TRACE-METAL LEACHING FROM PLUMBING MATERIALS EXPOSED TO ACIDIC GROUND WATER IN THREE AREAS OF THE COASTAL PLAIN OF NEW JERSEY

By George R. Kish, Jo Ann Macy, and Robert T. Mueller

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 87-4146

Prepared in cooperation with the

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION,

OFFICE OF SCIENCE AND RESEARCH

West Trenton, New Jersey

1987

DEPARTMENT OF THE INTERIOR

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CONVERSION FACTORS AND ABBREVIATIONS

For the convenience of readers who may prefer to use metric (International System) units rather than the inch-pound units used in this report, the values may be converted by using the following factors:

Multiply inch-pound unit	By	To obtain metric unit
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)

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ABSTRACT

The U.S. Geological Survey analyzed trace-metal concentrations in tap water from domestic wells (1) in newly constructed homes in Berkeley Township, Ocean County and Galloway Township, Atlantic County, N.J. and (2) in older homes in Beachwood Borough, Ocean County, N.J. All of the wells sampled are screened in the Kirkwood-Cohansey aquifer system. This aquifer system typically yields acidic water with low alkalinity and low hardness. The potable water distribution systems in all of the homes sampled are constructed primarily of copper with lead-based solder joints. Home water treatment systems are used in Berkeley Township while no treatment is used in Galloway Township. Tap water samples were collected after the water had been standing in the pipes overnight. In Beachwood, samples of tap water were collected from homes previously showing elevated concentrations of lead.

In Berkeley Township, 6 of the 11 samples exceeded both the maximum contaminant level (MCL) of the national primary drinking water regulation for lead (50 μg/L) and the secondary drinking water regulation (SDWR) for copper (1,000 μg/L). In Beachwood Borough, 2 of the 7 samples exceeded the MCL for lead.

In Galloway Township, three sets of samples were collected at each home: (1) after the water had been standing in the pipes overnight, (2) after the water had been running 2-3 minutes and a noticeable (to the touch) temperature change was detected, and (3) after the water had been running an additional 15 minutes. In the first sample set, 12 of 14 samples exceeded the MCL for lead and 13 of 14 exceeded the SDWR for copper. In the third sample set, none of the 14 samples exceeded the regulations for lead or copper.

The data indicate that significant amounts of lead and copper may be leaching from household plumbing systems into tap water. Increased residence time of soft, acidic ground water in new home plumbing systems resulted in increased trace metal concentrations in tap water.

INTRODUCTION

In 1981, a Beachwood, New Jersey, resident became ill and was diagnosed as having aluminum poisoning; it was recommended that water from his well be analyzed for trace metals. The resulting analysis showed lead in excess of the maximum contaminant level (MCL) of 50 μg/L[1] (micrograms per liter) established in 1976 by the U.S. Environmental Protection Agency (USEPA). In

[1] The National Primary Drinking Water Regulations promulgated by the U.S. Environmental Protection Agency in 1976 defines the maximum permissible level of a contaminant or maximum contaminant level (MCL) in water delivered to a public-water-supply user. These regulations are designed to safeguard public health and welfare and are based on the toxicity of the contaminant (U.S. Environmental Protection Agency, 1976). The Secondary Drinking Water Regulations (SDWR) are recommended standards for potable water based on aesthetic considerations such as taste, odor and appearance (N.J. Department of Environmental Protection, 1985). In this report, the Primary Regulations apply to lead, and the Secondary Regulations apply to copper and zinc.

response to this situation, the New Jersey Department of Environmental Protection, Division of Water Resources and the Ocean County Health Department sampled over 1,400 private wells in the Beachwood Borough and Berkeley Township areas (fig. 1). Fourteen percent of the wells sampled in Beachwood Borough and 6 percent sampled in one area of Berkeley Township exceeded the MCL for lead (table 1). The contamination was suspected to be in the aquifer; however, the source of the contamination was not known. In December 1982, the area was placed on the U.S. Environmental Protection Agency's National Priorities List (Superfund) (U.S. Environmental Protection Agency, 1984).

A subsequent investigation by Preczewski and Hayes (N.J. Department of Environmental Protection, written commun., 1983) could not identify a pattern of lead distribution in the wells typical of a contaminant plume in the ground water. No contamination was observed downgradient of a nearby municipal landfill. The elevated concentrations of lead found in the domestic wells did not correspond to soil type or to the proximity of major highways in the area. On the basis of these observations, it was postulated that lead might be leaching from the solder commonly used in household plumbing.

