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STATE OF NEW JERSEY

DEPARTMENT OF ENVIRONMENTAL PROTECTION

Rocco D. Ricci, Commissioner

B.L. - Let's discuss
& Sid. Gray
about Groundwater in
Aug/79.

8/2 - No contact
from individual
who was to do a
documentary
on uranium
issues.
B.L. in
Hdq & saw
Sid Gray.

A PRELIMINARY REPORT ON THE FINDINGS OF THE STATE GROUNDWATER MONITORING PROJECT

March, 1978

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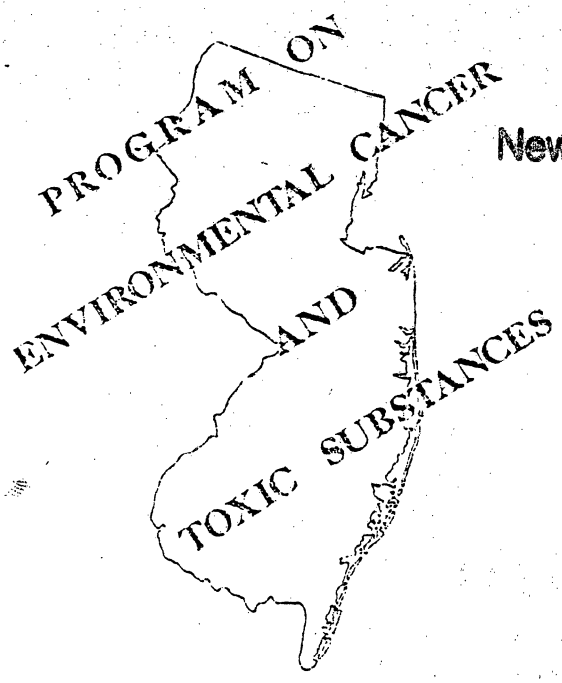

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SUMMARY

The Program on Environmental Cancer and Toxic Substances of the New Jersey Department of Environmental Protection has received the initial results from the statewide groundwater testing project. This project is examining the State's groundwater supplies for 50 selected toxic chemicals, several of which are suspected cancer causing agents. All laboratory work is being performed by the Department of Environmental Sciences of Rutgers University.

This project is the first of its kind and employs recently developed highly sensitive laboratory techniques (see report page 3). A total of 500 wells from all counties have been selected for testing, including public and private drinking supplies, industrial sites and wells in the vicinity of landfills.

The 50 chemicals for which the water is being tested are divided into three groups: organics, pesticides and metals. These groups are listed and defined in the attached report.

The initial results are from 250 wells located in twelve counties. In most cases the water quality was found to be far better than recommended federal drinking water standards. However, a total of twenty violations were uncovered. Intensive follow-up testing is now being done at these sites to insure the safety of all drinking water supplies and to identify sources of pollution.

The results, thus far, have revealed three trends in groundwater quality. 1) Virtually all the wells tested contained trace levels of some of the chemicals under investigation, 2) the

presence of low levels of pesticides is most prevalent in agricultural areas,and 3) the majority of the wells which were found to be contaminated by organic chemicals were located in heavily populated industrialized areas. A summary chart of all findings is found on pages 14-17 of this report. In no case was a well found to contain substances at concentrations that pose immediate danger to human health.

However, little is understood about the long term human health effects of low levels of these subtances in water (see page 9). Most of what is known has been learned from animal experiments, at concentrations much higher than found here, and it is difficult to apply these findings to human populations. Much work still has to be done by federal agencies and others to establish the possible health effects of long-term, low-dose exposures. The DEP Program on Environmental Cancer and Toxic Substances is conducting biological and chemical investigations in an attempt to determine if such environmental pollution is related, in any way, to the incidence of cancer in New Jersey.

This project is the first phase of a multi-year investigation of the state's groundwater supplies, and is one of several aimed at identifying and eliminating toxic contaminants in the New Jersey environment. Similar investigations of drinking and surface water supplies are planned, in addition to a statewide air testing project.

