978
WATER QUALITY ANALYSES

PARAMETER	UNITS	WELL NUMBERS											
		1		4		6		7		8		9	
GENERAL:		DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW
Total Organic Carbon (TOC)	mg/l	0.2	NA	0.6	NA	0.6	NA	1.1	NA	1.2	NA	1.2	NA
Conductivity	µmhos/cm	3870	NA	6630	NA	1540	NA	1920	NA	1160	NA	1090	NA
Freon Extractable Oil & Grease	mg/l	U	NA	1	NA	U	NA	U	NA	1	NA	U	NA
Phenolics - total recoverable	µg/l	3.7	NA	1.3	NA	0.1	NA	0.2	NA	4.0	NA	0.2	NA
Aromatic Amines	mg/l	U	NA	U	NA	U	NA	U	NA	U	NA	U	NA
Total Coliform	col/100 ml	NA	NA	400	NA	NA	NA	NA	NA	NA	NA	NA	NA
INORGANIC:													
Sodium (Na^+)	mg/l	850	800	1500	1390	240	236	410	400	150	143	150	139
Potassium (K^+)	mg/l	7.5	7.2	13	12	3.3	3.2	4.5	4.2	2.9	2.5	2.8	2.5
Calcium (Ca^{++})	mg/l	30	28	34	36	67	64	23	20	75	67	63	57
Magnesium (Mg^{++})	mg/l	10	9.6	13	13	17	16	4.4	4.6	24	23	20	19
Strontium (Sr^{++})	mg/l	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Mercury (Hg^{++})	ug/l	U	U	U	U	U	U	U	U	U	U	U	U
Rubidium (Rb^+)	mg/l	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Chlorine	mg/l	NA	1150	NA	2040	NA	314	NA	370	NA	190	NA	156
Chloride	mg/l	1010	NA	1860	NA	270	NA	320	NA	171	NA	138	NA
Arsenic	ug/l	NA	U	NA	0.8	NA	5.3	U	U	5.9	7.2	2.5	3.4

TABLE 16 (cont.)

PARAMETER	UNITS	1		4		6		7		8		9	
INORGANIC (Con't.)		DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW
Sulfates ($SO_4^=$)	mg/1	150	130	210	160	150	120	160	130	120	115	110	110
Bicarbonate (HCO_3^-)	mg/1	335	340	465	480	245	260	375	380	260	260	255	260
Bromine (Br^-)	mg/1	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Fluoride (F^-)	mg/1	0.72	0.4	0.78	0.5	0.54	0.2	1.6	0.9	0.64	0.5	0.46	0.2
Sulfide ($S^=$)	mg/1	U	U	U	U	0.06	U	U	U	U	U	U	U
ORGANICS:													
Diethyl Ether	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
1,1,2 Trifluorotrichloroethane	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Trichloroethylene	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Carbon Tetrachloride	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Hexachlorobutadiene	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Pentachlorophenol	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Tetrachlorophenol	ug/1	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Trichlorophenol	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Dichlorobenzene	ug/1	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U

TABLE 16 (cont.)

PARAMETER	UNITS	WELL NUMBERS											
		1		4		6		7		8		9	
		DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW
ORGANICS, Continued.													
Aniline	ug/l	U	U	U	U	U	U	U	U	U	U	U	U
Benzaldehyde	ug/l	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Pyridine	ug/l	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Hydroquinone	ug/l	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Butyric Acid	ug/l	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Ethyl acrylate	ug/l	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Aroclor 1242 (PCB)	µg/l	U	NA	U	NA	U	NA	U	NA	U	NA	U	NA
Aroclor 1254 (PCB)	µg/l	U	NA	U	NA	U	NA	U	NA	U	NA	U	NA
Aroclor 1260 (PCB)	µg/l	U	NA	U	NA	U	NA	U	NA	U	NA	U	NA
Freon	ug/l	U	U	U	U	U	U	U	U	U	U	U	U

U Material analyzed for, but not detected
NA Material not analyzed for in sample
mg/l = milligrams per liter
ug/l = micrograms per liter

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Senator LEVIN. I'll read just a portion of the report. Table 5 of the report indicates a number of health complaint items for which the percentage of persons reporting problems is greater for your area than the other areas. They do this by age and sex.

Under the age of 45, they found that in 61 instances, there were a greater percentage of complaints in your area than the other areas; whereas in only four of those indicators there was a greater number of complaints in other areas than in your area; and there was no difference between the areas in three of them.

Above the age of 45, they found in 50 of the types of complaints there was a greater percentage in your area complaining than in the other areas; whereas in 16 of those symptoms there was a greater percentage in the other areas than in your area; and in two there was no difference.

Then they also divided this by males and females, showing similarly very substantially greater numbers of complaints in your area in both males and females than in any other area which they tested.

Reading through the health complaints and problems which they tested for: leg or arm numbness, for instance, in your area 23 percent complained, in the other area only 12 percent complained.

Frequent dizziness, 14 percent in your area, 4 percent in the other area.

Pain in arms, legs, or lower back: 20 percent in your area, 12 percent in the other areas.

Nausea: 17 percent in your area, 9 percent in the other area.

I'm just reading right through the list here:

Feelings of unusual tiredness: 16 percent in your area, 11 percent in the other area.

Visual problems: 8 percent to 3 percent; and so forth.

Are you familiar with that report?

Mrs. KRUGER. Yes; I am.

Senator LEVIN. Does the water in your wells have an abnormal smell?

Mrs. KRUGER. There are various times when you can detect an odor or a taste, but it does fluctuate. Now, depending onto whose farm you go, you do detect different types of odor. I think that's part of our problem, that we do have such a variety of things that it makes it very difficult to make a simple diagnosis.

Senator LEVIN. Does it have an abnormal color or film?

Mrs. KRUGER. At my particular well, which is a flowing well, yes. We do have a shiny film that precipitates out, and we have a very distinct brown stain that also precipitates out.

Senator LEVIN. What have the State officials told you about taste, smell, and appearance?

Mrs. KRUGER. I think we've gone deeper than that. We haven't been concerned with the taste, the smell, or the appearances; basically, what makes up those three things.

Senator LEVIN. Can you estimate how much money you and area residents have spent in your efforts to remedy the problems through testing, xeroxing, personal time devoted to these efforts, writing reports, and writing letters? Could you give us an estimate?

Mrs. KRUGER. I believe that my actual cash outlay is probably in the neighborhood of $4,000. You cannot put a dollar value on the health

problems of the people in the area. There are some instances of $100,000. This, thankfully, has been covered by partial Blue Cross medical payments and this type of thing.

My time, I feel, has been more than justified if we can bring some definitive conclusions and some help to the thing. As far as my personal business of dairying, I also cannot put a dollar value on that, but it is no longer an active part of my life.

Senator LEVIN. Did your plans change, in terms of your farm?

Mrs. KRUGER. Yes; we have. As I restructure it, it has become again partially a viable operation. But the transition from dairy, which is a relatively regular income basis type of thing, to cash crop farming is a very dramatic change, when you have to schedule your payments and you're continually owing someone. The transition has been rather difficult.

Senator LEVIN. Senator Cohen?

Senator COHEN. Thank you, Senator Levin.

I guess I'd like to know from both the witnesses: What is your background in terms of education? I notice, for example, you use a lot of words pertaining to chemicals and you use them rather easily. Do you have a background in chemical studies?

Mrs. KRUGER. Senator, I did graduate from Michigan State. But the ironic thing about this is I started chemistry winter term and I dropped the course, and that changed my entire college career to retailing.

But as far as this particular investigation has been concerned, it has been entirely self-taught, and thanks to my variety of background in my college training, all of the things have kind of fit together to make this, I hope, as effective as it is.

Senator COHEN. Mrs. Jungnitsch?

Mrs. JUNGNITSCH. I had 1 year at Michigan State. Again, we learned what we know today through repeated trips to the library.

Senator COHEN. I raised the question because I majored in Latin poetry when I was in college, and you can see that I had difficulty in understanding all of the chemical terms. That's one of the reasons why I suggest that one need not have a degree in toxicology or chemical engineering or geophysiology. It's sort of self-protective on my own part, because I come back to the question of simple commonsense and common judgment.

I was wondering, in looking at the chart that you had prepared, did you prepare this for any of the health officials either at the State or Federal level, for example the Department of Natural Resources in Michigan? Is that the department you had contact with?

Mrs. KRUGER. As Kathryn mentioned, we went to Dr. Isbistur with just this portion of it. We did it only by a dot system at the time. And then, as I rethought the idea, I felt it was now time that I needed to specifically identify this horrible variety and the multiple-symptoms scenario. So no other agencies have seen this except you here.

Senator COHEN. I guess the question that I have is, obviously this is a very complicated area, that we have people who are well trained in the fields of toxicology. They reach different conclusions. Apparently there's a different conclusion reached by the Hemlock area study put out by the Michigan Department of Public Health and also an "Investigation of Groundwater Quality in the Hemlock Area of Saginaw County," put out by the Department of Natural Resources.

[Report referred to follows:]

INVESTIGATION OF GROUNDWATER QUALITY IN THE HEMLOCK AREA OF SAGINAW COUNTY

Michigan Department of Natural Resources
Water Quality Division
Groundwater Compliance and Special Studies Section
April 1979

SUMMARY

1. Sampling of water supply wells in the Hemlock area has not demonstrated organic chemical contaminants to be present in aquifers used by the wells.

2. No direct discharge of any organic chemicals to the aquifers used by the rural wells has been found to be taking place near the well that showed organic chemicals in one sample analysis by a private lab.

3. Naturally occurring salts from the upper bedrock formations seem to be affecting the water quality of some wells in the area. This may be partly due to abandoned oil and gas exploration wells.

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INTRODUCTION

DNR staff first became aware of concerns about the quality of groundwater in the Hemlock area when the Michigan Farmer Magazine July, 1978, issue reported a Department of Agriculture investigation of Mrs. Carol Jean Kruger's dairy farm. Mrs. Kruger had concerns that problems with her livestock might be due to chemical contamination. Human health problems caused her to be suspicious of her water supply. A Department of Public Health investigation on February 8, 1978, sampled the Kruger wells for routine water supply parameters and for pesticides. The sample results showed some of the waters had high salt levels, but did not show evidence of other substances being present at levels that would be expected to cause health problems.

Staff of the Water Quality Division, Groundwater Compliance and Special Studies Section reviewed Department of Public Health data in July, 1978, and looked for any known wastewater discharges to groundwaters in the Hemlock area. No nearby discharges to groundwater were identified, although it was noted that deep well injection of brines used by the Dow Chemical Company of Midland does take place in the area. No other actions were undertaken by the Department at that time because of the lack of evidence of a groundwater problem.

In October, 1978, Water Quality Division staff were contacted by residents from the Hemlock area. The residents requested a meeting to present data that they had collected which showed the presence of organic chemical contaminants in a sample from one of their wells. Such a meeting was held in Lansing on October 24 and included the two residents concerned, an attorney who owned land in the Hemlock area, the president of Advanced Analysis and Testing, staff from the Department of Public Health, two members of the press, and DNR lab and Water Quality Division staff.

Evidence of Groundwater Problem

Residents of Hemlock presented two sets of data to those at the October 24 meeting. One set of data was an inorganic analysis of samples from eight residential wells that had been performed by Advanced Analysis and Testing, a private laboratory in Grand Rapids. The second set of data were the results of a GC/MS analysis for purgeable hydrocarbons performed on one well sample by Raltech Scientific Services, Inc. of Madison, Wisconsin.

The inorganic analysis showed some of the wells to be high in chlorides and sodium (up to 2,784 and 4,740 mg/l, respectively). Iron and manganese concentrations reported for some wells were slightly above recommended criteria for drinking water supplies, but zinc, cadmium, copper and nickel concentrations were within recommended levels.

Advanced Analysis and Testing also reported concentrations for a parameter they labeled "organic." Upon questioning by Dr. James Bedford, of the Environmental Protection Bureau Lab, it was learned that this was actually a chemical oxygen demand analysis. Dr. Bedford pointed out that the COD analysis is affected by interferences which make the test invalid in water with high salt concentrations such as that from some of the wells sampled. Dr. Bedford also observed that the inorganic analysis appeared to be either incomplete or some reported concentrations were incorrect because there was not a good mass balance of cations and anions.

Based upon the initial Advanced Analysis and Testing results, the residents chose one of the original 8 wells sampled to be analyzed for organics (Well No. 4, located at 14320 Swan Creek Road). Advanced Analysis and Testing collected another sample from this well and transmitted it to Raltech in Wisconsin. The report of this purgeable hydrocarbon GC/MS analysis was the second set of data presented to the DNR at the October 24 meeting.

Four organic compounds were identified in the sample analyzed by Raltech. Diethyl ether was reported to be present as evidenced by causing a large peak in the total ion chromatagram and verified by its mass spectrum. Three other compounds were reported as present at very low levels: 1,1,2-Trichlorotrifluoroethane (a freon), trichloroethylene, and toluene. No attempt was made to quantify the amount of the substances identified in the sample.

Department staff agreed that if any of these compounds were in fact present in groundwaters of the area, it would be evidence that the groundwater was being contaminated by artificial means. Department staff, however, were concerned that if contaminated groundwater was causing problems in this area, then compounds other than those identified by Raltech might be present.

In addition to formally presenting the Department with the laboratory data, the residents shared some of the concerns which led them to be suspicious of the groundwater: animal and human health problems would seem to improve when those affected started distilling their water; oil sheens appeared on pools of water on their property and brown stains on water taps; extensive brine mining operations were near to their water supplies. These observations caused the residents to suspect that their groundwater was polluted and prompted them to seek the involvement of State agencies in attempting to identify a groundwater problem in their area. Investigations by the Departments of Public Health and Agriculture had not established any connection between the health problems suffered by the residents or their livestock with the use of their well waters. Some of their investigations were still in progress at the time that the Raltech findings were made known on October 24. A cooperative report issued in April, 1979, documents the involvement of the Department of Agriculture, Department of Public Health, and DNR in investigating the concerns.

Initiation of DNR Investigation

Water Quality Division staff expressed appreciation to the residents at the meeting for sharing their data and assured them that the Department would resample their wells and investigate the possibility of groundwater contamination in their area.

Such an investigation began immediately. Efforts were focused along two main objectives. The first objective was to collect evidence of the presence or absence of contaminants in the groundwaters by a program of sampling existing wells in the area of concern. The second objective was to locate any potential sources of contaminants that could enter groundwaters in the area.

DNR staff felt that identifying any potential sources of contaminants in the area would be very important because it could give an indication of any particular pollutants in addition to the compounds found by the Raltech lab that should be looked for in a water quality sampling program. If widespread groundwater contamination was a probable cause of a great deal of human and animal health sufferings in the area, DNR staff suspected that some substance other than those identified so far might be the cause of it.

WATER QUALITY INVESTIGATION

Groundwater sampling did not reveal evidence of widespread organic chemical contamination of well waters in the Hemlock area. The investigation did indicate that some groundwater is of poor quality due to high concentrations of salts, that one well has evidence of bacterial contamination, and that one well has trace amounts of freon and extractable oil/grease type compounds. Specific findings were:

1. Diethyl ether, toluene, freon, and trichloroethylene were not present in two samples collected from the well in which they were originally identified or in samples from eight other wells.

2. No specific organic compounds were found above laboratory detection limits and confirmed to be present in the groundwaters of the area.

   Carbon Tetrachloride was identified as being present at 3 micrograms per liter (just above the detection limit) in one sample from one well. It was not present on the repeat sampling of the well or in the 12 other samples collected.

   An unidentified halogenated hydrocarbon was found at a concentration less than 10 micrograms per liter in one sample from one well. It was not present in two other samplings of that well or in samples from any other wells.

   Aromatic amines were identified as being present at 0.3 mg/l in one sample from one well but were undetected in two repeat samplings of the well and in 12 other samples.

Freon extractable oil/grease is present at 1-2 mg/l in one well. It may be also present in another well which showed 0 in one sample and 1 mg/l in a second sample.

PCB (Aroclor 1260) was detected at concentrations between 0.3 and 0.5 micrograms per liter in one water sample from each of the three municipal wells. Resampling and analysis of water from these wells by the Department of Public Health showed PCB to be undetectable.

Phthalates (DEHP) were detected at concentrations between 0.024 and 0.032 milligrams per liter in one water sample from each of the three municipal wells. Resampling and analysis of water from these wells by the Department of Public Health showed phthalates to be undetectable.