Extensive research has been conducted in Europe, Great Britain, and the United States relating elevated trace-metal concentrations in drinking water to the types and ages of plumbing materials, residence time of the water in the plumbing system, and the corrosive nature of the water. When corrosive water is in contact with metal surfaces, trace metals may leach into the water (O'Brien, 1976). An indirect measure of water corrosiveness can be calculated from the Langelier Saturation Index (LSI). This index calculates the calcium carbonate saturation pH needed to form a protective calcium carbonate film on water-distribution pipes (American Public Health Association and others, 1980). The LSI is the pH of the water minus the calculated saturation pH. Positive values indicate that the water is supersaturated with calcium carbonate and that calcium carbonate will tend to precipitate from solution, depositing a coating on water pipes. Negative values indicate undersaturation and a tendency of the water to corrode the pipe interior. The LSI for ground water in the Kirkwood-Cohansey aquifer system in the Kirkwood Formation overlying the Cohansey Sand of Miocene Age in Ocean County, N.J. is about -6.1. This is based on a median pH of 5.4; a median hardness of 4 mg/L (milligrams per liter) (as $CaCO_3$); a median water temperature of 13.0 degrees Celsius; and a median alkalinity of 4 mg/L (as $CaCO_3$) (Harriman and Voronin, 1984).

Much of the drinking water consumed by people living in southern New Jersey is derived from the naturally corrosive ground water in the Kirkwood-Cohansey aquifer system, and plumbing systems in new homes are commonly constructed with copper pipes joined with lead-based solder, as is permissible under the plumbing codes of New Jersey and many other states. These facts, coupled with the marked increase in new home construction, may be causing an unnecessary health risk to people purchasing new homes in New Jersey.

Purpose and Scope

In 1983, the U.S. Geological Survey in conjunction with the New Jersey Department of Environmental Protection, Office of Science and Research,