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1. INTRODUCTION

The Program on Environmental Carcinogens and Toxic Substances (PECTS) of the New Jersey Department of Environmental Protection (DEP) has received the initial set of results from the statewide groundwater monitoring project. The purpose of the project is to obtain an assessment of the degree of contamination of the state groundwater supplies by selected toxic and carcinogenic compounds. It is one of several projects being conducted by PECTS aimed at identifying the presence of toxics and carcinogens in the New Jersey environment.

The wells being sampled in this project have been selected to include all counties in the State. They represent an equal distribution of private and public drinking supply wells, along with industrial sites and wells located in the vicinity of landfills.

The project is being conducted in coordination with the Division of Water Resources. All laboratory work is being performed by the Department of Environmental Sciences of Rutgers University.

The substances which are being analyzed for are:

Group I - Organics

Methylene Chloride
Methyl Chloride
Methyl Bromide
Chloroform
Bromoform
1,1,2-Trichloroethylene
1,1,2,2-Tetrachloroethane
Dibromochloromethane
Trifluoromethane
Carbon Tetrachloride
1,2-Dibromoethane
1,2-Dichloroethane
1,1,1-Trichloroethane
Vinyl Chloride
1,1,2,2-Tetrachloroethylene
o,m,p-Dichlorobenzene
Trichlorobenzene
Diiodomethane

Group 2

Pesticides & Related Compounds

Polychlorinated Biphenyls (PCBs)	Endrin
	Lindane
Heptachlor	Aldrin
Methoxychlor	Dieldrin
Toxaphene	Heptachlor Epoxide
DDT and associated compounds	Mirex

Group 3

Metals

Arsenic & compounds	Lead & compounds
Beryllium & compounds	Nickel & compounds
Cadmium & compounds	Selenium & compounds
Chromium & compounds	Zinc & compounds
Copper & compounds	

These substances have been identified by the Program on Environmental Cancer and Toxic Substances and by federal agencies as potential hazards (under specific conditions) to human health and the environment.

2. LIMITATIONS OF MEASUREMENT

Although the problem of environmental contamination by toxic chemicals has existed for decades, it has only recently been given national attention. Developments such as the discovery of high incidences of a rare liver cancer among vinyl chloride workers, the finding of widespread contamination of the Hudson River by toxic polychlorinated biphenyls (PCBs), and a statistical study linking elevated cancer rates to toxic contamination of the Mississippi River have spurred academic and government scientists to investigate the far-reaching effects of toxics in the environment.

This investigation by the DEP is the first in the country aimed at identifying and measuring the extent of groundwater contamination

by a wide range of toxic contaminants. Newly developed, highly sensitive analytical techniques are being used. The techniques include gas chromatography, liquid chromatography, mass spectrometry and high-sensitivity atomic absorption. They are capable of measuring contamination as low as ten parts per trillion (ten parts of contamination per trillion parts of water). This level of contamination has been compared to a cupful of contaminant in an ocean of water.

Unfortunately, as the sensitivity of analytical techniques increases so does the probability of error. When analyses are being conducted in the parts-per-trillion range there is always the possibility of sample contamination, in addition to instrument and observer variability. In order to statistically control for the variability at very low values, a lower limit of 0.1 parts per billion (ppb) was established for purposes of this report. Thus, any contaminants detected below this limit are reported as "less than one tenth part per billion" (designated by the abbreviation, <0.1 ppb).

A summary table of all findings is included. The table indicates ranges of contamination, along with the average and median values for each compound. Also listed are the safe drinking water standards recommended by the federal Environmental Protection Agency (EPA), as well as the number of high values in each county.

3. RESULTS

The initial data contains the results from 250 wells located in twelve counties: Bergen, Cumberland, Essex, Hudson, Hunterdon, Monmouth, Morris, Passaic, Salem, Somerset, Union and Warren. The

following are summaries of the findings for each of the three groups of compounds.

Group 1 - Organics

Laboratory analyses revealed widespread presence of a small number of organics. The compounds found most often were chloroform, carbon tetrachloride, trichloroethylene and trichloroethane. These solvents are widely used in industry and are also common ingredients in domestic cleaning fluids.