3. The well from which the sample was collected for the analysis by Raltech contained coliform bacteria both times it was sampled by Water Quality Division staff (400 and 1900 colonies per hundred milliliters.)

4. Groundwater can be characterized as brackish at four of the nine locations where it was sampled. Chloride concentrations in samples from these wells were greater than the 250 mg/l criteria recommended by EPA for aesthetic reasons. Total dissolved solids and sodium concentrations are similarly elevated. The waters were found to range from soft to very hard.

Sampling Locations, Dates, and Methods

Groundwater in the Hemlock area was sampled by using existing water supply wells. The location, description, and reference number of each well sampled is listed in Table 1 and is shown in Figure 1. Well No. 4 is the well from which the sample was obtained in which Raltech found the four organic chemicals. Wells numbers 1,6,7, and 8 were sampled because they are ones which the residents suspect are also contaminated (primarily because they feel improvements in their health when they stop drinking the water or distill it first.) Municipal wells were sampled at the request of the Department of Public Health. Well No. 9 was sampled because it serves several people at a small school and church and is located next to the other wells of concern.

Well No. 4 does not meet current Department of Public Health criteria for water well construction. The water supply system of this well does not yield enough water to assure that the samples obtained from it would be representative of the aquifer it taps. All other wells did yield a good flow at the time of sampling. For the November 28 sampling of the residential wells the capacity of each water supply system was computed, the flow of each system was measured, and a sufficient volume of water was discharged prior to sampling (except for Well No. 4) to assure that the samples represented water fresh from the aquifer.

Table 2 shows the dates from which water samples were obtained from the various wells in the Hemlock area. Dow Chemical Company participated in the November 28 sampling. Samples were collected by Dow staff at the same time as the DNR samples and many of the same analyses were made at both DNR and Dow Labs. Both labs findings were similar.

Water Analysis

The following substances were analyzed for in samples obtained from the water wells.

1. Diethyl ether, toluene, freon, and trichloroethylene, the substances identified by Raltech as being in one sample from Well No. 4.

2. Thirty-nine chemicals listed on the Critical Materials Register, (the 1978 list or a previous register). Thirty-four of these thirty-nine chemicals are reported to be used or produced at the Dow Chemical Company in Midland.

3. The presence of organic chemicals using gas chromatography with as many as three different GC scans per sample.

4. Several inorganic substances including heavy metals and salts.

5. General water quality parameters.

6. Total and fecal coliform.

7. General toxicity to the aquatic invertebrate, Daphnia magna as evidenced by a static bioassay.

Findings from the chemical analysis of the samples are summarized for each parameter in Table 3. Tables 4-7 show data for specific dates.

An additional analysis was made of water from Well No. 6 which had been passed through the resident's distillation apparatus. This was done because the first liquid the still produced was said to be bad by the residents. Samples of this liquid did not show the presence of volatile hydrocarbons or aromatic amines. Sample results are reported in Table 8.

Two conclusions about the toxicity of the groundwaters can be made from the data generated by the Daphnia bioassay.

1. Water from Well No. 4 is toxic to Daphnia and the high chloride concentration is likely to be the toxic agent.

2. No substance was present in samples from the other four wells that was extremely toxic to Daphnia. Some adverse affects were shown by the organisms in waters from wells 1, 6, 7, and 8. It could not be determined if the harmful effects were due to the presence of moderate levels of chlorides in the water, to the stress of handling organisms during the test, to the presence of a slightly hazardous chemical contaminant, or to a combination of these factors.

In summary, the bioassay did not give strong evidence that a chemical contaminant was present in the groundwater nor did it completely rule out the possibility.

IDENTIFICATION OF POTENTIAL SOURCES OF GROUNDWATER CONTAMINANTS

Map, file, and site visits have not identified any artificial source that is causing contaminants to enter the groundwaters on a continuing basis

near the wells of concern in the Hemlock area. Specific findings are as follows:

1. No routine discharges of wastewaters are made to groundwaters near the wells of concern that would be likely to cause widespread chemical contamination.

2. No random discharges of pollutants to groundwaters have been found to have taken place near the wells of concern in the study area.

3. The re-injection of spent brines to bedrock formations does take place throughout the area, but is not believed likely to contaminate upper aquifers. Small ponds associated with the brine operations are present next to most of the brine wells. The potential for these ponds to impact groundwaters has not been established.

4. Natural phenomena and past well drilling practices may be causing or accelerating long term changes in groundwater quality in the Hemlock area.

Existing Discharges to Groundwater

No discharges of wastewaters to groundwaters by means of seepage lagoons, septic tank systems, etc., other than residential septic tanks systems, have been found to be occurring anywhere within a three kilometer radius of Well No. 4. No wastewater discharges to groundwaters located outside the three kilometer radius are believed likely to cause contamination of the groundwaters in question. Known and potential groundwater discharges identified by this study are as follows:

1. Richland Township Wastewater Stabilization Lagoons (3.7 km northwest of Well No. 4).

These lagoons receive domestic sewage from a population of approximately 1,400 and slaughter house waste from a small meat packing operation. The lagoons are discharged on a semi-annual basis to McClellan run drain which is tributary to Swan Creek. This system is not designed to discharge to groundwater, but unintentional losses from leakage might occur.

2. Travelo Homes Corporation Seepage Lagoon (3.7 km northeast of Well No. 4).

This Company produces factory built homes. It discharges up to 1,000 gallons per day of domestic wastewater to two sewage disposal ponds. The ponds are located next to a drain that is tributary to Williams Creek both of which flow to the east away from the Hemlock area.

3. Dow Corning Semi-Conductor Products Seepage Lagoon (6.5 km northwest of Well No. 4.)

Semi-conductor grade silicon is manufactured at this plant. No critical materials are stated to be used in their operation. PCB's however, are present and are covered by an approved Pollution Incident Prevention Plan (PIPP).

4. Dow Corning Medical Products Plant Tile Field Discharge (6.8 km northwest of Well No. 4.)

Process, cooling, and sanitary wastes are discharged to the groundwater by subsurface application. Chromium, zinc, ammonia, and xylene are used in the operation. Water treatment chemicals are added to the cooling waters and are included in the discharge. PCB's are present at the plant and are covered by an approved PIPP. No problem is known to be associated with this discharge, most of which is cooling water.

Surface water run-off in the area of both Dow Corning plants is generally to the east, away from Hemlock.

Random Discharges to Groundwater

Several locations exist within a 1 kilometer radius of Well No. 4 (and greater) at which random discharges of various amounts of pollutants of groundwaters may have occurred at some time. We have no evidence that any discharge which could have caused contamination of the groundwaters in this area has ever occurred. However, such discharges might have taken place, but never been brought to the attention of the Department. Such locations include:

1. Sand pits (0.5 km south of Well No. 4 and several other locations)

Topographic maps indicate the presence of several sand pits throughout the study area, some with access roads leading to them. Many are located next to small bodies of water. It is possible that hazardous wastes may have been dumped into one of the pits and caused contaminants to leach into groundwaters. Evidence of such may or may not still be present. Unless such dumping occurred over a considerable period of time and involved large volumes of substances it is not expected that it would cause widespread contamination of groundwater in the Hemlock area.

2. Brine Transmission Pipelines (0.7 km east of Well No. 4 and extending north and south to Midland and St. Charles).

Parallel pipelines, one carrying brine from production wells to the Dow Plant in Midland and the other returning spent brine from the plant to the reinjection wells, are buried about 3 feet below the land surface. This system has been in operation since the 1950's. From time to time, leaks occur in the pipelines which cause brines to flow out to the ground until the leak is found and repaired.

Several factors determining whether the lost brines will contaminate groundwaters. For example, the volume of brine lost, nature of soil formations at the location of the leak, surface slope, and proximity of surface waters will determine if groundwaters become contaminated. Chlorides, sodium, and calcium are the major substances in the brine which are most likely to contaminate groundwaters.

It is not known to what extent the brines may have organic chemical contaminants in them. Spent brines (reinjection or disposal brines) are reported by Dow to contain about seven parts per million of organic carbon and 200 parts per million ammonia. Three parts per million of ethanol and traces of methanol and acetone have been found in the spent brines.

Table 9 and 10 reflect the components of brine currently being returned to underground formations by reinjection wells. We have no information about the nature of substances injected previous to 1974 or of the nature of the production brines.

Twenty-four losses of brine from these pipelines were reported to the DNR between June of 1977 and November of 1978. The average volume of each spill during this period was approximately 24,000 liters. We do not have complete records as to the numbers, locations, and volume of brine losses prior to May of 1977. It is possible that significant losses may have occurred during that time period which are not documented.

One brine loss is known to have occurred in the Hemlock area in October of 1978. The loss was discovered during a routine helicopter inspection of the pipeline and was found to be caused by a weld failure. An unknown amount of brine was spilled. Dow immediately began efforts to recover the lost brine by pumping it from the ground surface and by installing 13 recovery wells to collect any brine that may have seeped into groundwater. The quantity of brine lost and amount of fluid recovered is not known at this time. An evaluation of conditions at this spill site was to be made in early April, 1979.

Brine Production and Disposal

Wells owned by the Dow Chemical Company are used to transport brines to and from rock formations roughly 3,000 feet below ground level. Two such wells are located 1 kilometer away from water Well No. 4, and there are several others at greater distances along the pipeline routes. These operations began in the 1950's. Since the early 1970's, they have been regulated by the Geological Survey Division under the Mineral Well Act (Act 315) to minimize the chances that they could cause groundwater contamination.

According to the Geological Survey Division, it is unlikely that the fluids deposited in bedrock formations by this system could migrate upwards to groundwater being used by private wells. The primary basis for this judgment is the fact that there is an excess of 2,000 feet of shale between the Dundee formation

where brines are deposited and the upper aquifers which are used as water supplies. The two wells nearest water Well No. 4 each received approximately 3×10^9 gallons of brine prior to the last few years when they have been used very little. Before such wells can be put in use again, Dow must satisfy the Geological Survey that the well casings are sound and will deliver all brines into the formation for which they are intended. This was done in October of 1978, when Dow used one of the nearby wells for a short period of time. They demonstrated the well to be intact by conducting casing inspection and cement bond logs and a radioactive tracer survey. With the permission of the Geological Survey, they resumed use of one well (No. 81) in October of 1978. Shortly thereafter, the concerns about groundwater in the Hemlock area were expressed and the Geological Survey staff decided to close the well down. They had no indication that this well was in any way affecting groundwaters. However, they were aware of nearby oil and gas wells drilled to the Dundee formation that might allow some escape of the natural formation brines. It was decided not to allow the continued use of this well as an extra precaution for groundwater supplies in the area.

Brine Production Operations have been making greater use of a deeper strata, the Sylvania formation, in the last few years. Reinjection of spent brines into the Dundee is being phased out in general and one of the reasons is the Geological Survey's concern about the unknown status of abandoned wells in the area. The general location of the formations used by this system are illustrated in Figure 2 and the location of Dow's brine facilities in the Hemlock area are shown in Figure 3.

Most of the brine wells of the Dow system have a small pond constructed next to them. These can serve several purposes. Fresh water in them can be added to the saturated brines brought out by production wells so that the salts do not precipitate out as the brines cool. When accidental brine losses at the well head occur, the ponds may be used to catch any spilled brine. Sometimes the ponds receive the rinsing from the cleaning of drilling tools.

The potential for these ponds to contaminate groundwaters has not been fully evaluated. In general, they are small and appear to have clay bottoms. Ponds next to wells No. 50 and No. 81 were inspected on October 31, 1978, and the following observations made:

> The pond next to Well No. 50 is approximately 8 meters by 20 meters and up to 1 meter deep and is enclosed by a broken down fence. Deer tracks were numerous around the edge of the pond and aquatic insects and Characeae noted in the water. The bottom was of clay type material. A slight oil sheen was seen and decomposing plant material was scattered along the water's edge and bottom. Water samples showed: specific conductance = 1,175 micromhos per centimeter, COD = 32 mg/l, and TOC = ~~15.8~~ 9.8 mg/l.

Whether or not either of these ponds has ever contained hazardous substances or if they lose water to the groundwaters is not known.

Past Well Drilling Practices

For over a century, well drilling activities to explore and to develop the various resources in the Saginaw County area have been widespread. Although these practices in themselves may not cause contamination of groundwaters, they might serve as a mechanism by which fresh water aquifers could become degraded. This is particularly true when a deeply drilled well is abandoned without properly being plugged. The open hole that remains can sometimes serve as a path for contaminants to move from the surface down to the groundwater. It might also make it possible for substances formerly confined to deeper bedrock formations to migrate upward to aquifers originally free of the substances.

It is unknown how many such wells were drilled, how many were properly plugged when abandoned, or the locations of many of the wells. Drilling activities which are known to have taken place in and around the Hemlock area are listed below. The location of any such known wells in the Hemlock area are indicated in Figure 3.

1. Brine - salt production

   Since at least as early as 1859, when brine was being mined from the Marshall sandstone formation in Saginaw County, deep wells have been drilled to find and use this resource. Over the years, several companies have been involved in this enterprise with different degrees of success. Hundreds of salt wells were drilled. At one time the State Salt Commission plugged as many of the wells as could be found.

2. Coal exploration and mining

   Beginning in the late 1890's numerous borings were made in the Saginaw County area in search of coal. These penetrated much shallower than the brine and oil wells, generally less than 250 feet deep.

   The majority of the known coal borings were done south of the Hemlock area over six kilometers away from Well No. 4. One coal boring has been reported to be 2.7 kilometers northwest of Well No. 4, and there are indications that it did show coal.

3. Oil and gas exploration and production

   In 1924 to 1925, oil was found in the Dundee formation. Several exploratory wells were subsequently drilled throughout Saginaw County including the Hemlock area during the 1930's and 1940's.

   Many of the wells drilled in this effort are recorded with the Geological Survey Division. One is located 0.4 kilometers southwest of Well No. 4. This well was drilled to 3,900 feet in 1939

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and was unsuccessful in hitting a petroleum deposit. It is recorded with the Geological Survey Division that the well was plugged in 1940 according to the standards that applied at that time but did cave-in in 1941 and was replugged.

At least seven wells drilled for oil and gas exploration purposes can be identified within a 3 kilometer radius of Well No. 4. These are shown on Figure 3. For any of these which are known to be plugged after they were abandoned, it is difficult to conclude whether the well is still adequately sealed to prevent the movement of substances between rock formations.

HYDROGEOLOGIC FACTORS AFFECTING GROUNDWATER QUALITY

Salts found in upper bedrock formations are likely to degrade aquifers in the Hemlock area such as those used by Wells No. 4 and No. 1 for residential water supplies. It is far less likely that substances found in deeper formations, either naturally or artificially, are contaminating the upper aquifers.

General Hydrogeologic Relationships

Glacial drift in the Hemlock area ranges from approximately 115 to 250 feet deep as shown by well logs. The drift is predominantly clay, but does include various mixtures of sands and gravels. Water can be obtained from local aquifers within the drift in some places, such as in the case of Well Nos. 6, 8, and 9, and the municipal wells. Water is also obtained from bedrock wells as is the case with Well Nos. 1 and 4. Some of the major bedrock formations and their characteristics in the Saginaw County area are:

Saginaw Formation (shales-sandstones)
Contains fresh water and coal deposits. Locally mineralized in the Saginaw area and possibly contaminated due to salt wells.

Parma Formation (sandstone)
Contains brine, may have fresh water in some areas. Is not continuous throughout the area.

Marshall Formation (sandstone)
Similar to Parma, contains brine but may have fresh water in some areas.

Coldwater Formation (shales)
One of the major aquicludes in the area.

Berea Formation (sandstone)
Contains brine.

Traverse Formation (limestones and shales)
Contains brine.

Dundee Formation (dolomite/limestone)
Used by Dow as a source of brine. Spent brines are returned to this formation. Oil has been found in parts of formation.

In general, water from wells in the bedrock aquifer was found to be of lower quality than the water from wells in the glacial drift. Chloride and dissolved solids concentrations were found to increase with increasing well depth as is illustrated in Figure 4. The bedrock wells show very high chlorides and dissolved solids concentrations when compared to the drift wells.

Causes of Salt Water Movement

Salt water can migrate to fresh water wells by at least two means in the Hemlock area. Fresh water withdrawn by water wells may be replaced over with salt water from unconfined formations below the fresh water zone, particularly during periods of low recharge. If the salt water aquifer is confined, the movement may still take place due to the presence of many abandoned holes which may not be adequately plugged. Figures 5, 6, and 7 illustrate salt water movement to fresh water zones.