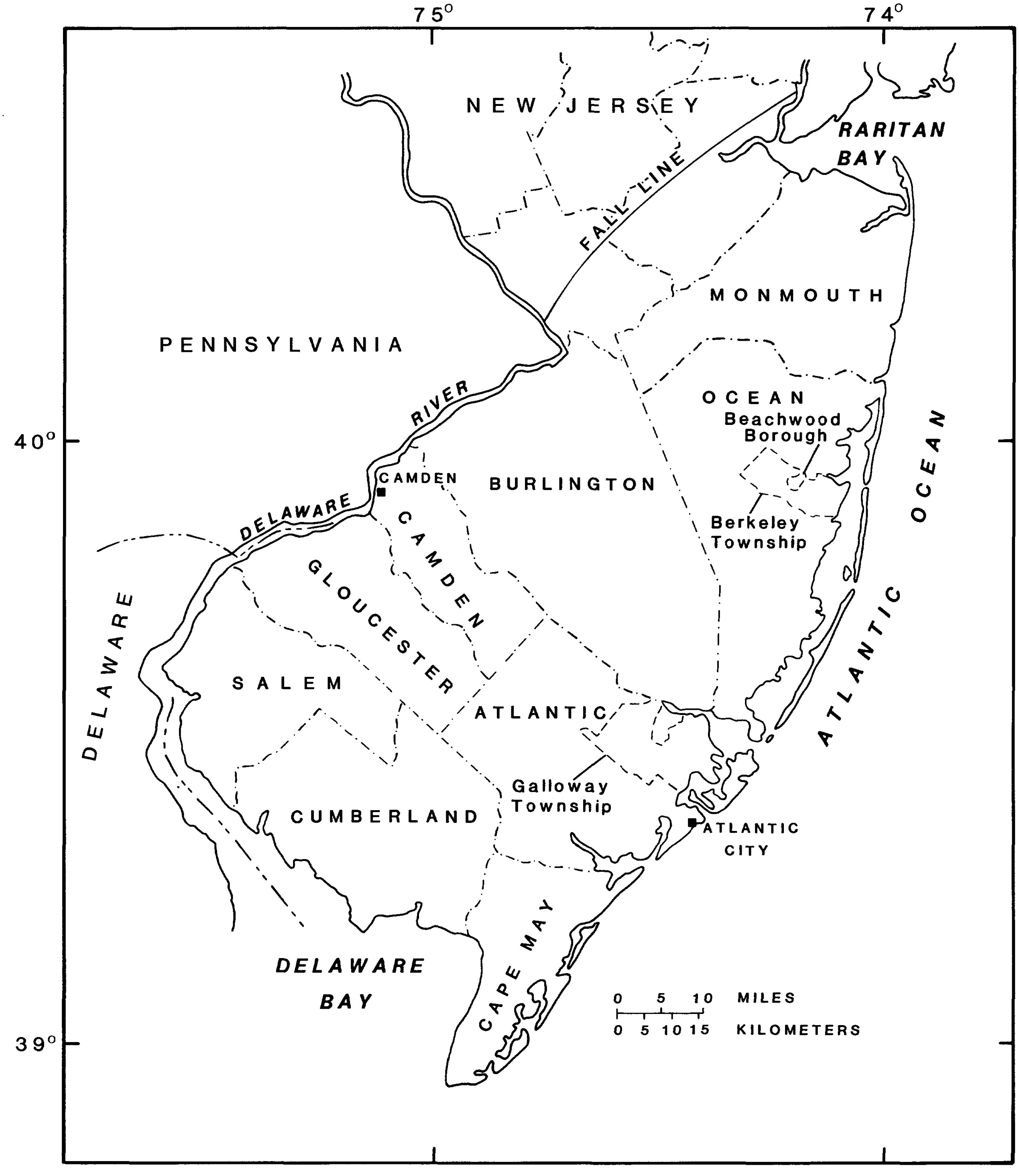

Figure 1.--Location of lead contamination study areas.

Table 1.-- Frequency of lead concentrations in domestic wells in Beachwood Borough and Berkeley Township, New Jersey, 1982

[μg/L, micrograms per liter]

Location	Number of wells sampled	Number of wells below 10 μg/L	Number of wells between 10-50 μg/L	Number of wells above 50 μg/L standard[1]	Percentage of wells above 50 μg/L standard[1]
Beachwood	590	370	138	82	14
Berkeley					
Area 1	464	316	121	27	6
Area 2	133	111	21	1	<1
Area 3	338	295	40	3	<1

(From Preczewski, J. and Hayes, T., New Jersey Department of Environmental Protection, Division of Water Resources, written commun., 1983)

[1]Maximum contaminant level for lead in drinking water (U.S. Environmental Protection Agency, 1976)

began a geochemical study to evaluate the possible contributions of environmental lead from regional sources to the shallow ground water. Potential sources of lead included pesticide usage, naturally occurring mineral deposits, automobile exhaust emissions and home plumbing systems.

This report focuses on the leaching of lead and other trace metals from home plumbing systems in three areas within the New Jersey Coastal Plain--the Beachwood Borough and Berkeley Township areas in Ocean County and Galloway Township in Atlantic County, New Jersey. Beachwood Borough and Berkeley Township were chosen because of the 1981 documentation of lead contamination in these communities. Galloway Township was selected to determine if trace-metal leaching from plumbing materials exposed to corrosive ground water might be occurring in other areas of the New Jersey Coastal Plain.

Previous Investigations

Several studies have been conducted on the relation between plumbing-system construction and drinking-water quality. A summary of the results of selected studies is presented in tables 2 and 3. Research in soft-water areas of Great Britain indicates that a positive correlation exists among the lead used in plumbing systems, dissolved lead in tap water, and the levels of lead in blood (Parry, 1967; Crawford and Morris, 1967; Moore and others, 1977; Beattie and others, 1972a; Addis and Moore, 1974). In Glasgow, Scotland, lead concentrations in tap water averaged 358 μg/L in households where lead pipes or lead-lined pipes were used (Beattie and others, 1972b). A survey of tap water in Great Britain found that approximately 8, 34 and 9 percent of the households sampled in England, Scotland, and Wales had lead concentrations greater than 50 μg/L (Matthew, 1981) (table 2).

In British Columbia, a study of water supplies contaminated by lead leaching from the service lines (Wong and Berrang, 1976) found that the concentration of lead varied with the amount of water flushed through the plumbing system. The observed concentration of lead in early morning samples ranged from 60 to 2,600 μg/L when 0.5 liter of water was flushed through the sytem prior to sampling; when 25 liters of water were flushed through the system, the concentration range was lowered to 20 to 260 μg/L.

In a laboratory experiment, Wong and Berrang (1976) passed varying volumes of soft, acidic water through a simulated household plumbing system to observe the dissolution of lead into the water. Cumulative volumes of 80, 1,200, 12,000, and 25,000 liters of water were flushed through the simulated system. The water that remained in the lines after each flushing was permitted to stand for one hour before a sample was collected. After flushing the system with 12,000 liters, the concentration of lead in the standing sample was 96 μg/L, nearly twice the MCL. After the system had been flushed with 25,000 liters, the concentration of lead in the standing sample decreased to 34 μg/L.