The presence and concentration of organic contamination varies according to land use. The highest values were found in heavily industrialized areas, while rural and agricultural areas yielded low or non-detectable results. A total of seven wells exceeded 100 ppb. (Although there are no recognized safety standards for organics in drinking water, the EPA has recently proposed a 100-ppb standard for a selected group of organics known as the trihalomethanes.) All of these wells were located on or near industrial sites and are not used for drinking purposes. Follow-up monitoring is being planned to insure that contamination from these sites does not threaten any nearby aquifers used as sources of drinking water.

A large percentage of the wells tested contained trace or non-detectable concentrations of the organic compounds. In no case was a well found to pose any immediate danger to human health.

Group 2 - Pesticides

As was the case for the organics (group 1), the presence and

concentration of pesticides in the groundwater varies with land use. These compounds were most commonly found in the agricultural areas of the state. Pesticide contamination of groundwater was virtually non-existant in the heavily populated and industrialized areas which were monitored.

The most commonly occuring pesticides are lindane, heptachlor and DDT. The use of lindane and heptachlor is currently restricted in New Jersey, and DDT is banned. The presence of these compounds in the groundwater was not entirely unexpected since all three have been used extensively in the past to control soil insects, flies, mosquitoes and household pests.

The levels of pesticide contamination were very low. The mean values of all the compounds were below .1 ppb. Only three wells exhibited pesticide values exceeding recommended federal drinking water standards. Resampling at two of these wells (which are used for drinking purposes) failed to detect any pesticides. It is therefore presumed that the initial samples were contaminated in some way and do not reflect the true quality of the groundwater. The third violating well is located at an industrial site and is not used for drinking purposes. However, resampling of this well is planned as part of the follow-up monitoring project. Once again, no wells were found to pose any immediate danger to human health.

Group 3 - Metals

Virtually every well tested contained detectable levels of all the metals. This is due, in part, to the fact that many of the metals occur naturally in groundwater. However, the widespread presence of metals such as cadmium and chromium, which are usually

found only in extremely low levels in natural waters, might indicate some seepage of metals into groundwater aquifers.

A total of ten wells exhibited metal values exceeding recommended standards. Seven of these wells were located at industrial sites, and two of the remaining three were located at landfills which receive industrial waste.

The overwhelming majority of the samples contained trace concentrations of metals. Most wells were in the range of 1 ppb or below. These levels are far below the recommended standards. In no case was a domestic or public supply well found to contain concentrations of metals posing any immediate danger to human health.

4. HEALTH EFFECTS

All of the compounds and substances being analyzed for in this project are toxic under certain conditions, and many are recognized carcinogens. They have been selected from the Environmental Protection Agency list of toxic substances and the New Jersey DEP list of selected environmental carcinogens. Most of what is known about the health effects of these substances has been learned from animal tests and high-dose occupational exposures. Very little is known of the effects of long-term low-dose exposure to these toxics. Recently there have been several statistical studies which have suggested a link between toxic contamination of drinking water and increased rates of cancer mortality. These studies are far from definitive, however, and much additional research is needed before the health effects of low-level environmental contamination are understood.

The following is a short summary of current information on the health effects of those substances found in the state's groundwater.

Group I - Organics

Recent studies have linked the presence of chlorinated organics in drinking water to elevated rates of cancer mortality. However, these studies involve chlorinated surface water supplies which contain levels of organics well above those found in the groundwater supplies of this investigation.

Three of the four compounds most often found in this investigation have been shown to cause cancer in laboratory tests. Carbon tetrachloride, chloroform and trichloroethylene have each produced tumors when administered to laboratory animals at doses many times higher than those detected in these samples.

At high doses, these compounds have been shown to have toxic effects in man ranging from nausea to liver damage and death. However, virtually no data are available on the human health effects of low-level exposure. It is hoped that current research by federal and state agencies utilizing animal testing and epidemiological studies of exposed human populations will soon provide a better understanding of the role of these compounds in human disease.

Group II - Pesticides

The chlorinated pesticides have been used for at least three decades, and there are still no definite conclusions regarding their

long-term low-dose human health effects. Because of their chemical stability, the pesticides are metabolized slowly, and, if absorbed into the human body, are stored in the fatty tissues. It is this property, along with high-dose toxic effects, which has led to the banning or strict control of several of these compounds. At high doses, organic pesticides result in effects range from headaches and dizziness to convulsions and death.