Geologic Cross Section

Figure 8 is a geologic cross section which shows a water well, an abandoned oil and gas well, and a brine disposal (repressurization or reinjection) well in relation to the subsurface geology of the Hemlock area. The cross section is made through water Well No. 1 and its exact location is shown in Figure 9. This graphic presentation makes clear the following:

1. Salt bearing formations (Parma and Marshall) exist within 1,000 feet of the aquifers being used for water supplies.

2. The Dundee formation which has received spent brines from Dow Chemical is over 2,000 feet away (vertically) from the aquifers used for water supplies.

3. Extensive shale formations separate the Dundee formation from the upper aquifers.

4. An oil and gas exploration well near the water well and reinjection well has penetrated through all formations down to the Dundee. It is not known if the plugging done in 1941 has completely sealed all formations or not.

Water and Brine Ionic Composition

Brines of different origin vary in the ratios of inorganic ions within them. If a brine enters fresh water, essentially a dilution process occurs, and the ions are still present in the same ratios to each other as prior to the dilution. If two brines are mixed, it would, of course, be expected that the ionic ratios would change. Figures 10 and 11 illustrate the ratio of ions in each of the well waters, in the Parma and Marshall formation brines, and in spent brine deposited in the Dundee formation by Dow.

From the diagrams, the following observations can be made.

1. Salts in the water wells are made up primarily of sodium chloride with negligible amounts of calcium, particularly in the wells of highest salt concentration (No. 4 and No. 1).

2. Parma formation brines are very similar in ionic composition to the salts in the water wells; that is, they are primarily sodium chloride.

3. Marshall formation brines are also primarily sodium chloride, but do contain a recognizable amount of calcium.

4. Reinjection brine is primarily calcium chloride.

This analysis is supportive of the conclusion that upper bedrock formation brines are likely to be entering the aquifers used by area water wells and that the brines disposed of by Dow are not likely to be entering these aquifers.

QUESTIONS NOT ADDRESSED BY THIS STUDY

In order to completely define groundwater relationships in the Hemlock area, several questions not addressed by this study would need to be answered. Some of these questions may be pursued at any time, particularly if new evidence of artificial groundwater contamination is discovered.

Groundwater Movement

Groundwater gradients and velocities have not been determined as part of this investigation. It could be inferred from the topography of the area that groundwater movement will generally be toward the southeast and east following Smith Drain, then northward. Velocities are not expected to be very great as land surface and surface water elevations do not change greatly from this part of the watershed to the discharge at Saginaw Bay (approximately a 13.7 meter fall in over 40 kilometers.)

Area residents are of the opinion that their water quality changes quite drastically over relatively short periods of time. Two samplings by this study at 35 days apart are insufficient to establish any trends, but did not show large differences in water quality. Some water quality data from Well No. 1 was collected and analyzed by other labs at least 3 other times since November of 1977. This data must be interpreted with caution, but does show that water quality changes have occurred at this point in the aquifer, particularly near the end of 1978. The conductivity of water samples collected from Well No. 1 for the bioassay was 50% lower than that measured in samples collected just prior to and after the bioassay. If these measurements are valid, it would be evidence of a significant change in the nature of the aquifer over a short period of time. These relationships are presented in Figure 12.

Frequent sampling of this well over a long period of time can be undertaken to document what variation of water quality does occur at one point in the aquifer.

Nature of Substances Transported in Brine System

At this time we have little evidence of what substances may have passed through the Dow brine system since it was put into operation. Our knowledge of the composition of the brine prior to its being used by Dow is especially limited. Dow has presented evidence that diethyl ether, freon, and trichloroethylene are not present in any phase of their brine system. They have documented toluene and benzene to be present in raw (production) brines at concentrations of 180 ppb and 700 ppb, respectively. A more thorough investigation of this system can be undertaken if it is deemed warranted.

CONCLUSION

This study has attempted to determine if aquifers in the Hemlock area show evidence of artificial chemical contamination. Data collected thus far has not shown any such contaminant to be present. The study was not intended to be a thorough hydrogeological investigation or an assessment of the effects of the use of these waters.

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ACKNOWLEDGMENTS

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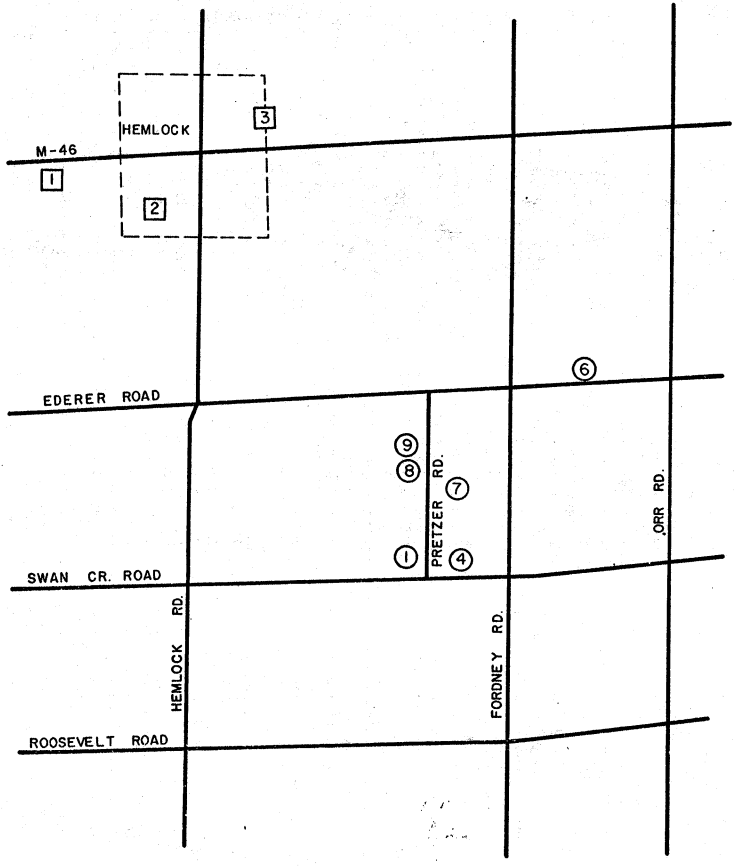
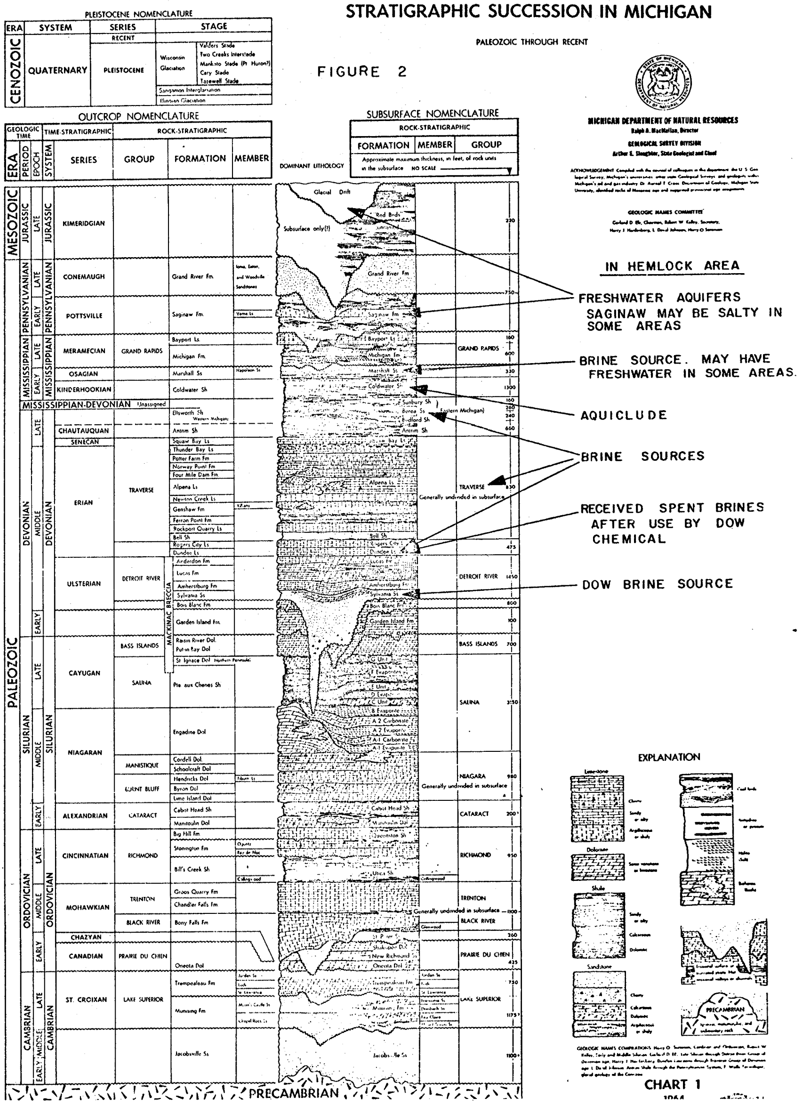
FIGURES

FIGURE 1
GROUNDWATER SAMPLING LOCATIONS
HEMLOCK AREA
GROUNDWATER INVESTIGATION
MICHIGAN DEPARTMENT OF NATURAL RESOURCES



LEGEND:
(1) RESIDENTIAL WELL
[1] MUNICIPAL WELL

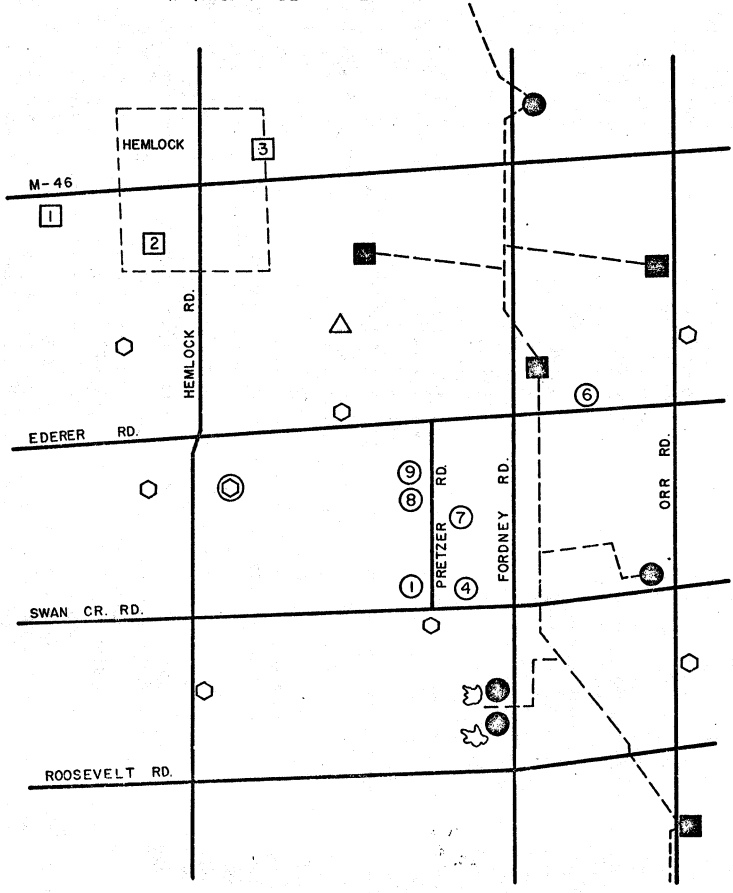
N
0 1 KILOMETER



STRATIGRAPHIC SUCCESSION IN MICHIGAN
PALEOZOIC THROUGH RECENT
FIGURE 2
MICHIGAN DEPARTMENT OF NATURAL RESOURCES
PLEISTOCENE NOMENCLATURE
ERA
SYSTEM
SERIES
STAGE
RECENT
CENOZOIC
QUATERNARY
PLEISTOCENE
OUTCROP NOMENCLATURE
SUBSURFACE NOMENCLATURE
ROCK-STRATIGRAPHIC
FORMATION
MEMBER
GROUP
DOMINANT LITHOLOGY
MESOZOIC
PALEOZOIC
KIMERIDGIAN
CONEMAUGH
POTTSVILLE
MERAMECIAN
OSAGIAN
KINDERHOOKIAN
MISSISSIPPIAN-DEVONIAN
CHAUTAUQUAN
SENECAN
ERIAN
ULSTERIAN
CAYUGAN
NIAGARAN
ALEXANDRIAN
CINCINNATIAN
MOHAWKIAN
CHAZYAN
CANADIAN
ST. CROIXAN
PRECAMBRIAN
IN HEMLOCK AREA
FRESHWATER AQUIFERS
SAGINAW MAY BE SALTY IN SOME AREAS
BRINE SOURCE. MAY HAVE FRESHWATER IN SOME AREAS.
AQUICLUDE
BRINE SOURCES
RECEIVED SPENT BRINES AFTER USE BY DOW CHEMICAL
DOW BRINE SOURCE
EXPLANATION
CHART 1

FIGURE 3

WATER SAMPLING AND MINERAL WELL LOCATIONS
HEMLOCK AREA
GROUNDWATER INVESTIGATION
MICHIGAN DEPARTMENT OF NATURAL RESOURCES



LEGEND:

- (1) RESIDENTIAL WELL
- [1] MUNICIPAL WELL
- BRINE REPRESSURIZATION WELL
- BRINE PRODUCTION WELL
- △ COAL BORING
- ⬡ DRY HOLE - OIL EXPLORATION
- ◎ OIL WELL
- ---BRINE LINES
- POND AT WELL HEAD