Studies conducted by the Minnesota Department of Health and the Wisconsin Department of Natural Resources showed that 37 percent and 35 percent of the early morning tap water samples exceeded the MCL for lead (Minnesota Department of Health, written commun., 1985; Wisconsin Department

Table 2.-- Percentage of tap water samples equal to or exceeding established concentration limits for lead and copper in selected studies.*

[a dash indicates no data was available]

Location	Number of Samples	Percentage of samples equal to or exceeding established limits	Reference
		Lead	
England	--	8	Matthew, 1981
Scotland	--	34	Matthew, 1981
Wales	--	9	Matthew, 1981
Boston area, Ma.	936	15	Karalekas and others, 1976
Seattle, Wa.	22	23	Hoyt and others, 1978
Wisconsin	37	35	Wisconsin Dept. of Natural Resources, 1985 (personal commun.)
Minnesota	46	37	Minnesota Dept. of Health, 1985 (personal commun.)
Chesterfield Co., S.C.	217	10	Sandhu and others, 1977
Carroll Co., Md.	350	24	Lovell and others, 1978
Nova Scotia	55	20	Maessen and others, 1985
Morris Co., N.J.	135	25	Benson and Klein, 1983
So. Huntington, L.I.,N.Y.	--	68 #	Murrell, 1985
So. Huntington, L.I.,N.Y.	--	15 ##	Murrell, 1985
Beachwood Borough, N.J.	590	14	Preczewski and Hayes, 1983 (written commun.)
Beachwood Borough, N.J.	7	28	This report
Berkeley Township, N.J.	11	55	This report
Galloway Township, N.J.	14	86	This report
		Copper	
Carroll Co., Md.	350	67	Lovell and others, 1978
Nova Scotia	55	53	Maessen and others, 1985
Morris Co., N.J.	31	58	G. Annibal, 1985 (personal commun.)
Berkeley Township, N.J.	11	55	This report
Galloway Township, N.J.	14	86	This report

* primary drinking water regulation of 50 µg/L for lead; secondary drinking water regulation of 1,000 µg/L for copper
\# homes built between 1980 and 1983
\## homes built between 1955 and 1979

Table 3.-- Concentrations of metals in standing and running tap water samples in selected areas

[a dash indicated no data was available]

Location	Metal	Concentration (µg/L) Standing water Mean	Standing water Max	Running water Mean	Running water Max	pH Range	Reference
Surface-Water Supply, Some Lead-Lined Distribution Pipes, Lead-Soldered Copper Pipes in Homes							
Worcester, Ma.	Pb[1]	273	1,900	0#	0#	6.30	O'Brien, 1976
New Bedford, Ma.	Pb	76	--	13	--	6.00-7.30	Karalekas and others, 1978
Ground-Water Supply, Lead-Soldered Copper Pipes in Homes							
Chesterfield County, S.C.	Pb	--	--	21	180	4.20-7.80	Sandhu and others, 1977
	Cu[2]	--	--	219	1,560	do.	do.
Morris Township, N.J.	Pb	53	260	18	39	5.70-6.90	Benson and Klein, 1983
Wisconsin	Pb	24*	1,200	<3*	130	--	Wisconsin Dept. of Natural Resources, 1985 (personal commun.)
Minnesota	Pb	38*	1,500	<10*	24	--	Minnesota Dept. of Health, 1985 (personal commun.)
Washington Township, N.J.	Cu	2,000*	10,200	<100*	1,600	5.40-7.50	Annibal, 1985 (personal comm.)
Hacketts Cove, Nova Scotia	Pb	40	--	2	--	6.40-6.86	Maessen and others, 1985
	Cu	1630	--	90	--	do.	do.
East Dalhousie, Nova Scotia	Pb	140	--	0.7	--	5.59-6.03	Maessen and others, 1985
	Cu	1100	--	80	--	do.	do.

* Median

\# No detection limit reported by the author

[1] Pb = lead

[2] Cu = copper

of Natural Resources, written commun., 1985) (table 2). Water samples in both studies generally were the first water collected from household taps after the water had been standing in the water pipes over night. The maximum standing water lead concentrations were 1,500 μg/L and 1,200 μg/L, respectively (table 3).