Recent research has found that many of the pesticides produce cancer in test animals. DDT and lindane, which were among the most commonly found pesticides in this investigation, both have produced cancer in animals.

Available data from animal testing fails to provide adequate information on the long term effects of these compounds in humans. Much more research is needed before the effects of minute amounts of pesticides in drinking water are known.

Group III - Metals

The human health effects of the metals analyzed in this project are widely varied. Copper and zinc, in small amounts, are necessary in human metabolism. On the other hand, arsenic, beryllium, cadmium, chromium, and nickel have been linked to increased cancer incidence in cases of occupational exposure, and have demonstrated carcinogenic potential in laboratory animals.

Since most of these metals occur naturally in the environment, the recommended standards for safe drinking water are higher than those for pesticides. Although the high-dose toxic effects of metals are well understood, the effects of long-term low-level

exposure again are unknown. The presence of cadmium and selenium in drinking water has been linked to cardiovascular disease, particularly hypertension. However, there is no evidence that non-occupational exposure to these metals constitues a cancer hazard

5. FUTURE PLANS OF THE PROGRAM ON ENVIRONMENTAL CANCER AND TOXIC SUBSTANCES

This statewide survey of groundwater by DEP marks the beginning of a multi-year effort to identify and eliminate those toxic substances that are contaminating the state groundwater supplies. The information gained from this initial phase of the project will indicate those areas where more extensive monitoring of groundwater is needed.

In addition to testing groundwater, the DEP Program on Environmental Cancer and Toxic Substances will soon initiate statewide monitoring of air, surface water, and additional dirnking water sources for the presence of toxics and carcinogenic compounds. The Program is also utilizing short-term biological tests in order to measure the cancer-causing potential of air and water samples throughout the state.

Information gained from these monitoring projects will be mapped to define those areas of the state which are contaminated by toxic substances and to identify those populations which may be exposed to potential cancer-causing agents. The information will then be statistically related to cancer mortality rates to determine if the geographic distribution of cancer is related to environmental contamination. Through this type of environmental

monitoring, coupled with geographic and statistical analyses, the Program on Environmental Cancer and Toxic Substances hopes to identify those environmental contaminants which may be related to the high incidence of cancer in New Jersey.

A. Summary Chart - High Values by County

County	# of Wells Sampled	No. of High Values* Organics	Pesticides	Metals
Bergen	8	1	0	0
Cumberland	24	1	0	3
Essex	17	1	0	0
Hudson	4	0	1	0
Hunterdon	26	0	0	1
Monmouth	40	0	0	1
Morris	26	1	0	0
Passaic	11	2	0	0
Salem	37	1	2	1
Somerset	15	0	0	0
Union	10	0	0	0
Warren	30	0	0	2

*For pesticides and metals high values are defined as any values exceeding the EPA recommended safe drinking water standard. For organics, high values are those exceeding 100 ppb, a standard recently proposed by EPA for a select group of organics known as trihalomethanes.

B. Summary Chart - Organics

	Number of wells in designated range					Parts per billion (ppb)	
	>100	100-10	10-1	.9-.1	<0.1	Mean	Median
Methylene Chloride	0	0	0	0	237	<0.1	<0.1
Methyl Chloride	0	0	0	0	237	<0.1	<0.1
Methyl Bromide	0	0	0	0	237	<0.1	<0.1
*Chloroform	3	4	48	79	103	5.2	0.2
*Bromoform	0	1	2	14	216	0.2	<0.1
1,1,2-Trichloroethylene	2	12	21	49	153	5.7	<0.1
1,1,2,2-Tetrachloroethane	0	0	1	22	211	<0.1	<0.1
1,1,2-Trichloreothane	0	0	15	23	199	1.0	<0.1
*Dibromochloromethane	0	0	1	18	208	<0.1	<0.1
*Trifluoromethane	0	0	0	0	237	<0.1	<0.1
Carbon Tetrachloride	1	1	8	35	190	1.0	<0.1
1,2-Dibromoethane	0	3	2	8	224	0.5	<0.1
1,2-Dichloroethane	0	1	4	4	228	0.1	<0.1
1,1,1-Trichloroethane	3	20	97	69	48	8.9	1.0
Vinyl Chloride	0	0	0	0	237	<0.1	<0.1
1,1,2,2-Tetrachloroethylene	0	12	15	42	168	2.1	<0.1
o,m,p-Dichloro benzene	0	0	1	0	236	<0.1	<0.1
Trichlorobenzene	0	0	0	0	237	<0.1	<0.1
Diiodomethane	0	0	2	43	192	<0.1	<0.1

*Although there are no reognized safety standards for organics in drinking water, the EPA has recently proposed a 100-ppb standard for a selected group of organics known as the Trihalomethanes.