N

0 1KILOMETER

FIGURE 4
DISSOLVED SOLIDS vs. WELL DEPTH
HEMLOCK GROUNDWATER INVESTIGATION
OCTOBER 25, 1978 AND NOVEMBER 28, 1978 DATA

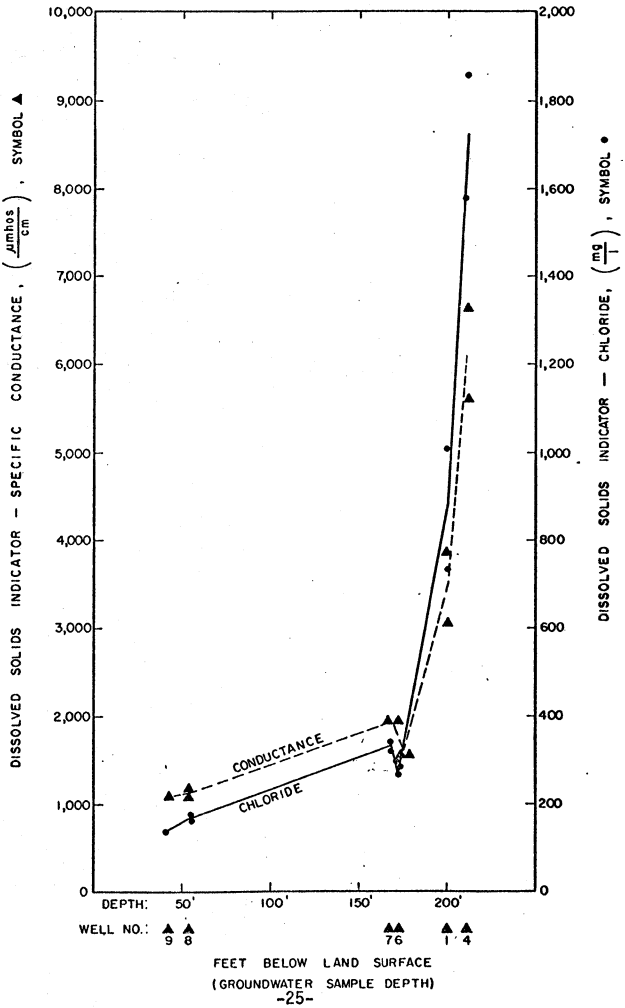


Figure 5

Salt Water Replacement of Freshwater

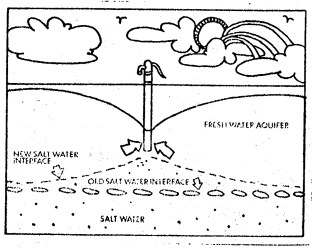


Figure 6

Salt Water Movement Through Casing Leaks

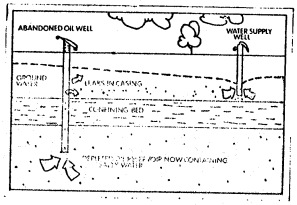


Figure 7

Salt Water Movement Through Abandoned Hole

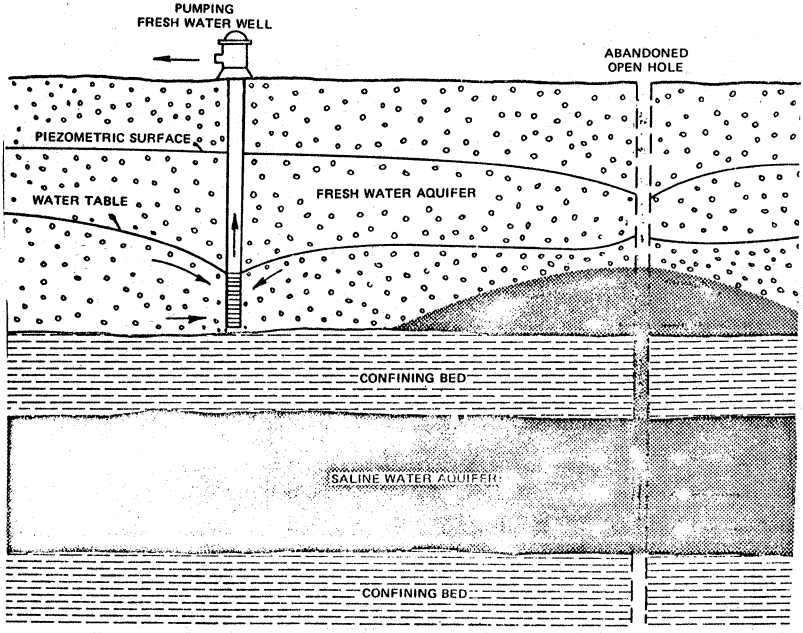
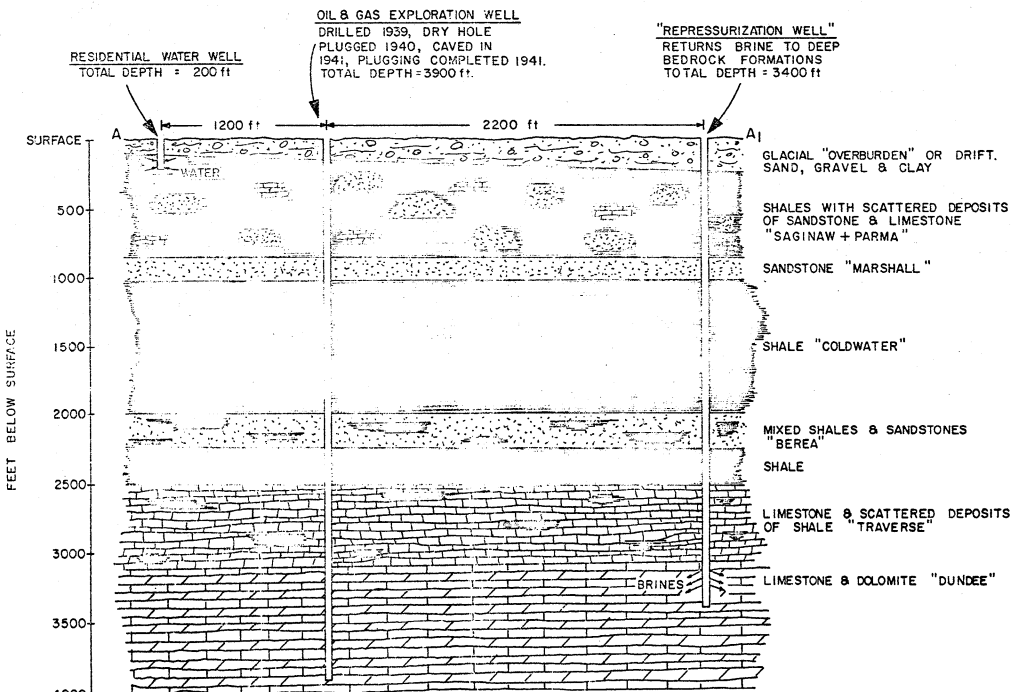
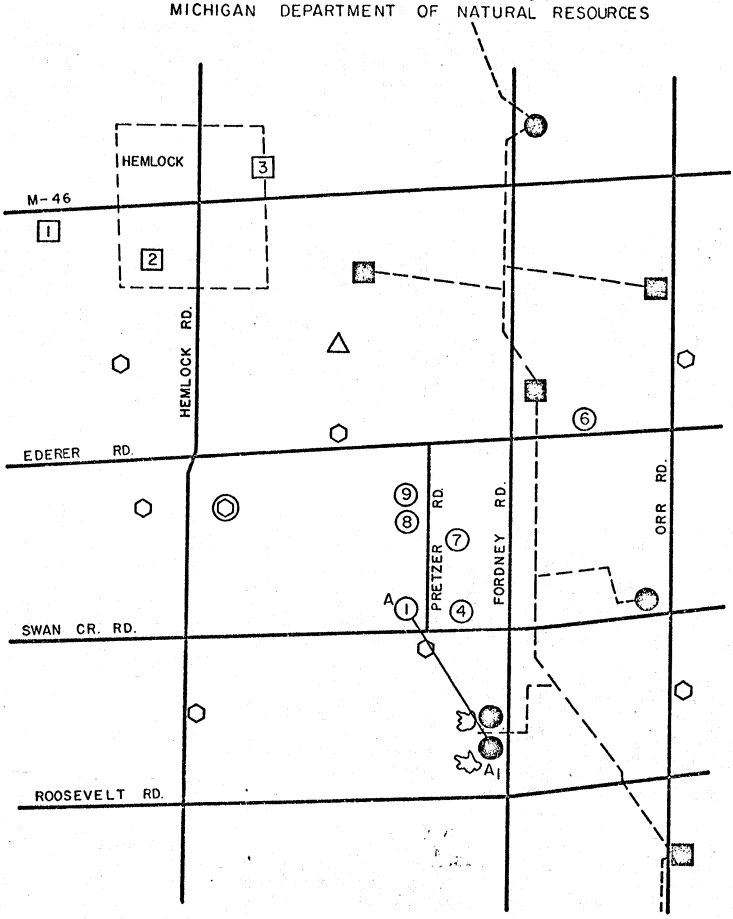


FIGURE 8
HEMLOCK AREA GROUNDWATER INVESTIGATION
GEOLOGIC CROSS SECTION



NOTE: THE LOCATION AND NATURE OF THE FORMATIONS INDICATED HERE ARE NOT EXACT INTERPRETATIONS OF THE LOGS FOR EACH OF THESE WELLS. THE CROSS SECTION DOES REPRESENT A SUMMARY OF THE MAJOR STRATA ENCOUNTERED BY EACH WELL SHOWN.

FIGURE 9
LOCATION OF GEOLOGIC CROSS SECTION
HEMLOCK AREA
GROUNDWATER INVESTIGATION
MICHIGAN DEPARTMENT OF NATURAL RESOURCES



LEGEND:

- (1) RESIDENTIAL WELL
- [1] MUNICIPAL WELL
- BRINE REPRESSURIZATION WELL
- BRINE PRODUCTION WELL
- △ COAL BORING
- ⬡ DRY HOLE - OIL EXPLORATION
- ◎ OIL WELL
- ---BRINE LINES
- POND AT WELL HEAD
- A——————A1 LOCATION OF CROSS SECTION

N

0 1KILOMETER

FIGURE 10

MAJOR IONS IN WELL WATERS

HEMLOCK GROUNDWATER INVESTIGATION

NOVEMBER 28, 1978 DATA

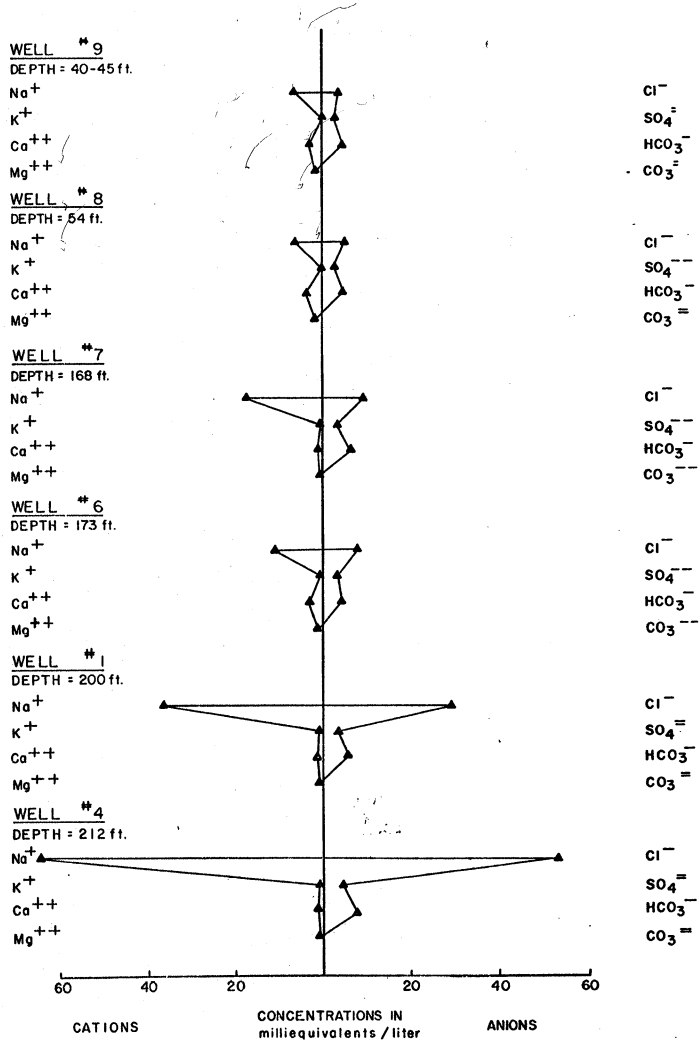
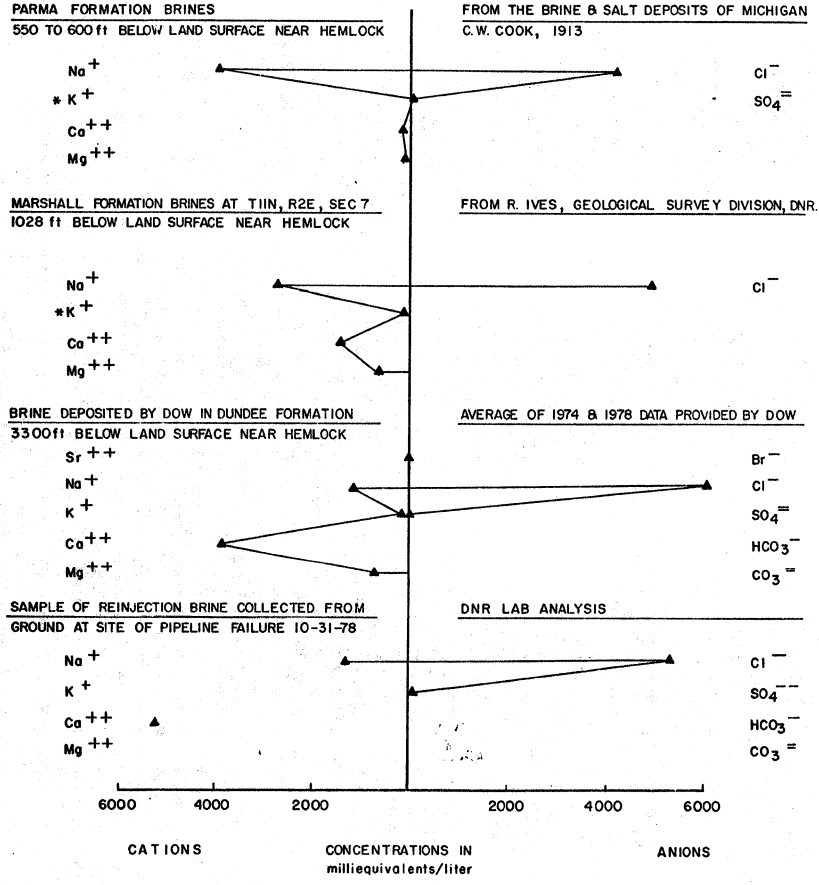


FIGURE 11

MAJOR IONS IN BRINES

HEMLOCK GROUNDWATER INVESTIGATION



*CONCENTRATION INFERRED BASED ON MASS BALANCE AND OTHER DATA FROM AREA.

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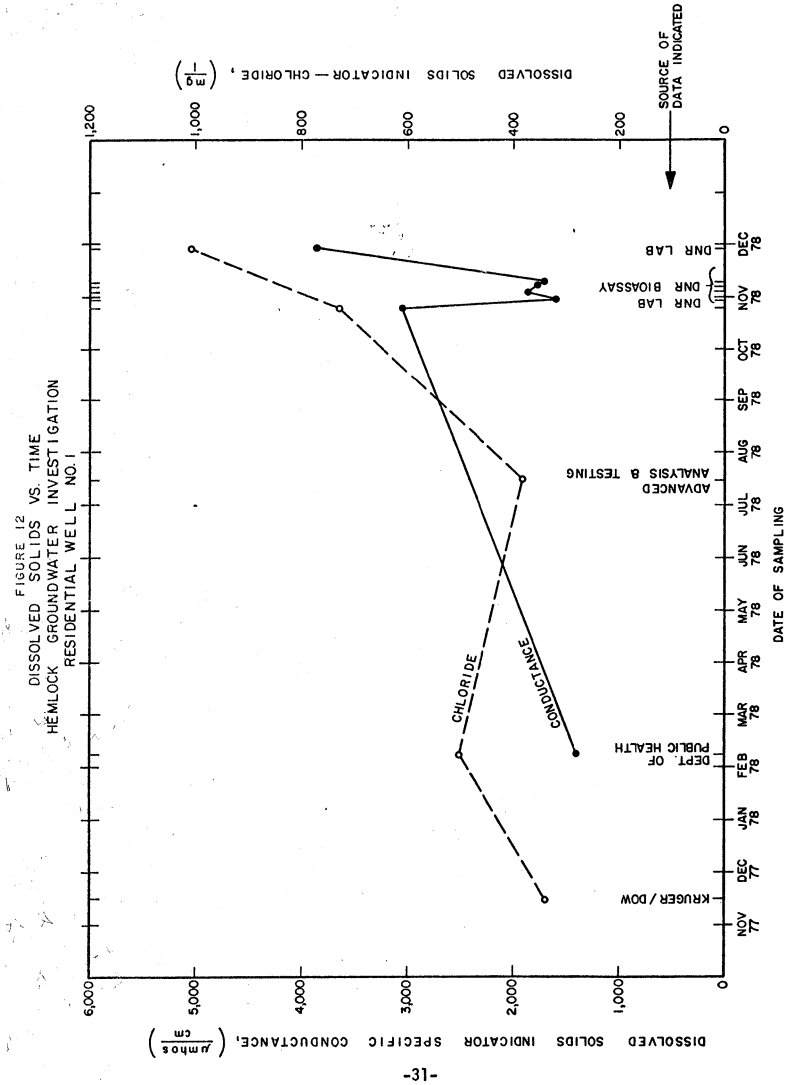

FIGURE 12
DISSOLVED SOLIDS VS. TIME
HEMLOCK GROUNDWATER INVESTIGATION
RESIDENTIAL WELL NO. 1

TABLE 1

Hemlock Groundwater Investigation
Groundwater Sampling Locations -
Well Data

Well Number	Location	Description
Residential Wells:		
1	2880 Pretzer Road Hemlock, Michigan NE 1/4, SE 1/4, SW 1/4, Sec. 2, T11N R2E	Total depth = 200 feet into sandstone. Flows at surface. Submersible pump. M.D.P.H. approved construction. Log available.
4	14320 Swan Creek Road Hemlock, Michigan SE 1/4, SW 1/4, SE 1/4, Sec. 2, T11N R2E	Total depth is said to be about 212 feet. Casing comes up into 3 feet diameter crock. Suction pipe goes down casing to water at unknown level. System not capable of providing continual flow of water for valid groundwater sample. No log available.
6	13584 Ederer Road Hemlock, Michigan SE 1/4, SE 1/4, SW 1/4, Sec. 36, T12N R2E	Total depth = 173 feet into sand. Static water level is 5 feet below ground level. Jet pump. Log available.
7	2495 Pretzer Road Hemlock, Michigan SE 1/4, SW 1/4, NE 1/4, Sec. 2, T11N R2E	Total depth said to be 168 feet. Submersible pump at 100 feet. Construction meets M.D.P.H. approval criteria. No log available.
8	2430 Pretzer Road Hemlock, Michigan SE 1/4, SE 1/4, NW 1/4, Sec. 2, T11N R2E	Total depth = 54 feet in sand and gravel. Water level even with land surface. Jet pump. Construction meets M.D.P.H. approval criteria. Log available.