In Morris County, New Jersey, Benson and Klein (1983) sampled private wells in homes of varying ages and found that the mean lead concentration of standing tap water was 53 μg/L, whereas the mean of the running tap water was 18 μg/L (table 3). Fifty-eight percent of the standing water samples, collected during a 2-month period from 31 new homes in Washington Township, Morris County, New Jersey, exceeded the SDWR for copper. The median standing-water concentration of copper was 2,000 μg/L, whereas the median running-water concentration was <100 μg/L (Annibal, G.M., Madison Health District, oral commun., 1985) (table 3).

Acknowledgments

The authors are grateful to the following individuals for helpful suggestions in the planning phase of this work: Norman E. Murrell of Holzmacher, McLendon and Murrell; Michael Alarcon of the Nassau County Health Department, Long Island, New York; Peter C. Karalekas, U.S. Environmental Protection Agency, Boston, Massachusetts; and Peter Lassovszky, U.S. Environmental Protection Agency, Washington, D.C. The authors wish to thank the following individuals for providing data used in this report: Garry M. Annibal, Madison Health District, Morris County, New Jersey; Larry B. Landsness, Wisconsin Department of Natural Resources, Madison, Wisconsin; and Richard Clark, Minnesota Department of Health, Minneapolis, Minnesota.

The authors are also grateful to Dr. Wen Yuan, Rutgers University Environmental Sciences Department for the analysis of trace metals in the water samples.

This research was funded, in part, by the Office of Science and Research, New Jersey Department of Environmental Protection.

DATA COLLECTIONS AND METHODS

A three-phase sampling network was established to (1) resample some of the homes that in 1982 had tap-water lead concentrations in excess of the MCL (Beachwood Borough), (2) sample new homes (less than 1 year old) with domestic wells and in-home treatment systems (Berkeley Township), and (3) sample new homes with domestic wells but without home treatment systems (Galloway Township).

In phase one, an inventory of the homes sampled in 1982 in Beachwood Borough was conducted. Seven out of the 20 homes with the highest lead concentrations were selected for resampling. However, between 1982 and 1984, Beachwood Borough had extended the public water-supply lines to six of the seven homes selected for sampling. Each home, now connected to the public water supply, had been allowed to keep one outside tap connection to the domestic well for nonpotable use. Two samples were obtained from this outside tap at each home sampled. The first sample was collected after the tap had been unused for at least 6 hours. The second sample was collected after the lines were flushed and the field pH and specific conductance had stabilized. The volume of water pumped to waste prior to stabilization of field parameters (100 to 900 gallons) was assumed to be sufficient to flush holding tanks, pipes, and well casing.

In phase two, a group of homes in Berkeley Township was selected for sampling. Each of the homes was less than 1 year old and had a copper plumbing system. All of the homes had some type of in-line water treatment between the well and the tap. The treatment systems ranged from simple filtration units to demineralization systems with pH adjustment and carbon adsorption. The water samples were collected by the homeowners using a protocol established by Karalekas and others (1978). The homeowners were given two sample bottles and were instructed to collect the first morning water from either the kitchen or bathroom tap. One sample bottle was a 500 ml (milliliter) polyethylene bottle for metals analysis that was rinsed in acid/deionized water, and the other was a 500 ml polyethylene bottle for field measurement of pH and specific conductance that was rinsed in deionized water. Within 2 hours of collection, the acid-rinsed bottle was treated with concentrated nitric acid to a pH of less than 2. Specific conductance and pH were measured in the field from the second bottle.

In phase three, a group of new homes in Galloway Township was selected for sampling. Each home had copper plumbing and no water-treatment system. The homeowners collected the water samples using the same sampling protocol as in the second phase, except that two additional sample sets were obtained. After filling the first set of bottles, the tap water was permitted to run until there was a noticeable (to the touch) water temperature change from warm to cool (less than 5 minutes). This temperature change was presumed to indicate that the indoor plumbing was cleared of all standing water; then a second sample was collected. A third set of samples was obtained after an additional 15 minutes of flushing. Within 2 hours of collection the samples for metals analysis were acidified with concentrated nitric acid to a pH of less than 2. Field pH and specific conductance were measured from the second bottle in each set.

All of the samples were analyzed for trace metals by the Environmental Science Department at Rutgers University by using chelation-extraction followed by graphite-furnace atomic absorption (U.S. Environmental Protection Agency, 1979). For quality assurance, blank samples and reference samples were disguised and sent for analysis along with the tap-water samples. The water-quality data in this report were also subject to the standard quality-assurance procedures used by the U.S. Geological Survey's laboratory system as described by Friedman and Erdmann (1982).