C. Summary Chart - Pesticides

	Recommended drinking water standards (EPA)	Number of Wells in Designated Range					parts per billion (ppb)	
Pesticides	EPA	>100	100-10	10-1	.9-.1	<0.1	Mean	Median
Polychlorinated Biphenyls Arochlor 1254	1 ppb	0	0	0	0	250	<0.1	<0.1
BHC	none	0	0	0	1	250	<0.1	<0.1
Lindane	4 ppb	0	0	0	1	249	<0.1	<0.1
Aldrin	1 ppb	0	0	0	4	246	<0.1	<0.1
Dieldrin		0	0	0	9	233	<0.1	<0.1
Heptachlor	0.1 ppb	0	0	0	1	248	<0.1	<0.1
Heptachlor Epoxide	0.1 ppb	0	0	0	2	249	<0.1	<0.1
Toxaphene	5 ppb	0	0	0	0	250	<0.1	<0.1
pp'DDE	50 ppb	0	0	0	9	243	<0.1	<0.1
op'DDT	50 ppb	0	0	0	13	236	<0.1	<0.1
Methoxychlor	1000 ppb	0	0	0	0	250	<0.1	<0.1
Mirex	none	0	0	0	1	249	<0.1	<0.1
Endrin	0.5 ppb	0	0	0	7	244	<0.1	<0.1
Chlordane	3 ppb	0	0	0	4	246	<0.1	<0.1

D. Summary Chart - Metals

	EPA Drinking Water Standards (ppb)	Number of Wells In Designated Ranges				parts per billion (ppb)	
		>100	100-11	10-D.L.*	Less than D.L.*	Mean	Medium
Arsenic	50	2	1	79	161	7.0	<1
Beryllium	No Std.	0	1	7	237	0.9	<1
Cadmium	10	1	2	21	221	2.7	<1
Copper	1,000	8	42	172	20	17.6	3
Chromium	50	2	15	156	72	5.2	2
Nickel	No Std.	1	42	43	159	10.3	<5
Lead	50	4	15	105	121	6.0	1
Selenium	10	0	0	70	174	1.2	<2
Zinc	5,000	44	105	47	49	228	20

*D.L.- Detection limit. The D.L. varies for the different metals. For Arsenic, Beryllium, Cadmium, Copper, Chromium, and Lead, the detection limits are 1 ppb. For Selenium, the detection limit is 2 ppb. For Nickel and Zinc, the detectin limits are 5 ppb.

7. DEFINITIONS

Toxic substance - a general term for any substance which can cause an adverse environmental or biological change or effect, and are potentially hazardous to human health in certain quanties.

Recommended standards - these are the recommended safety limits for each compound in drinking water. The values have been arrived at through extensive biological testing procedures. No harmful effects have been observed in test animals for concentrations at this level or below in drinking water. Chronic effects may possibly occur from long-term trace exposure. A significant margin of safety has been calculated into these values to minimize any risk of harmful effects.

ppb - parts per billion. This is a standard unit of measure for water sampling. A concentration of 1 ppb would mean one part of contaminant for every billion parts of water.

Mean value - this value is the average for each compound in all the wells. The detection limit was taken as the concentration for those wells with values below detection.

Median value - the median value is the middle number in a ranked group of observations. In this case, since there are 250 observations, the median was completed by averaging the 125th and 126th observations.

Organics - a class of chemicals containing carbon and hydrogen atoms, not necessarily obtained from living organisms. Many organics are artificially synthesized and are widely used in industry.

Pesticides - a group of chemicals, often organics, used to control noxious or unwanted species of plants or insects.

Metals - a group of chemical elements which possess the following characteristics: shiny luster, good reflectors of light and good conductors of electricity.