Well Number	Location	Description
Semi-public Wells:		
9	2290 Pretzer Road Hemlock, Michigan SE 1/4, NE 1/4, NW 1/4, Sec. 2, T11N R2E	Total depth said to be between 40 and 45 feet. Jet pump. No log available.
Municipal Water Supply Wells:		
1(A)	500 feet South of M-46 on West side of Hemlock NE 1/4, SW 1/4, Sec. 28, T12N R2E	Total depth = 171 feet in sand and gravel. Static water level = 12 feet below land surface. Log available.
2(B)	West end of Sproll Street, Hemlock NE 1/4, SW 1/4, SE 1/4, Sec. 28, T12N R2E	Total depth = 172 feet in sand and gravel. Static water level is 25 feet below land surface. Log available.
3(C)	Blumke Memorial Park Hemlock NE 1/4, SE 1/4, NW 1/4, Sec. 27, T12N R2E	Total depth = 138 feet in sand and gravel. Static water level is 9 1/2 feet below land surface. Log available.

TABLE 2

HEMLOCK GROUNDWATER INVESTIGATION

WATER SAMPLES COLLECTED BY DEPARTMENT OF NATURAL RESOURCES

DATE	SAMPLE LOCATION	PURPOSE
October 25	Residential water supply wells (Numbers 1, 4, 6, 7 and 8)	Chemical Analysis
October 31	Municipal water supply wells (Number 1, 2, and 3)	Chemical Analysis
	Two ponds next to #50 Brine well (labeled south pond & north pond)	Chemical Analysis
	Residential water supply wells (#s, 1, 4, 6, 7 and 8)	Bioassay
	Reinjection brine spilled from transmission pipeline	Chemical Analysis
November 3	Residential water supply wells (#s, 1, 4, 6, 7 and 8)	Bioassay
November 6	Residential water supply wells (#s, 1, 4, 6, 7 and 8)	Bioassay
November 9	Residential water supply wells (#s, 1, 6, 7 and 8)	Bioassay
November 13	Residential water supply wells (#s 1, 6, 7 and 8)	Bioassay
	Residential well #6	Chemical Analysis
November 28	Residential water supply wells (#s, 1, 4, 6, 7 and 8)	Chemical Analysis
	St. John's Lutheran Church, School, and Parsonage, water supply well (#9).	

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TABLE 3

HEMLOCK GROUNDWATER INVESTIGATION
Summary of Groundwater Quality Data

Source: Department of Natural Resources' analyses of samples from three municipal, one semi-public, and five residential water supply wells.

Dow Chemical Company analyses of samples from one semi-public and five residential water supply wells.

The range of findings for each parameter analyzed and total number of observations of each parameter (sum of analyses made) is reported. For some parameters, the concentrations were compared with a recommended safe level for that parameter in drinking water. The criteria for comparison is listed for those parameters and the source of the criteria is referenced by footnote.

Specific information about the location and nature of the wells sampled is available from the Groundwater Compliance and Special Studies Section of the Water Quality Division. Samples indicated as coming from well #4 may not be representative of groundwater at that location.

Parameter and Units	Criteria for Drinking Water	Number of Observations	Range of Analysis Results	Special Notes
Total Organic Carbon mg/l	--	14	0.1 to 1.4	
Specific Conductance umhos/cm	--	14	675 to 6630	Total dissolved solids greater than 1000 mg/l are considered excessive.[3] Conductance values > 1550 umhos/cm indicate TDS concentrations are likely to be > 1000mg/l

Parameter and Units	Criteria for Drinking Water	Number of Observations	Range of Analysis Results	Special Notes
pH S.U.	5 to 9[1]	8	7.7 to 8.2	
Total Coliforms col/100 ml	<1[2]	6	<100 to 1900	Coliform present only in well #4 (two samples, 400 and 1900)
Fecal Coliform col/100 ml	<1[2]	5	<10	
Freon Extractable Oil and Grease mg/l	"Virtually free from any"[1]	14	U to 2	Well #8 measured 1 mg/l and 2 mg/l on successive samples. Well #4 = 1 mg/l on one of two samples
Total Recoverable Phenolics ug/l	1[1]	14	.1 to 7.6	Criteria is specifically for phenol. An indepth analysis of samples showing 3.7 and 4.8 ug/l of total recoverable phenolics did not detect the presence of any of 40-50 specific phenolic compounds at levels >1 ug/l[4]
Aromatic Amines mg/l	--	15	U to 0.3	0.3 mg/l detected in sample from Well #6 on first sampling but undetected in same well on 2 repeat samplings and all other well samples.

Parameter and Units	Criteria for Drinking Water	Number of Observations	Range of Analysis Results	Special Notes
Methylene Blue Active Substances mg/l	0.5[3]	8	.015 to .08	
Inorganic:				
Ammonia mg/l	--	8	.22 to .55	
Nitrate-Nitrite mg/l	10[2]	8	.003 to .16	
Total Phosphorus mg/l	--	8	.008 to .102	
Sodium mg/l	--	14	81 to 1500	
Potassium mg/l	--	14	1.9 to 13	
Calcium mg/l	--	14	4.4 to 75	
Magnesium mg/l	--	14	3.1 to 25	
Chloride mg/l	250[3]	14	45 to 1860	4 residential wells exceed criteria
Chlorine mg/l	--	6	156 to 2040	
Total Sulfates mg/l	250[3]	14	60 to 210	
Total Alkalinity mg/l	--	5	195 to 332	
Bicarbonate mg/l	--	14	230 to 480	
Carbonate mg/l	--	14	0	
Bromine mg/l	--	6	U	
Fluoride mg/l	2.4[2]	14	.2 to 2.3	
Sulfide mg/l	--	14	U to 0.15	
Iodide mg/l	--	8	.002 to .017	

Parameter and Units	Criteria for Drinking Water	Number of Observations	Range of Analysis Results	Special Notes
Boron mg/l	--	8	0.3 to 4.6	
Arsenic ug/l	50[2]	6	U to 7.2	
Strontium mg/l	--	6	U	
Rubidium mg/l	--	6	U	
Mercury ug/l	2[2]	6	U	
Cadmium ug/l	10[3]	8	<1	
Total Chromium ug/l	50[2]	8	1 to 5	
Hexavalent Chromium ug/l	--	5	<1 to 2	
Copper ug/l	1000[2]	8	3 to 29	
Iron ug/l	300[3]	8	74 to 740	
Nickel ug/l	--	8	<5	
Lead ug/l	50[2]	8	<5	
Zinc ug/l	5000[2]	8	<1 to 200	
Manganese ug/l	50[1]	8	5 to 22	
Antimony ug/l	--	8	<5	
Silver ug/l	50[2]	8	2 to 6	
Titanium ug/l	--	8	<25	
Cyanide ug/l	200[3]	8	U to .4	Undetected in all private wells

Parameter and Units	Criteria for Drinking Water	Number of Observations	Range of Analysis Results	Special Notes
Organics:				
diethyl ether ug/l	--	15	U	
toluene ug/l	--	15	U	
1,1,2, trichlorotri-fluoromethane(freon) ug/l	--	15	U	
trichloroethylene ug/l	--	15	U	
carbon tetrachloride ug/l	--	14	U to 3.	3 ug/l found in one sample from well #7. None present when #7 was resampled or in any other samples.
Volatile hydrocarbon scan ug/l	--	15	U to 10	Other than above, one unknown at <10 ug/l found in a sample from well #6. This unknown was not present the two other times the well was sampled.
Aroclor 1242 (PCB) ug/l	--	14	U	
Aroclor 1254 (PCB) ug/l	--	14	U	
Aroclor 1260 (PCB) ug/l	--	14	U to 0.5	Present in original samples from municipal wells. Undetected when resampled and tested by both DNR and DPH labs

Parameter and Units	Criteria for Drinking Water	Number of Observations	Range of Analysis Results	Special Notes
PBB ug/l	--	8	U	
Benzene ug/l	--	8	U	
Xylene ug/l	--	8	U	
Diethyl benzene ug/l	--	8	U	
Cumene ug/l	--	8	U	
Styrene ug/l	--	8	U	
Vinyl toluene ug/l	--	8	U	
Chlorobenzene ug/l	--	8	U	
Phthalates ug/l	--	8	U to 32	Present in original samples from municipal wells. Resampling and analysis by DPH found them to be undetected.
2,4,5, T ug/l	--	8	U	
Hexachloroebenzene (HCB) ug/l	--	8	U	
Nitrophenol ug/l	--	8	U	
Butanol ug/l	--	8	U	
Picloram ug/l	--	8	U	
Hexachlorobutadiene ug/l	--	6	U	
Pentachlorophenol ug/l	--	6	U	
Tetrachlorophenol	--	6	U	

Parameter and Units	Criteria for Drinking Water	Number of Observations	Range of Analysis Results	Special Notes
Trichlorophenol	--	6	U	
Dichlorobenzene ug/l	--	6	U	
Aniline ug/l	--	6	U	
Benzaldehyde ug/l	--	6	U	
Pyridine ug/l	--	6	U	
Hydroquinone ug/l	--	6	U	
Butyric acid	--	6	U	
Ethyl acrylate	--	6	U	

Key to Symbols:

mg/l = milligrams per liter; ug/l = micrograms per liter; umhos/cm = micromhos per centimeter; <= less than; U = undetected; > = greater than

References:

1. Quality Criteria for Water, U.S. E.P.A., July, 1976

2. Major Requirements of the Federal Interim Primary Drinking Water Regulations Covering Public Water Systems Established Under the Safe Drinking Water Act, (PL 93-523), Effective date: June 24, 1977

3. Drinking Water Standards, 1973 Revision, Appendix, EPA Advisory Committee on the Revision and Application of Drinking Water Standards recommendations to the Administrator, Environmental Protection Agency

4. L.B. Westover, Dow Chemical Company, letter to G. Klepper, Michigan Department of Natural Resources, December 19, 1978

TABLE 4

WELL SAMPLES
HEMLOCK AREA
October 25, 1978
Michigan DNR

PARAMETER	WELL NUMBER				
	1	4	7	8	6
Chemical Oxygen Demand (mg/l)(C.O.D.)	Interference	Interfer.	8	5	6
Total Organic Carbon (mg/l) (T.O.C.)	0.2	0.8	0.1	1.0	0.6
pH (S.U.)	7.8	7.8	8.2	7.7	7.7
Nitrate-Nitrite (mg/l)	0.005	0.160	0.008	0.005	0.006
Ammonia (mg/l)	0.41	0.55	0.27	0.29	0.28
Organic Nitrogen (mg/l)	0.14	0.15	0.12	0.12	0.13
Total Phosphorus (mg/l)	0.012	0.015	0.010	0.102	0.008
Chloride (mg/l)	730	1580	340	169	270
Total Sulfates (mg/l)	130	180	160	120	140
Sodium (mg/l)	710	1400	490	170	270
Potassium (mg/l)	7.3	13.0	4.9	3.1	3.8
Calcium (mg/l)	29.	32.	12	70	65
Magnesium (mg/l)	9.6	12.0	3.1	25.0	17.0
Conductivity (umhos/cm)	3060	5600	1925	1140	1485
Total Alkalinity (mg/l)	244	328	332	205	195

PARAMETER	WELL NUMBER				
	1	4	7	8	6
Carbonate (mg/l)	0	0	0	0	0
Bicarbonate (mg/l)	296	400	406	250	238
Iodide (mg/l)	0.007	0.017	0.003	0.002	0.002
Fluoride (mg/l)	1.3	1.4	2.3	1.1	0.92
Boron (mg/l)	2.9	4.6	4.0	0.5	0.6
Sulfide (mg/l)	<.05	<.05	<.05	0.15	<.05
Phenol (µg/l)	5.2	7.0	7.6	5.0	2.0
Total Cyanides (mg/l)	U	U	U	U	U
Total Cadmium (µg/l)	<1	<1	<1	<1	<1
Total Chromium (µg/l)	4	5	1	2	2
Hexavalent Chromium (µg/l)	<1	1	< 1	2	<1
Total Copper (µg/l)	7	29	4	4	4
Total Iron (µg/l)	130	610	74	700	410
Total Nickel (µg/l)	<5	<5	<5	<5	<5
Total Lead (µg/l)	<5	<5	<5	<5	<5
Total Zinc (µg/l)	<1	100	50	200	50
Manganese (µg/l)	22	16	5	12	11
Antimony (µg/l)	<5	<5	<5	<5	<5

PARAMETER	WELL NUMBER				
	1	4	7	8	6
Silver (µg/l)	4	6	2	2	4
Titanium (µg/l)	<25	<25	<25	<25	<25
Aroclor 1242 (PCB) (µg/l)	U	U	U	U	U
Aroclor 1254 (PCB) (µg/l)	U	U	U	U	U
Aroclor 1260 (PCB) (µg/l)	U	U	U	U	U
PBB (µg/l)	U	U	U	U	U
Freon Extractable Oil & Grease (mg/l)	U	U	U	2	U
MBAS (mg/l)	0.07	0.05	0.06	0.08	0.06
Aromatic Amines (mg/l)	U	U	U	U	0.3
Diethyl Ether (mg/l)	U	U	U	U	U
Benzene (mg/l)	U	U	U	U	U
Toluene (mg/l)	U	U	U	U	U
Trichloroethylene (mg/l)	U	U	U	U	U
1,1,2 - Trifluorotrichloroethane (mg/l)	U	U	U	U	U
Xylene (mg/l)	U	U	U	U	U
Diethyl Benzene (mg/l)	U	U	U	U	U
Cumene (mg/l)	U	U	U	U	U
Styrene (mg/l)	U	U	U	U	U

PARAMETER	WELL NUMBER				
	1	4	7	8	6
Vinyl Toluene (mg/l)	U	U	U	U	U
Chlorobenzene (mg/l)	U	U	U	U	U
Phthalates (mg/l)	U	U	U	U	U
2,4,5-T (mg/l)	U	U	U	U	U
Hexachlorobenzene (HCB) (mg/l)	U	U	U	U	U
Nitrophenol (mg/l)	U	U	U	U	U
Butanol (mg/l)	U	U	U	U	U
Carbon Tetrachloride (mg/l)	U	U	.003	U	U
Fecal Coliform col/100 ml	<10	<10	<10	<10	<10
Total Coliform col/100 ml	<100	1900	<100	<100	<100

U means material analyzed for, but not detected.