TAP-WATER SAMPLING

Results

In Beachwood Borough, where the ages of the homes ranged from 3 to 24 years, two of seven samples equaled or exceeded the MCL for lead (table 4). The mean lead concentration of 27 μg/L in standing water decreased to 9 μg/L in running water. The mean copper concentration of 146 μg/L in standing water decreased to 63 μg/L in running water; the mean zinc

Table 4.-- Lead, copper, and zinc concentrations in standing and running tap water from houses more than 3 years old in Beachwood Borough, New Jersey

[µg/L, micrograms per liter]

	Concentration (µg/L)		
	Lead	Copper	Zinc*
Mean			
Standing	27	146	163
Running	9	63	22
Median			
Standing	12	43	140
Running	8	29	22
Range			
Standing	6-89	13-650	32-350
Running	3-17	9-270	6- 55
Number of samples	7	7	7
Number of samples equal to or exceeding established regulations			
Standing	2	0	0
Running	0	0	0

* values given are for dissolved zinc

concentration of 163 μg/L in standing water decreased to 22 μg/L in running water. This decrease in trace-metal concentrations between standing and running water is shown in figure 2. The 1982 mean lead concentration calculated from the same group of homes sampled and analyzed by the Ocean County Department of Health was 2,116 μg/L.

The results of analyses of standing tap-water samples taken from new homes in Berkeley Township are summarized in table 5. Lead concentrations in 6 of 11 homes sampled exceeded the MCL. The minimum lead value of 2.0 μg/L was obtained from a home with a treatment system, which included demineralization, pH adjustment, and carbon adsorption. Copper concentrations in 6 of 11 homes sampled exceeded the SDWR of 1,000 μg/L.

The results of samples collected at new homes in Galloway Township, are shown in table 6. Twelve of 14 samples of standing water exceeded the MCL for lead. In the second sample set, collected after the pipes inside the house were flushed, only two samples exceeded the MCL for lead. None of the third set of samples, collected after an additional 15 minutes of flushing, exceeded the MCL for lead. The maximum concentration of lead in standing water was 800 μg/L; the maximum concentration of lead in running water was 14 μg/L.

Similarly, copper exceeded the SDWR of 1,000 μg/L in 13 of 14 standing-water samples, and in 9 of 14 samples collected after the water lines were flushed. None of the samples collected after 15 additional minutes of flushing exceeded the SDWR for copper. The maximum copper concentration in standing water was 12,300 μg/L, whereas the maximum concentration of copper in running water was 680 μg/L.

Zinc exceeded the SDWR of 5,000 μg/L in only 1 of 14 standing-water samples. Maximum zinc concentrations ranged from 12,000 μg/L in standing water to 370 μg/L in running water.

Relation to other studies

In Beachwood Borough, New Jersey, the mean lead concentration (27 μg/L) in the standing-water samples of the seven homes sampled in 1984 is significantly lower than the mean lead concentration (2,116 μg/L) of the 1982 data. Several investigators (Murrell 1985a, 1985b; Lassovszky, 1984; and Lovell and others, 1978) have demonstrated that as the age of a home increases, the concentration of lead observed in standing tap water decreases. Although the Beachwood data appears to support this correlation, it would be premature to conclude this for two reasons. A small number of samples were collected in 1984, and alterations were made to the original home-plumbing systems when the homes were connected to the public water supply. The 1982 samples were collected from taps within the houses' original plumbing systems. Water flowing to the tap was exposed to a much longer length of plumbing and to more soldered joints than the water sampled in 1984. By 1984, there was only a short length of pipe connecting the outside tap to the well.

In 1985, Murrell sampled tap water from selected homes on Long Island, New York. He found that, in homes built between 1980 and 1983, 68 percent of the samples exceeded the MCL for lead. In homes built between 1955 and