< means actual value is known to be less than value given.

mg/l = Milligrams per liter

µg/l = Micrograms per liter

TABLE 5

WELL SAMPLES
RICHLAND TOWNSHIP WATER SUPPLY
OCTOBER 31, 1978

DEPARTMENT OF NATURAL RESOURCES

PARAMETER	WELL NUMBER 1	2	3
Chemical Oxygen Demand (mg/l)	5	4	6
Total Organic Carbon (mg/l)	1.4	1.2	1.3
pH (S.U.)	7.7	7.7	7.7
Nitrate-Nitrite (mg/l)	0.005	0.003	0.005
Ammonia (mg/l)	0.22	0.25	0.38
Organic Nitrogen (mg/l)	0.15	0.21	0.19
Total Phosphorus (mg/l)	0.012	0.023	0.022
Chloride (mg/l)	45	45	66
Total Sulfates (mg/l)	60	60	65
Conductivity (umhos/cm)	675	675	705
Sodium (mg/l)	81	81	110
Potassium (mg/l)	2.6	2.7	1.9
Calcium (mg/l)	51	52	37
Magnesium (mg/l)	20	20	18
Carbonate (mg/l)	0	0	0
Bicarbonate (mg/l)	258	262	230
Iodide (mg/l)	0.005	0.004	0.004
Fluoride (mg/l)	0.64	0.54	0.56
Boron (ug/l)	400	300	500
Sulfide (mg/l)	<0.05	<0.05	<0.05
Phenol (ug/l)	<0.1	<0.1	1.0
Total Cyanides (mg/l)	0.0002	0.0004	0.0001
Total Cadmium (ug/l)	<1	<1	<1
Total Chromium (ug/l)	3	4	2
Total Copper (ug/l)	7	9	3
Total Iron (ug/l)	740	270	220
Total Nickel (ug/l)	<5	<5	<5
Total Lead (ug/l)	<5	<5	<5
Total Zinc (ug/l)	11	22	7
Manganese (ug/l)	22	6	4
Antimony (ug/l)	<5	<5	<5
Silver (ug/l)	3	4	4
Titanium (ug/l)	<25	<25	<25
Aroclor 1242 (PCB) (ug/l)	U	U	U
Aroclor 1254 (PCB) (ug/l)	U	U	U
Aroclor 1260 (PCB) (ug/l)	0.3	0.5	0.4
PBB (ug/l)	U	U	U
Freon Extractable Oil (mg/l)	U	U	U
MBAS (mg/l)	0.015	0.015	0.015
Aromatic Amines (mg/l)	U	U	U
Diethyl Ether (mg/l)	U	U	U
Benzene (mg/l)	U	U	U
Toluene (mg/l)	U	U	U
Xylene (mg/l)	U	U	U
Diethyl Benzene (mg/l)	U	U	U

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Cumene (mg/l)	U	U	U
Styrene (mg/l)	U	U	U
Vinyl Toluene (mg/l)	U	U	U
Chlorobenzene (mg/l)	U	U	U
Trichloroethylene (mg/l)	U	U	U
Freon (mg/l)	U	U	U
Butanol (mg/l)	U	U	U
Phthalates (DEHP) (mg/l)	0.024	0.032	0.024
Phthalates (DNBP) (mg/l)	U	U	U
2,4,5-T (mg/l)	U	U	U
Picloram (mg/l)	U	U	U
Hexachlorobenzene (mg/l)	U	U	U
Nitrophenol (mg/l)	U	U	U

U means material analyzed for, but not detected
< means actual value is known to be less than value given
mg/l = milligrams per liter
ug/l = micrograms per liter

TABLE 6

HEMLOCK GROUNDWATER INVESTIGATION

Residential Well Sample
November 13, 1978

Results of Laboratory Analysis

Well No. 6	Aromatic Amines = undetected Volatile Hydrocarbon Scan = one unknown halogenated compound present at less than 10 ug/l.

TABLE 7

HEMLOCK AREA GROUNDWATER INVESTIGATION
WELLS SAMPLED BY MICHIGAN DNR
and
DOW CHEMICAL COMPANY
November 28, 1978
WATER QUALITY ANALYSES

PARAMETER	UNITS	WELL NUMBERS											
		1		4		6		7		8		9	
GENERAL:		DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW
Total Organic Carbon (TOC)	mg/l	0.2	NA	0.6	NA	0.6	NA	1.1	NA	1.2	NA	1.2	NA
Conductivity	µmhos/cm	3870	NA	6630	NA	1540	NA	1920	NA	1160	NA	1090	NA
Freon Extractable Oil & Grease	mg/l	U	NA	1	NA	U	NA	U	NA	1	NA	U	NA
Phenolics - total recoverable	µg/l	3.7	NA	1.3	NA	0.1	NA	0.2	NA	4.0	NA	0.2	NA
Aromatic Amines	mg/l	U	NA	U	NA	U	NA	U	NA	U	NA	U	NA
Total Coliform	col/100 ml	NA	NA	400	NA	NA	NA	NA	NA	NA	NA	NA	NA
INORGANIC:													
Sodium (Na^+)	mg/l	850	800	1500	1390	240	236	410	400	150	143	150	139
Potassium (K^+)	mg/l	7.5	7.2	13	12	3.3	3.2	4.5	4.2	2.9	2.5	2.8	2.5
Calcium (Ca^{++})	mg/l	30	28	34	36	67	64	23	20	75	67	63	57
Magnesium (Mg^{++})	mg/l	10	9.6	13	13	17	16	4.4	4.6	24	23	20	19
Strontium (Sr^{++})	mg/l	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Mercury (Hg^{++})	ug/l	U	U	U	U	U	U	U	U	U	U	U	U
Rubidium (Rb^+)	mg/l	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Chlorine*	mg/l	NA	1150	NA	2040	NA	314	NA	370	NA	190	NA	156
Chloride	mg/l	1010	NA	1860	NA	270	NA	320	NA	171	NA	138	NA
Arsenic	ug/l	NA	U	NA	0.8	NA	5.3	U	U	5.9	7.2	2.5	3.4

*Analysis by Neutron Activation which measures chlorine in any form including chlorides.

Hemlock Area Well Analyses, Page 2

PARAMETER	UNITS	1		4		6		7		8		9	
INORGANIC (Con't.)		DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW
Sulfates ($SO_4^=$)	mg/1	150	130	210	160	150	120	160	130	120	115	110	110
Bicarbonate (HCO_3^-)	mg/1	335	340	465	480	245	260	375	380	260	260	255	260
Bromine (Br^-)	mg/1	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Fluoride (F^-)	mg/1	0.72	0.4	0.78	0.5	0.54	0.2	1.6	0.9	0.64	0.5	0.46	0.2
Sulfide ($S^=$)	mg/1	U	U	U	U	0.06	U	U	U	U	U	U	U
ORGANICS:													
Diethyl Ether	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
1,1,2 Trifluorotrichloroethane	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Trichloroethylene	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Carbon Tetrachloride	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Hexachlorobutadiene	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Pentachlorophenol	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Tetrachlorophenol	ug/1	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Trichlorophenol	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Dichlorobenzene	ug/1	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U

Hemlock Area Well Analyses, Page 3

PARAMETER	UNITS	WELL NUMBERS											
		1		4		6		7		8		9	
		DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW	DNR	DOW
ORGANICS, Continued.													
Aniline	ug/1	U	U	U	U	U	U	U	U	U	U	U	U
Benzaldehyde	ug/1	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Pyridine	ug/1	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Hydroquinone	ug/1	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Butyric Acid	ug/1	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Ethyl acrylate	ug/1	NA	U	NA	U	NA	U	NA	U	NA	U	NA	U
Aroclor 1242 (PCB)	µg/1	U	NA	U	NA	U	NA	U	NA	U	NA	U	NA
Aroclor 1254 (PCB)	µg/1	U	NA	U	NA	U	NA	U	NA	U	NA	U	NA
Aroclor 1260 (PCB)	µg/1	U	NA	U	NA	U	NA	U	NA	U	NA	U	NA
Freon	ug/1	U	U	U	U	U	U	U	U	U	U	U	U

U Material analyzed for, but not detected
NA Material not analyzed for in sample
mg/1 = milligrams per liter
ug/1 = micrograms per liter

TABLE 8

ANALYSIS OF INITIAL DISTILLATE
COLLECTED FROM JUNGNITSCH STILL
(Water collected from Well #6)
November 28, 1978

Parameter		Distillate Samples Collected Over Time[1] 1 (DNR)	2 (DOW)	3 (DNR)
Carbon Tetrachloride	ug/l	U (1.0)[2]	U (2.0)	U (1.0)
Trichloroethylene	ug/l	U (1.0)	U (2.0)	U (1.0)
Toluene	ug/l	U (100)	U (1.0)	U (100)
Diethyl Ether	ug/l	U (100)	U (5-10)	U (100)
Freon	ug/l	U (1.0)	U (5-10)	U (1.0)
Aromatic Amines	ug/l	U (200)	NA	U (200)
Aniline	ug/l	U (200)	NA	U (200)

[1]Sample #1 was the first 40 milliliters of distillate to come off still. Sample was analyzed by DNR lab. Sample #2 was the second 40 milliliters of distillate to come off still. Sample was analyzed by the Dow lab. Sample #3 was the third 40 milliliters of distillate to come off still. Sample was analyzed by Dow lab.

[2]Detection limits for each parameter are in parentheses.

KEY:
U Material analyzed for, but not detected
NA Material not analyzed for in sample
ug/l = micrograms per liter

TABLE 9

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

WATER QUALITY DIVISION

Chemical Analysis of Brine Spill

Fremont Township, Saginaw County, Sec. 1, T11N, R2E

October 31, 1978

A failure of a transmission pipeline carrying spent brine from the Dow Chemical Company plant to reinjection wells occurred some time during the week preceding October 31, 1978. DNR Staff from the Office of Oil and Hazardous Materials Control in Mt. Pleasant responded to the reported spill and supervised its clean-up. Staff of the Groundwater Compliance and Special Studies section who were in the area at the time collected samples of the spilled brine from pools on the ground on October 31, 1978.

The results of chemical analyses of the samples, which may reflect contamination by ground cover and soils at the spill site, are as follows:

Total Organic Carbon		120 mg/l		
Chloride		187,000 mg/l		
Total Sulfate		940 mg/l		
Specific Conductance		155,000 µmhos/cm		
Fluoride		4.8 mg/l		
Sodium		30,000 mg/l		
Calcium		105,000 mg/l		
Freon extractable oil & grease		6 mg/l		
Total recoverable phenolics		640 µg/l		
Total Cyanide		<.01 mg/l		
Total Cadmium	Digested:	<10 µg/l	Undigested:	<10 µg/l
Total Chromium	Digested:	750 µg/l	Undigested:	420 µg/l
Total Copper	Digested:	370 µg/l	Undigested:	320 µg/l
Total Iron	Digested:	5000 µg/l	Undigested:	5000 µg/l
Total Nickel	Digested:	<50 µg/l	Undigested:	1200 µg/l
Total Lead	Digested:	<50 µg/l	Undigested:	<50 µg/l
Total Zinc	Digested:	80 µg/l	Undigested:	160 µg/l
Manganese	Digested:	130 µg/l	Undigested:	380 µg/l
Antimony	Digested:	<50 µg/l	Undigested:	<50 µg/l
Silver	Digested:	680 µg/l	Undigested:	600 µg/l
Titanium	Digested:	600 µg/l	Undigested:	3000 µg/l

mg/l = milligrams per liter
µmhos = micromhos per centimeter
µg/l = micrograms per liter
< = less than

GRK 2/22/79

TABLE 10

CHEMICAL ANALYSIS OF REINJECTION BRINE

Source of Data: Dow Chemical Company

#6 POND INJECTION BRINE

	1974	1978
Specific Gravity	1.235	1.237
Calcium Chloride	17.9 %	16.5 %
Magnesium Chloride	3.23 %	2.63 %
Sodium Chloride	5.27 %	5.74 %
Potassium Chloride	0.94 %	1.10 %
Lithium Chloride	0.026%	0.028%
Strontium Chloride	0.52 %	0.43 %
Boron	295 ppm	280 ppm
Rubidium	13 ppm	12 ppm
Bromide	173 ppm	166 ppm
Iodide	14 ppm	8 ppm
Organic Carbon	7 ppm	7 ppm
Inorganic Carbon	3 ppm	3 ppm
Ammonia	200 ppm	200 ppm

The following elements were analyzed for but not detected at the stated detection level of the method used.

	1974 Detection Level	1978 Detection Level
Sulfate	30 ppm	30 ppm
Iron	1 ppm	1 ppm
Cesium	20 ppm	20 ppm
Copper	4 ppm	1 ppm
Nickel	8 ppm	1 ppm
Aluminum	20 ppm	10 ppm
Manganese	8 ppm	1 ppm
Chromium	8 ppm	1 ppm
Zinc	40 ppm	5 ppm
Titanium	8 ppm	1 ppm

11/10/78
C. E. Hamilton

Senator COHEN. So here we have at least two groups of experts who may come to different conclusions or be unable to reach some of the judgments. I suppose it raises a perennial question and problem. Perhaps we become so educated that we overlook some of the essential simplicities. And I simply wanted to commend the two of you for putting the kind of effort into this particular issue. I think for average citizens to take the time, as Senator Levin pointed out, and the money—perhaps not an overwhelming amount; but $4,000 out of your pocket is a significant amount of money.

That's what we are paying taxes for. Theoretically, at least, you are paying your tax dollars to State and Federal Governments so that those agencies that are charged with the responsibility of developing the expertise to fulfill those responsibilities. And here we have another case of two average, I'd say better than average, people who have put a lot of time and a lot of effort into trying to develop facts which make sense, at least, to a person, a layman, in terms of drawing some incidence and drawing conclusions from those incidences, which perhaps the experts can't agree upon. And yet it's there and no one seems to know why.

So I simply want to commend you and ask you one further question: Who do you think should pay for the damages incurred here. You mentioned a lot of people who are afraid to come forward, understandably so if they're going to be denied disability payments because of chemical toxins, who do you think should pay? Should it be the State who has jurisdiction? Should it be the Federal Government? Should it be the companies involved, perhaps, if there is any line of probability or causative connective factor that can be drawn?

Who do you think should bear the responsibility for the damages that have been suffered; it's $4,000 in your case—but let's assume it's physical damage, people developing cancer, disability, loss of jobs? In that case, who should be held responsible, in your judgment?

Mrs. KRUGER. I believe that we all must be responsible. First, I think we as individuals are responsible for cleaning up, let's say, our own messes. Then I believe that industry and the chemical people should also be made to be responsible for their byproducts, which I think in many cases are recoverable and reusable, rather than just simply dispensing and disposing of them.

As far as the medical problems of the patients, the people in the area involved, they can no longer go on individually performing some of these tests. So I believe we need qualified environmental doctors to come in and do blood work, perhaps even biopsies, to produce background to make this total effort.

There again, all of us, I believe, are going to have to share in the costs of this. It's hard in many cases to say, OK, you're to blame, you must take care of this.

Senator COHEN. I'm not asking for a legal judgment, because that's something that the law will provide for. But you've offered your commonsense.

I guess one of the problems is that you may have a small firm that doesn't have the capital structure with which to pay for the damage which may very well have been inflicted. And then, of course, the

agency that would have had charge and responsibility and failed to measure up to that responsibility—should that agency, which is the arm of the State, be required to compensate individual owners?

Or should we go further than that, should we start passing Federal laws which are in force and rules which have not been promulgated?

So I didn't want you to try to structure a legal conclusion. That's for us to do and the courts to do. But rather, just your own commonsense attitude.

Mrs. JUNGNITSCH. Senator Cohen, could I make a comment here?

Senator COHEN. Yes.

Mrs. JUNGNITSCH. The one thing that I'm sure all the residents in our area want is to be able to go back once again and turn on your faucet and to be able to have a drink of water, instead of going through a 3½-hour process to get 1 gallon of water.

Senator COHEN. That's all I have, Mr. Chairman.

Senator LEVIN. Mrs. Kruger, the document that we placed before you and placed in the record, labeled as exhibit A, is a letter that you sent to the Environmental Protection Agency in December of 1977. Did you ever receive a response to that letter?

Mrs. KRUGER. No, I did not.

Senator LEVIN. Part of that letter reads as follows:

> I do not have conclusive proof as yet that our water supply is contaminated. Let me suggest to you that I am not an isolated case, just that after 4 years of trying to solve problems, I'm finally learning the truth. I am observing things in my immediate neighborhood that are truly frightening.
>
> We have been living experimental research.

Was there any oral response? When I asked you if there was a response, I meant writing. Was there any response at all?

Mrs. KRUGER. There was no response at all. But I have since learned that it is indeed necessary to have a name. At the time all I had was the agency, the general name and address, and not a specific individual. So I kind of blame myself for not getting through to the proper channels, and I find that is extremely important to locate and follow through, and to keep digging at those problems.

Senator LEVIN. You shouldn't have to do that continual digging. A letter to an agency without a specific name on it should be perfectly adequate.

In paragraph 2, you cited problems of maintaining your dairy herd which resulted in disposal of 70 head and small calves, which is over 50 percent. Does that mean 50 percent of your cattle died?

Mrs. KRUGER. No, sir, that means they were culled out because they were no longer capable of continued production what with all the various things that happened to them.

What I am attempting to describe here, this was a consistent rate year after year of a 50-percent turnover in my animals, not necessarily all deaths. The death rate was about 10 percent.

Senator LEVIN. What were the adverse health effects, briefly, that you observed in those animals in that particular herd at that time?

Mrs. KRUGER. Again, the death, weight loss, enlarged joints, lameness, hair loss, low milk production, abortions, stunted growth, black and brown teeth, toxic eyes, abnormal feet, abnormal white blood cell counts, and inability to breed.

Senator LEVIN. In paragraph 3, what do you mean by the phrase, "When trace minerals are fed, some of the animals refuse to eat the grain"? In other words, why would you feed trace minerals to these animals?

Mrs. KRUGER. This is a normal part of dairy concentrates, that you do indeed feed as a nutritional supplement. My feed man and I have discussed many times that I indeed did not feed enough, and I repeatedly told him that my animals could not tolerate it, that apparently what they were already carrying in their systems—and as I tried to force-feed, if you will, by these additional mineral supplements, I would blow up legs, the cows would refuse to eat their grain, I would totally throw off what little milk production I had left.

And it's very hard to explain these things and get someone to understand.

Senator LEVIN. In exhibit B you wrote to the State department of public health:

> I'm weary of government's inability to respond to inquiries for help. It is becoming more apparent that the State doesn't care what happens to its constituents.

This is a letter dated January 24, 1978. What prompted you to write in that manner?

Mrs. KRUGER. I was searching for someone to get to, since I had no response to my environmental letter. I picked a name at random out of the Saginaw News. This gentleman happened to be Dr. Price. I was thinking that I had to attach names to specific people, so that I could get on a one-to-one basis with somebody. You cannot get a response from an agency's name. You have to get through to the individuals involved.

Senator LEVIN. Could you estimate the number of inquiries that you made to the State for assistance, written and oral?

Mrs. KRUGER. I believe you have them all, Senator. I think you could do that better this morning than I can.

Senator LEVIN. I can't testify. So could you estimate?

Mrs. KRUGER. I believe I had 52 attached documents to my written testimony.

Senator LEVIN. Exhibit C, which is in the record, is a letter you wrote to John Isbister, Michigan Department of Public Health, in February of 1978. In your prepared statement, which by the way will be made part of the record—all prepared statements this morning will be made part of the record, and we appreciate your oral summaries of them—you indicated that you wrote this letter because Dr. Isbister had not been informed of the health problems.

Had you previously informed the County Health Department of those problems?

Mrs. KRUGER. I had discussed the situation, yes, with the local health authorities. But there was no communication, apparently, down to the State level. In fact, our county still does not believe that we have a problem in Hemlock.

Senator LEVIN. On page 3 of that letter you wrote that you wished that you could supply him with the answer relative to contaminants. Did he ask you for the answer?

Mrs. KRUGER. That was the question that was always asked, if we knew what to test for.

Senator LEVIN. He did not specifically ask you to give him the reason; you just indicated that you didn't have the answer. Is that it?

Mrs. KRUGER. No, but I certainly tried to uncover part of the answer, Senator.

Senator LEVIN. Did he ever indicate to you that he referred the situation to other authorities for further action?

Mrs. KRUGER. No. Because of our actions, we continued to reinvolve various agencies. It was taken on our testimony, rather than their initiative.

Senator LEVIN. In the last paragraph of the letter, February 14, 1978, you indicated then that you wrote everything you could as of that date:

I will do whatever I can to assist you and the staff to give this priority. I again request the procedure for biopsying myself if this is the only sure method of determination.

Was there ever a biopsy taken?

Mrs. KRUGER. Eventually, our local doctor did get the necessary kits, but that was not done.

Senator LEVIN. In his response to you, dated February 23, 1978, which is exhibit C–2, did he indicate that they could not do the type of analytical screening for toxic substances for individuals except on an exceedingly limited basis; is part of the problem the lack of facilities to do this kind of work on a large-scale basis?

Mrs. KRUGER. This is correct.

Senator LEVIN. In December of 1978, you wrote our State representative, asking him to inquire as to the status of the mass spectrometer unit in the laboratory of the Department of Natural Resources. What led you to believe that the unit was inoperative?

Mrs. KRUGER. As we appeared on a local television panel discussion, we had a private conversation with the groundwater quality division and the health department. This came out as part of our private conversation. And that was my reason for pursuing it, because I thought then he could address that situation and perhaps we could work it both from an individual level and from our representative's level.

Senator LEVIN. Was it Mr. Andrew Hogarth of the Water Quality Division of the DNR who indicated to you that the unit was inoperative?

Mrs. KRUGER. Yes; it was.

Senator LEVIN. What was the response that you received to that letter?

Mrs. KRUGER. I did get from Representative Bush's secretary an acknowledgement of that letter, but nothing concrete that I know of, of additional followthrough after that.

Senator LEVIN. Mrs. Jungnitsch, in a letter from the DNR to you, dated January 10, 1979, they indicated that an operable mass spectrometer would be a useful instrument for many environmental situations. Is that an accurate statement of that letter? You have that in front of you, labeled exhibit E.

Mrs. JUNGNITSCH. Yes.

Senator LEVIN. You had previously written them on December 18, 1978; is that correct?

Mrs. JUNGNITSCH. That's correct.

Senator LEVIN. In the letter, you indicated that you were rural residents of Hemlock, that DNR had been in your area several times taking water samples, and that in your well they found aromatic amines? And the volatile hydrocarbon? Because of their limited laboratory equipment, they were not able to identify the specific type amine or hydrocarbon. If the mass spectrometer were operable, this job could be done; is that correct?

Mrs. JUNGNITSCH. This is the way I understand it; yes.

Senator LEVIN. Do you know whether that mass spectrometer was ever used for that purpose?

Mrs. JUNGNITSCH. To my knowledge, it was not. And we were later told that this mass spectrometer was donated to the Michigan State Police.

Senator LEVIN. What other contact did you have with the DNR besides that letter?

Mrs. JUNGNITSCH. Repeated trips to Lansing with Carol Jean. They were to our house several times collecting water samples. We had several phone conversations.

Senator LEVIN. Senator Cohen.

Senator COHEN. Just a couple of points.

Mrs. Jungnitsch, what was your husband's condition diagnosed as?

Mrs. JUNGNITSCH. Guillain-Barre syndrome.

Senator COHEN. Not being familiar with the medical factors involved, was there any casual connection described by the doctors between your husband's condition and the drinking water, for example?

Mrs. JUNGNITSCH. I don't understand your question.

Senator COHEN. In other words, what do the doctors say caused that condition? I am not familiar with the disease.

Mrs. JUNGNITSCH. This was the condition that many people developed after receiving the swine flu inoculation. My husband did not receive a flu inoculation. We were never told where he got it. It's one of the viruses.

Senator COHEN. Mrs. Kruger, you state that the county maintains there is no problem?

Mrs. KRUGER. That is correct.

Senator COHEN. Is that right? Is it because, in your judgment, the county lacks expertise in the field to make such an assessment? Let me backtrack. How many people are employed by Dow Chemical in that county?

Mrs. KRUGER. I would say the majority of their employees are from this area. I should also mention that, in addition to our area, I feel that there are more residents than just us involved in this particular thing, but in order to keep my credibility and to make a point of emphasis, we have indeed restricted it to our specific area.

Senator COHEN. I guess the question I raised—I am not sure what the answer is and it may be an unfair question as such. But in listening to your testimony, I heard you say you presented this evidence to local officials and they deny there is a problem. There may be a reasonable basis for their denial. On the other hand, they may be acting out of some fear that if the Environmental Protection Agency were to take action if they had the jurisdiction to take action, or if the State of Michigan took action, or if local county officials took action, this might in some way have economic repercussions.

And it brought to mind, as I was sitting here listening, a novel I read some years ago, called "Jaws," and the principle involved there was not dissimilar if that were the case: Fear of the loss of economic resources of a large industry—there it was tourism; here it might be one of the largest employers—has prevented people from drawing conclusions which otherwise the body of evidence might lead them to. On the other hand, there may be no causal connection, and it may be coincidental and it may be improper to draw such a conclusion.

But I was not clear from your statement when you said that the county maintains there is no problem, whether there were factors in your mind which led the county to state that there was no problem.

Mrs. KRUGER. I believe, from my point of view, that it's the inability to take a stand or maybe fear of—I don't want to step on any toes; I certainly have nothing personal against Dow. I don't believe they purposely did this; it's just another one of these things that happened that we now have to cope with.

But the point is that we must recognize it, and that's what the State and county officials in our area are failing to do. They want to really bury their heads in the sand.

Senator COHEN. Why do you think—I guess it comes back to the question why do you think this is so, if, in fact, there is a causal connection; if, in fact, you have the kind of damages that can be suffered not only by animals, but by people and future generations? Why, in your judgment, would State and local officials abdicate their responsibility if, in fact, the facts are clear?

Mr. KRUGER. Because they can't go to the textbooks, they can't go to any background material, there is nothing for them to refer to. And so you have to start somewhere. Let's make us, then, the basis.

Senator COHEN. What did you start with? You say there is nothing to refer to.

Mrs. KRUGER. I dug it out. I mean——

Senator COHEN. That's what I am getting at.

Mrs. KRUGER. OK. But that takes time, dedication, involvement.

Senator COHEN. Are you saying, then, that the local officials, the State officials who are charged with this responsibility don't have the time, dedication, resources?

Mrs. KRUGER. That's correct.

Senator COHEN. They do not have that?

Mrs. KRUGER. No. I hate to say that they have desk jobs, but in some instances I really do believe that is the case.

Senator COHEN. That's all.

Senator LEVIN. Part of your written testimony is a report from Raltech Laboratories; is that correct?

Mrs. KRUGER. Correct.

Senator LEVIN. That was a report that you paid for?

Mrs. KRUGER. That's right.

Senator LEVIN. Where is Raltech Laboratories?

Mrs. KRUGER. Raltech Laboratories is in Madison, Wis.

Senator LEVIN. Could you summarize the findings of that lab report for us?

Mrs. KRUGER. Two Grand Rapids area chemists that we had been dealing with got themselves certified as carriers, and one of them hand-

delivered a specimen of water kept under constant temperature to Raltech. And it was another shot in the dark, because I was so sure there had to be something there. We had no idea; in fact, they also assured me there is nothing in the water. The findings then came back: diethyl ether, trichloroethylene, toluene, and 1,1,2-trichlorotrifluoroethane.

However, we did not specify quantitive results, and I am sorry now at this point that we did not, because that has been kind of a point of contention, that there are very minute trace elements.

Senator LEVIN. The contention is that there may have been minute trace levels, or do we know?

Mrs. KRUGER. We know neither. All we know is that they established the fact that they were indeed there.

Senator LEVIN. Just to make sure that I can understand—not being a chemist either—exactly what you said: You're saying the Raltech Lab report, which is part of your testimony, indicated at that time that Raltech found diethyl ether, toluene, trifluorotrichloroethane, and chloroethane?

Mrs. KRUGER. Right.

Senator LEVIN. And trichloroethylene.

All right. First of all, did you pay for that report?

Mrs. KRUGER. Yes, I did.

Senator LEVIN. Do you know whether it would cost more to have sought a quantitative report?

Mrs. KRUGER. I really don't know.

Senator LEVIN. Do you know what laboratories charge to tell you how many parts per million or billion there are?

Mrs. KRUGER. I am sorry, I can't answer that. I don't know if it's different to measure, or if they can do that on the chart that comes off and read it.

Senator COHEN. Could I just come back to one point, Mr. Chairman?

In other words, I have got a sheet here which says "Suspect Chemicals in the Hemlock Area Groundwater." You had 1-year college training in the study of chemicals; you spent $4,000 of your own money.

Mrs. KRUGER. Sir, I did not; I had high school chemistry, and I dropped out of college chemistry after 2 weeks. [Laughter.]

Senator COHEN. You had high school chemistry, spent $4,000 of your own money, and the time and effort to make this determination; and you're saying that the county officials, State officials, Federal officials don't have the expertise, the resources, or the will to produce the same sort of report?

Mrs. KRUGER. No.

Senator LEVIN. I am not sure I heard the answer to the question.

Mrs. KRUGER. I don't mean to incriminate all these individuals, because we are, again, just people. And it does take this type of dedication to dig these things out, and we all become involved in the mundane, everyday, business office routine, whatever. And where I have spent many, many night hours digging and following through, calling people, rechecking, because this has been the sole project for me in my spare time, so then, if you will, I have become the expert to now help teach those other people to, in turn, help me.

Senator COHEN. Has the county offered to hire you?

Mrs. KRUGER. No; I can't get a job anywhere, and I do need one.

Senator LEVIN. Your farm is no longer as productive, I gather?

Mrs. KRUGER. No; it is not.

Senator LEVIN. Do the citizens in your area feel the way you both do about these problems?

Mrs. KRUGER. It has gotten to the point that, "Carol Jean, you cannot quit; you must go on." And so someone appointed myself and also Kathryn as spokesmen on behalf of all of us.

Senator LEVIN. Is there general support in the area for your efforts?

Mrs. KRUGER. For those who have indeed serious health problems, yes. But there again there is that portion of the community who have no problems or are unaware of the depth of our investigation; then I would say it's negative in that area.

Mrs. JUNGNITSCH. One point that we should make here: Many of our neighbors are employees of—and it is extremely unfair to expect these people to come forward. And at one point when this whole mess started, I was told on the phone that it would be a tremendous economic hardship to the State of Michigan should this chemical company be forced out.

Senator LEVIN. Who told you that?

Mrs. JUNGNITSCH. This was in the same conversation with Dr. Bloomer, when we discussed our blood serum evaluations.

Senator LEVIN. Who is Dr. Bloomer?

Mrs. JUNGNITSCH. He is in our State testing laboratory.

Senator LEVIN. The State of Michigan?

Mrs. JUNGNITSCH. The State of Michigan.

Senator LEVIN. What would you like Government to do that it hasn't? After your response we're going to have to recess for about 10 minutes because there is a rollcall vote on the floor.

Mrs. KRUGER. I believe the most urgent thing is to do some testing of the people—blood serum counts, this type of thing—and perhaps to identify and have these blood tests sent later to a central agency and be looked at by qualified doctors in an attempt to perhaps suggest some treatment.

As far as additional testing, I believe that all our wells are available for whatever tests that need to be done if, in fact, some of these compounds that did these things in the area are even traceable, we may pick them up in some of the residues.

But I believe at this point that the emphasis should be on the people's problems.

Senator LEVIN. Thank you.

We are going to recess now until 11 because of a rollcall vote on the floor of the Senate. We will resume at that time.

[Brief recess.]

Senator LEVIN. The hearing is now again in session.

We want to thank Mrs. Kruger and Mrs. Jungnitsch for coming. We will excuse you at this time. If you are able to stay, we may have some additional questions for you later.

Mrs. JUNGNITSCH. Thank you.

Mrs. KRUGER. Thank you, Senator.

[Related Hemlock item follows:]

SUSPECT CHEMICALS IN THE HEMLOCK AREA GROUNDWATER

Chemical name	DOW	DNR[1]	Raltech Labs	Health Department
Dioxin	Tests not taken to determine presence or absence.	Tests not taken to determine presence or absence.	Tests not taken to determine presence or absence.	Tests not taken to determine presence or absence.
Diethyl ether	Tested for, but not detected.	Tested for, but not detected.	Detected, quantitative levels not measured.	Do.
Toluene	do	do	do	Do.
1,1,2-Trifluoro-Trichloroethane	do	do	do	Do.
Trichloroethylene	do	do	do	Do.
Carbon Tetrachloride	do	3 ppb	Tests not taken to determine presence or absence.	Do.
Hexachlorobutadiene	do	Tested for, but not detected.	do	Do.
Phenols	Tests not taken to determine presence or absence.	7.6 ppb	do	Do.
Pentachlorophenol	Tested for, but not detected.	Tested for, but not detected.	do	Do.
Tetrachlorophenol	do	Tests not taken to determine presence or absence.	do	Do.
Trichlorophenol	do	Tested for, but not detected.	do	Do.
Aroclor 1242 (pcb)	Tests not taken to determine presence or absence.	do	do	Do.
Aroclor 1254 (pcb)	do	do	do	Do.
Aroclor 1260 (pcb)	do	0.5 ppb	do	Do.
PBB	do	Tested for, but not detected.	do	Do.
Phthalates	do	32 ppb	do	Do.
Volatile hydrocarbon[2]	do	10 ppb	do	Do.
Aromatic Amines	do	0.3 mg/l	do	Do.
Total Coliform	do	1900 COL/100ml	do	Do.
Freon extractable oil and grease	do	2 ppm	do	Do.
DDT	do	Tests not taken to determine presence or absence.	do	0.04 ppb.
DDE	do	do	do	0.05 ppb.