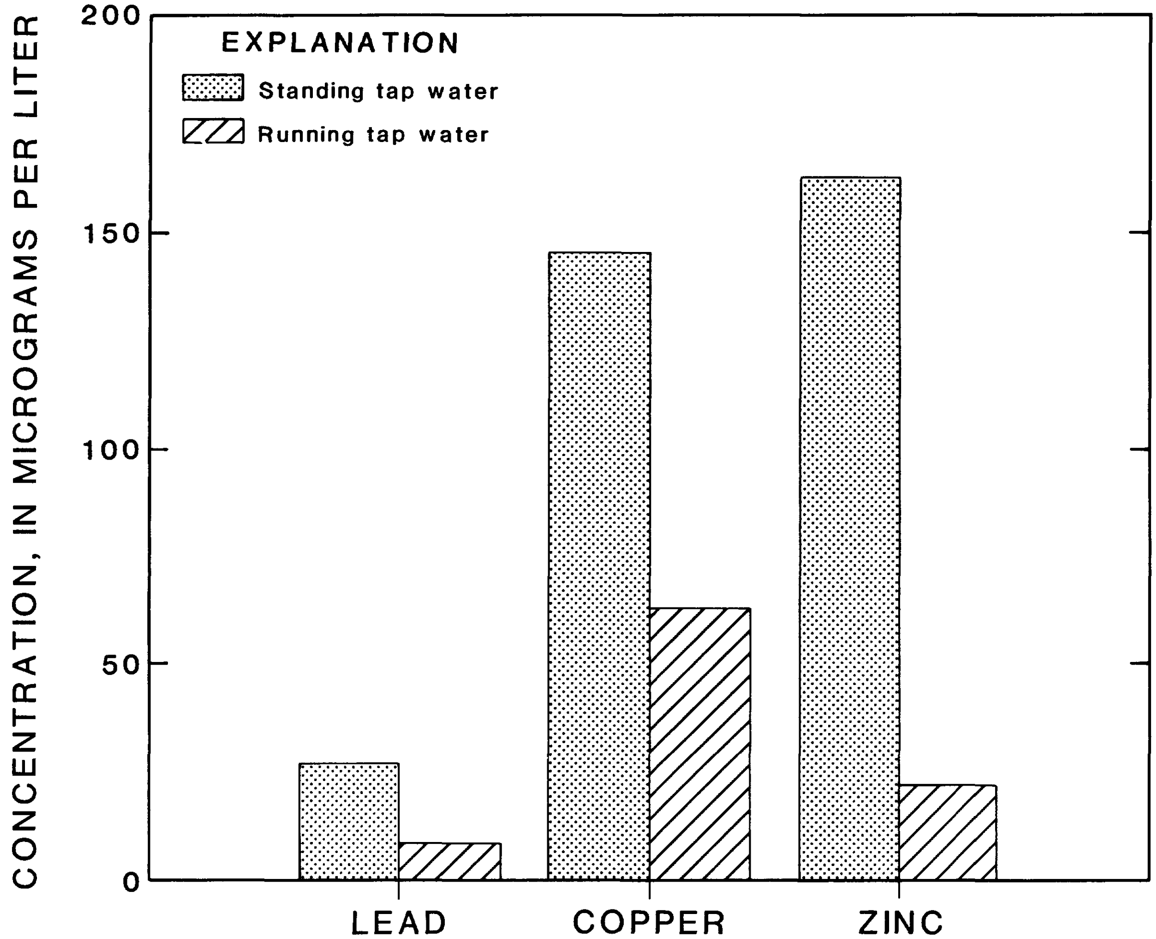

Figure 2.--Mean concentration of lead, copper, and zinc for standing and running tap water in homes more than 3 years old in Beachwood Borough, New Jersey, 1984.

Table 5.--Lead, copper and zinc concentrations in standing tap water from houses less than 1 year old in Berkeley Township, New Jersey

[μg/L, micrograms per liter]

	Concentration (μg/L)		
	Lead	Copper	Zinc
Minimum	2	28	18
Maximum	400	1,450	1,680
Mean	140	1,060	440
Median	101	1,034	280
Number of samples exceeding established regulations	6	6	0
Number of samples	11	11	11

Table 6.--Lead, copper and zinc concentrations in standing and running tap water from houses less than 1 year old in Galloway Township, New Jersey

	Concentration (μg/L)		
	Lead	Copper	Zinc
Mean			
Standing	193	8,762	1,280
At temperature change	47	4,123	127
Running	3	159	54
Median			
Standing	167	9,850	417
At temperature change	34	3,355	78
Running	2	78	11
Range			
Standing	8-800	118-12,300	20-12,000
At temperature change	.7-272	7-14,300	8- 600
Running	.1- 14	4- 680	6- 370
Number of samples	14	14	14
Number of samples exceeding established regulations			
Standing	12	13	1
At temperature change	2	9	0
Running	0	0	0

1979, only 15 percent exceeded the MCL for lead (table 2). A water-quality survey of private wells in Chesterfield County, South Carolina (Sandhu and others, 1977) detected lead in 90 percent of the wells sampled, with 10 percent exceeding the MCL (table 2). They found that lead concentrations were higher in recently constructed homes. In Carroll County, Maryland, a random sampling of 350 homes (Lovell and others, 1978) showed that 24 percent of the early-morning (standing) water samples exceeded the MCL for lead and 67 percent exceeded the SDWR for copper (table 2). In those samples exceeding the MCL for lead, 64 percent came from plumbing systems 3 years old or less, and 94 percent had pH measurements of 6.5 or less.