[1] Highest level measured.
[2] Specific type of volatile hydrocarbon was not identified.

Senator LEVIN. At this time we would ask the following persons, if they would, to come forward: Dr. Howard A. Tanner, Director, Michigan Department of Natural Resources; accompanied by William Marks, Jack Bails, and Dr. James Truchan. Also, Mr. Thomas F. Schimpf, Assistant Attorney General for the State of Michigan.

TESTIMONY OF HOWARD A. TANNER, DIRECTOR, MICHIGAN DEPARTMENT OF NATURAL RESOURCES; ACCOMPANIED BY WILLIAM MARKS, ASSISTANT CHIEF, BUREAU OF ENVIRONMENTAL PROTECTION; JACK BAILS, CHIEF, ENVIRONMENTAL ENFORCEMENT DIVISION; JAMES TRUCHAN, ENVIRONMENTAL SPECIALIST; AND THOMAS F. SCHIMPF, ASSISTANT ATTORNEY GENERAL, ENVIRONMENTAL PROTECTION DIVISION

Senator LEVIN. Dr. Tanner, we welcome you here. We wonder if you would identify your colleagues with you this morning.

Dr. TANNER. Thank you, Senator, Mr. Chairman.

Thomas Schimpf is on my far left, representing Frank Kelley, the Attorney General; Bill Marks is on my left. I brought two staff members particularly to talk about our legislation, the Michigan State legis-

lation that is going forward in our efforts to control the future disposal of hazardous wastes in our State. On my immediate right is Jack Bails, Chief of the Environmental Enforcement Division, who will handle many of the technical aspects of my testimony regarding our investigation program procedures. And to his immediate right is Dr. James Truchan, of the staff.

Senator LEVIN. Thank you. You may proceed, and, if you can, please summarize. We will put your entire statement in the record.

Dr. TANNER. Thank you again, Mr. Chairman.

I am Dr. Howard A. Tanner, Director of the Michigan Department of Natural Resources. I will have a brief summary statement. I have my remarks printed, as well as a supporting report and supporting photographs.

I thank you for this opportunity to present the Michigan Department of Natural Resources' programs associated with hazardous waste management, particularly associated with the implementation of the Resource Conservation and Recovery Act, or RCRA.

My prepared materials detail a number of serious problems that Michigan has had to deal with in the past few years, and we have dealt with those primarily on our own State and our own limited resources. In the report there is substantial detail on 13 examples, but I want to emphasize that those cases of investigation are not inclusive; those are simply examples of the types of problems that we face associated with the production, transport, the storage, and the disposal of hazardous wastes, particularly inappropriate disposal of hazardous wastes.

The Subcommittee has eight copies, which I refer you to, of colored prints that I hope will display even more vividly a feeling, an understanding, an explanation of the kinds of problems we find ourselves involved in. I would most sincerely like to testify to you this morning that we have not solved all of our hazardous waste problems. We have come a long way in the last few years, particularly the last two, but we are a very long way from solving all of our problems.

I would sincerely hope that Federal help in the form and in the statutes of RCRA and TOSCA legislation will provide some of the sorely needed Federal assistance in our State. Basically, the things that I would like to discuss in my summary are what actions we have taken, how recent State legislation and funding have addressed the problem, and finally where we would like to be in the future and how we propose to get there.

The attached report entitled, "Progress in Hazardous Waste Control in Michigan," details where my agency has focused our attention since 1977. Basically, the beginning point in this era, I guess, would be our clean up of what we refer to as the Oakland-Ankersen in downtown Pontiac, a so-called waste reclaiming facility which actually was an accumulation point. We ended up with a bankrupt company with over 25,000 barrels of materials which we disposed of properly at great expense and substantial risk to employees.

That was the first of our hazardous waste experience in my tenure, and I think that we have gone on from there. And I would like, as I begin to approach the end of my remarks, to call upon Jack Bails to elaborate on some of those. I have also brought with me some copies of Michigan legislation that addresses how we are going to deal with

hazardous wastes in the future, which I think addresses rather well some of the many deficiencies that we have discovered in the existing statutes. That bill has passed both the Michigan House and the Michigan Senate and awaits the Governor's signature. Since he was a strong supporter of the bill, I think we can assume that it will be signed in the near future.

In the past 2 years, we have built, staffed, organized an extremely active Division of Environmental Enforcement which Jack Bails heads. We have focused on a review of the historical problems. We have identified the deficiencies in State statutes. We have identified the deficiencies in manpower and technical resources. And we have at least been partially successful in obtaining new statutes and increased funding at the State level.

We think that we have now the basic tools to deal with the problems of hazardous wastes in the future, although let me emphasize that, in our opinion, State monetary resources will always be limited, and the cost of investigating and cleanup of old problems is beyond Michigan's ability to handle alone.

As we go through a number of the instances in question, please note the majority of them, being old problems, are problems that have been allowed to accumulate through inappropriate interpretation, inappropriate understanding of the hazards involved, and the inability to deal with them basically in dumps of one type or another.

I would like to mention briefly the relationships of the Michigan Department of Natural Resources and the regional offices of the Environmental Protection Agency, particularly in regard to enforcement and investigative actions. I must say that during the past 2 years of our development of an active attack on our hazardous waste problems that we've had our differences with EPA on enforcement. I would also add that we have made great strides in moving beyond our difficulties and into a cooperative position.

Incidentally, I would invite you to have your staff investigate our record of fines, penalties, damages, pollution control, facility construction that we have required corporations to go through in the past 2 years. I frankly am proud of this effort, and I would invite anyone to review it carefully and thoroughly and make your own judgment.

However, despite these efforts, which we, I suppose, being somewhat provincial, happen to believe are the best or nearly the best in the Nation, we have frequently experienced what we feel is increased unjustified criticism from EPA. It seems they have tended to take a focus on what we have not done and to approach those deficiencies in unfavorable contrast to us, rather than concentrating on what we are doing and how they can help us do it.

We believe that we have exercised good judgment in the selection of our priorities. We believe that our development of the most important, the most serious, the most hazardous sites has been accurately done, and that we have moved expeditiously with the resources that we have available. I stress again that neither Michigan nor EPA will ever have enough money to address all of the violations adequately and as promptly as people would like to have us do.

I think more recently, as RCRA and TOSCA have placed EPA in a responsive position in regard to hazardous wastes, our cooperation has improved enormously. There are positive benefits developing in the

relationship between EPA and the Michigan Department of Natural Resources. I have met several times with the new Administrator, who is present here today, and I look forward to a 2-day meeting between his staff and mine during the week of August 13.

With this fresh outlook in the State-EPA relationship, we believe that joint determination of priorities is the single most important issue that we would like to have a cooperative understanding with EPA on. We would pick out what we believe to be the highest priority items to be attacked first, and we would hope that they would review and concur or differ, if they find necessary, and we would make appropriate adjustments.

If that priority list is jointly developed, then I would look forward to technical support, laboratory support, and hopefully financial support in a cooperative and coordinated program.

I would close by saying that I believe that Michigan has come a long way. I believe that we compare favorably with any other programs in the country, including Federal programs. That does not mean that our programs are adequate. That does not mean that there aren't many more things that remain to be done. We believe, however, with the additional resources, with the additional statutes, and with the determination we've had so far, that we're competent to move forward and produce a model program that will be an example for the rest of this country, and we're proud to be able to offer that to you this morning.

If I may, I would like to call on Jack Bails for some additional comments as part of the summary statement.

Senator LEVIN. Mr. Bails?

Mr. BAILS. The report that is attached with copies provided to the Subcommittee details the last 2 years in our progress we feel we've made in hazardous waste controls since the first major incidents when the State got involved in a cleanup program involving several thousand barrels of toxic and hazardous materials. In that report. we talked about a number of incidents, some of which have become infamous outside our own State boundaries, particularly the Velsicol Michigan Chemical operation at St. Louis, which also resulted in the PBB contamination of both the environment and of livestock on farms from a feed mixup. In addition to problems created by the feed mixup, the company itself had problems at a plant site contamination at Pine River and unfortunately we found out some time after the production of PBB had stopped that large quantities had been dumped in the nearby county operated landfill in which we are still studying the problem. But it's clear now the material was potentially leaching off the landfill site and approaching nearby wells.

To date, the State has spent very nearly $60 million in attempts to rectify the problems, compensate farmers, and in investigations associated with the production of PBB at that site. The State currently has a several-million-dollar law suit pending against the company. Our agency took an action to revoke the discharge permit, because the company failed to install water pollution equipment to meet our demands. The company closed their facility last year in Michigan.

The Story Chemical site in the Muskegon area—it was another bankrupt facility. It went bankrupt again late in 1976. Our own department people had to go over and extract the waste that had been buried on that site. Unfortunately, there was severe water contamina-

tion involved in nearby homes. There's a photograph attached of water taken about a quarter of a mile from the Story Chemical site. That problem has not been resolved, despite the fact that we found another company willing to buy the property and willing to put up some money. They took off some of the wastes from the site. There are still some wastes on the site. There is no acceptable water supply for many nearby homes, and there is material yet to be excavated from the ground.

The Hooker Chemical Co. problem is currently under litigation by the State. It came to our attention much as the Hemlock situation has come to your attention from citizens' complaints. It took us some 2 years to fully develop the information as to the source of the problem, starting first with the surface water discharge and finding finally that large quantities of materials had been dumped at the plant site over a period of 15 to 20 years, that had contaminated both the ground water and seeped into White Lake.

We are also in litigation with another chemical company in Michigan, Bofors-Lakeway, for very similar problems—disposing of hazardous wastes on company property on sandy soils which has leached into the ground water and a nearby stream. The State is asking for damages and clean up of that facility in a suit filed by the Michigan Attorney General at our request.

We've had our problems with liquid incinerators, not only in Ankersen but at Berlin-Farro, where again there were large quantities of stored material on the site and a liquid incinerator that simply did not operate up to environmental standards. That facility was closed, and there's a pending court order for site clean up at that facility as well.

There are indicated a number of other incidents, again not covering all of those that we've attempted to handle in the last 2 years, but examples of production of hazardous waste problems, of disposal problems associated with hazardous wastes, problems in transport of hazardous wastes that have occurred in Michigan, to give you the scope of the kind of problems we have to deal with. Throughout the last 2 years, part of what we were doing was identifying where our State's shortcomings were, where we needed new statutes, where we needed new expertise.

We now have a new toxic wastes management bill, which passed both the house and senate in Michigan. It's in the Governor's hands for his signature, which calls for more or less a cradle-to-grave manifest system for tracking of hazardous materials from the time they're produced to the time they're adequately disposed of.

We now have a better legal handle on controlling some of these problems in the future. But many of the past problems remain to be investigated, and it's a very expensive and slow process to determine what happened 20 years ago and what the impact is today and what can be done to clean it up.

One of the problems that we have to face is that many of the responsible parties are no longer viable. They have no assets, and the State and/or the Federal Government is going to have to step in and pay the cost of removing these materials from the environment that are creating problems. We've also identified in this 2-year period where we can best use Federal assistance—always money—but in ad-

dition to that, we find that some of the capabilities in the technical area are available to the Federal agencies but are not available to us—particularly laboratory analysis of some of these more unique and exotic compounds that we run into, verifying our analytical techniques that have to be developed in each individual case, assistance in the form of expert witnesses both within Federal agencies, EPA, and FDA in some cases, but also the availability of witnesses which Federal agencies have used from time to time in the private sector. We would like those made available to the State when we have particular problems.

We have not, for a number of reasons, had the kind of Federal assistance we'd like to have had in the past. We feel one of the major reasons was the restrictions that were placed on EPA in terms of expenditures of their money and time and effort directed to surface water discharges. Many of our problems in Michigan are related to ground water and the disposal of hazardous wastes.

Hopefully, now with RCRA we can look forward to more cooperation at the Federal level to solve some of these extremely dangerous situations we find ourselves in in Michigan. And I might add I don't think they're unique to Michigan. I think you'll find them in any industrialized State. They may become worse in Michigan because of some of our particular soil types being sand and the many people who are dependent upon ground water in our State for their domestic water supply.

So the same problems may exist in other States, but it comes to our attention earlier, because it affects human health directly through the water supplies.

Dr. TANNER. Senator, if I may, I would ask Bill Marks to explain the legislation that is ongoing in Michigan, if that is appropriate.

Senator LEVIN. If you could be brief.

Mr. MARKS. Yes, Mr. Chairman.

I think the most important thing about the legislation is not its content but the process that was used to develop it. It was the process that involved almost every interest of local government, those that generate hazardous wastes, those that treat hazardous wastes, the regulators, and a consensus process developed which I think makes it a unique piece of legislation, particularly in one area, because the Michigan legislation provides for the siting of hazardous waste facilities. It establishes a system, and that system is a siting board, consisting of local representatives, State representatives, appointed by the Governor, and State agency people. They have to actually vote.

But I think the consensus of the legislation, conceived on that principle, may make this siting provision workable. I think if it does, that's a unique piece of legislation. It provides for licensing haulers and facilities. It creates a $30 million closure fund paid for by fees on hazardous wastes. This fund will be used 15 years after a facility closes. The determination will be made as to its future usability. If it's not deemed usable—in other words if it's to be left untouched—this maintenance fund, the State would take title to the land and use that fund to forever maintain it. I think that's a good provision. It of course provides for the manifest system. It provides for the rather severe penalty system.

We've reviewed all of the legislation that's been enacted to date in the United States, and it is by far the most comprehensive.

[The prepared statement and attachments of Dr. Howard A. Tanner follow:]

STATEMENT OF DR. HOWARD A. TANNER, DIRECTOR, MICHIGAN DEPARTMENT OF NATURAL RESOURCES

Thank you for the opportunity to present testimony before your Committee on Michigan's problems associated with the hazardous waste management and the implementation of the Resource Conservation and Recovery Act (RCRA).

In addition to the oral statement I will present to you, I have prepared materials for the Committee which detail a number of serious problems that Michigan has had to deal with in the past two years largely on its own with very limited Federal assistance. The thirteen problems cited in this report are by no means all of the hazardous waste problems we have dealt with; however, they do provide an example of the types of issues we face with the production, transport, storage and disposal of hazardous waste.

In eight copies of this attached report, we have included colored prints of sites so that you can better comprehend the complexity and size of these problems. The volume of waste generated by a highly industrialized state such as Michigan is enormous. Until you have seen what can accumulate at an unregulated waste storage and disposal site in a matter of months, it is difficult to believe—these color prints help put the problem in perspective.

I would like to testify that we have all our hazardous waste problems solved in Michigan. We have come a long way in the past few years, but we are a long way from solving all our problems. We hope that RCRA and TSCA legislation at the national level will provide sorely needed federal assistance to our State.

I would like to discuss Michigan's response to hazardous waste problems in three time sequences:

1. What actions we have taken in the past two years to identify and correct problems;
2. How recent state legislation and funding has addressed the problems; and finally,
3. Where we would like to be in the future.

The attached report entitled, "Progress in Hazardous Waste Control in Michigan" details where my agency has focused our attention since 1977 when we became involved in the first major hazardous waste cleanup project at a facility in Pontiac, Michigan, known as Ankersen Resource Systems, Inc. This report also discusses the problem areas that still need attention. It enumerates the State resources and deficiencies related to hazardous waste disposal problems; and it responds to the question, "What can the Federal government do to help?" I will be happy to respond to questions that the committee may have on this report either at the end of my presentation, or at a later date after members have had an opporunity to study the report in detail.

I have also brought two copies of new Michigan legislation controlling the production, transport, storage and disposal of hazardous waste for committee staff to review. The bill is currently being prepared in final form for signature by the Governor. The copy we have provided you is reasonably close to the final version which was hurriedly passed by the Michigan Senate last week before the summer recess. This new Act follows close on the heels of a new solid waste management act passed in January of this year in Michigan. Together, these two statutes cover the cradle to grave concept of industrial liquid and solid waste disposal. Many of the legal deficiencies identified during the past two years concerning the control of hazardous waste have now been rectified.

Finally, this new state hazardous waste management bill addresses primarily the future. It provides for a manifest system which will enable the State to monitor the production, transport, storage and final disposal of hazardous waste. In addition, it establishes a mechanism for the siting of hazardous waste disposal facilities in the State; and authorizes the State to construct such faciilties should private enterprise fail to do so.

Briefly in summary, Michigan has had an active program in the control of hazardous waste. In the past two years, we have stepped up investigation and enforcement activities focusing on historical problems which threatened public