In Berkeley Township, the percentage of samples with concentrations of lead and copper greater than the MCL and SDWR is similar to those reported in the literature. However, in Galloway Township, the percentage of samples exceeding these limits far exceeds those typically reported in the literature (table 2). The higher percentages in Galloway Township may reflect the lack of water-treatment systems in the homes sampled in this township, and a median pH that is more acidic (5.81) than the median pH (6.95) in Berkeley Township.

In Galloway Township, the mean standing-tap-water concentration of lead and copper exceeded the mean running-tap-water concentrations. This suggests that significant amounts of lead and copper are being leached into the drinking water from the plumbing materials. The decrease in metal concentrations between standing and running water in this study is consistent with similar studies of copper water lines joined with lead-based solder in acidic, soft-water regions (Maessen and others, 1985; Lovell and others, 1978; Benson and Klein, 1983; Murrell, 1985a, 1985b; Lassovszky, 1984; de Mora and Harrison, 1984; Neff, 1985).

Maessen and others (1985) examined the mobilization of metals from plumbing materials in private wells in areas with soft water in Nova Scotia. In the standing-water samples, 20 percent exceeded the MCL for lead, and 53 percent exceeded the SDWR for copper (table 2), whereas, running-water samples had a significant decrease in lead and copper concentrations.

SUMMARY AND CONCLUSIONS

In December 1982, Beachwood Borough and the Berkeley Township area, Ocean County, N.J., was placed on the U.S. Environmental Protection Agencies National Priority List, because of suspected localized lead contamination in the Kirkwood-Cohansey aquifer system. In 1983, the U.S. Geological Survey in conjunction with the New Jersey Department of Environmental Protection, Office of Science and Research, began a geochemical study to evaluate the possible contributions of environmental lead from regional sources to the shallow ground water. Potential sources of lead included pesticide usage, naturally occurring mineral deposits, automobile exhaust emissions, and home plumbing systems. When the elevated concentrations of lead found in the domestic wells did not correspond to soil type or to proximity of major highways in the area, it was postulated that lead might be leaching from the solder commonly used in household plumbing.

Tap-water samples from domestic wells in newly constructed homes in Berkeley Township, Ocean County and Galloway Township, Atlantic County, N.J., were analyzed for trace-metal concentrations. The potable water-distribution systems in all of the homes sampled are constructed primarily of copper with lead-based solder joints. Home water treatment is used in Berkeley Township but not in Galloway Township. Tap water was collected after the water had been standing in the pipes overnight. In Berkeley, 6 of 11 samples exceeded both the U.S. Environmental Protection Agency's primary drinking water regulation for lead (50 μg/L) and the secondary drinking water regulation for copper (1,000 μg/L). In Galloway, 12 of 14 samples exceeded the primary drinking water regulations for lead and 13 of 14 exceeded the secondary drinking water regulation for copper. After collecting the standing-water samples, the water was left running for 15 minutes and a second sample was collected. None of the running-water samples exceeded the regulations for lead or copper. Available data suggest a correlation between the residence time of soft, acidic ground water in new home plumbing systems and elevated trace-metal concentrations in drinking water derived from domestic wells within the New Jersey Coastal Plain.

Although New Jersey does not appear to be unique in regard to the leaching of trace metals from plumbing systems in contact with soft, acidic ground water, there is an immediate need to determine the magnitude of this problem within the State. In order to determine the extent of the trace-metal leaching problem, a comprehensive data collection program emphasizing homes built within the last several years in the New Jersey Coastal Plain is needed.

As a result of this and other studies, the recently enacted Safe Drinking Water Act Amendments of 1986 will phase out the use of lead-tin solder in new home construction by 1988. In New Jersey, the Department of Community Affairs has banned the use of lead-tin solder in new home construction effective January 1987. Although plumbing systems in homes built after 1986 will be free of lead-tin solder, the public health risk from homes constructed in the last several years is unknown.

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