MERCURY IN GROUND WATER, SOILS, AND SEDIMENTS OF THE KIRKWOOD-COHANSEY AQUIFER SYSTEM IN THE NEW JERSEY COASTAL PLAIN

by Julia L. Barringer, Cecilia L. MacLeod, and Robert A. Gallagher

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CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATIONS

Multiply Length	By	To obtain
inch (in.)	2.54	centimeter
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
Area		
acre	4,047	square meter
acre	0.4047	hectare
square foot (ft^2)	0.09294	square meter
square mile (mi^2)	2.590	square kilometer
Volume		
ounce, fluid (fl. oz)	29.57	milliliter
ounce, fluid (fl. oz)	0.02957	liter
gallon (gal)	3.785	liter
cubic foot (ft^3)	0.02832	cubic meter
Flow		
foot per year (ft/yr)	0.3048	meter per year
million gallons per day (Mgal/d)	0.04381	cubic meter per second
Mass		
ounce, avoirdupois (oz)	28,349,000	microgram
ounce, avoirdupois (oz)	28,349	milligram
ounce, avoirdupois (oz)	28.35	gram
pound, avoirdupois (lb)	453.6	gram
pound, avoirdupois (lb)	0.4536	kilogram
ton, short	907.2	kilogram
ton, short	0.907	metric ton

Temperature

degree Fahrenheit (°F)	°C = 5/9 x (°F-32)	degree Celsius (°C)

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929-- a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Water-quality, soil-concentration, atmospheric-deposition, and load abbreviations:

mg/L	- milligrams per liter (parts per million)	ng/m^3	- nanograms per cubic meter
µg/L	- micrograms per liter (parts per billion)	DO	- dissolved oxygen
ng/L	- nanograms per liter (parts per trillion)	VOC	- volatile organic compound
µmoles/L	-micromoles per liter	lbs/acre	- pounds per acre
g/mole	-grams per mole	g/ha	- grams per hectare

CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATIONS--Continued

Water-quality, soil-concentration, atmospheric-deposition, and load abbreviations:--Continued

µg/Kg	-micrograms per kilogram (parts per billion)
mg/g	-milligrams per gram (parts per thousand)
µg/m2/yr	-micrograms per square meter per year
gal/d	-gallons per day
L/d	liters per day
L/yr	-liters per year
µg/yr	-micrograms per year

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by Julia L. Barringer, Cecilia L. MacLeod, and Robert A. Gallagher[1]

ABSTRACT

Since 1982, concentrations of total mercury that exceed 2 micrograms per liter have been reported in ground-water samples from the Kirkwood-Cohansey aquifer system, the most areally extensive unconfined aquifer in the New Jersey Coastal Plain. By 1988, the number of cases reported had alerted State and county agencies to the possibility of a widespread environmental problem. A study of the lithology of the aquifer sediments indicated that the mercury was unlikely to derive from natural sources; the aquifer is composed primarily of quartz sand, and few heavy minerals that might contain mercury are present or are likely to weather. A study of naturally occurring mercury concentrations in ground water indicated that background concentrations were on the order of 10 nanograms per liter or less.

In 1992, the U.S. Geological Survey, in cooperation with the New Jersey Department of Environmental Protection, began a 2-year study to evaluate the extent of mercury-contaminated ground water in the Kirkwood-Cohansey aquifer system in the New Jersey Coastal Plain previously identified by State and county agencies and to propose and evaluate hypotheses regarding possible mercury sources. The first phase of the study, with which this report is concerned, consisted of compiling available data on mercury concentrations in ground water and soils, determining mercury distributions in soils and aquifer sediments, sampling ground water, compiling and evaluating data on possible sources of mercury, and developing hypotheses regarding the causes of the occurrences of mercury in ground water.

Currently (1993), water from private, mostly domestic wells that contains concentrations of mercury equal to or greater than 1 microgram per liter has been identified by State and County agencies in 34 distinct areas in seven counties in southern New Jersey. Of the 2,239 wells in these areas for which data were available, 306 yielded water at least once that contained mercury in concentrations that exceeded the U.S. Environmental Protection Agency's maximum contaminant level of 2 micrograms per liter. The concentration used in this report to define a site of elevated mercury concentrations in ground water--1 microgram per liter--was chosen because it is two orders of magnitude greater than background levels and is greater than the method detection limit or practical quantitation limit used by virtually all the laboratories that generated data used in this report. Total-mercury-concentration data for an additional 31 wells not associated with the 34 sites of elevated mercury concentrations in ground water also were compiled.

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[1] New Jersey Department of Environmental Protection

The compiled data include results of repeated sampling and analysis conducted by State and county agencies to evaluate the possibility that mercury measured in the ground water was the result of contamination during sample collection or analysis. The reproducibility of results by different laboratories, the repeatability of results in samples collected by different investigators, the rigor of quality-assurance and quality-control procedures, and the consistency of results for individual wells sampled over time has provided convincing evidence that the mercury concentrations represent an environmental problem.

Soils at 6 of the 34 sites were analyzed for mercury, as were undisturbed forest soils. Mercury was found to accumulate in the organic and clay-rich horizons of the forest soils, but was distributed relatively evenly in vertical sections through the disturbed soils at the sites. Moreover, concentrations of mercury were substantially less in the disturbed soils than in the undisturbed soils. Concentrations of mercury in cores of soils and aquifer sediments from 2 of the 34 sites of elevated mercury concentrations in ground water were found to be within the range of naturally occurring concentrations.

Possible sources of mercury in the ground water from the 34 sites were evaluated; the sources include (1) contamination introduced during sampling; (2) contamination introduced by materials in the pumps; (3) contamination from household sources such as septic systems, disinfectants used in wells, and house paint; (4) point sources such as landfills, military installations, industrial or commercial sites, or cemeteries; (5) atmospheric deposition; and (6) land-applied substances such as mercurial pesticides or mercurial seed dressings.

An examination of past and present land use at the 34 known sites of elevated mercury concentrations in ground water indicates that former land use at 26 of the sites was at least partly agricultural and that residential development typically began in the 1950's or 1960's. Possible point sources, such as known landfills, military installations, industrial and commercial operations, and cemeteries, are found in relatively close proximity (1 to 3 miles) to many of the 34 sites. Detailed examination of 13 sites that had previously been evaluated by State or county officials and evaluations of possible point sources within 3 miles of the remaining 21 sites indicate that a pattern of contamination from point sources does not appear to exist. Ground-water-flow directions inferred from topography or determined from available water-level data and monitoring-well water-quality data indicate that, in most cases, landfills do not appear to be sources of mercury to the sites. There are currently no data that indicate that past or present military operations are sources of mercury to the 34 sites. Ground water at those sites within 3 miles of a Superfund site does not appear to be hydraulically connected to contaminant plumes at the Superfund sites. Data on industrial and commercial sites, both former and existing, were limited, and few conclusions could be drawn. The majority of known industrial operations do not appear to be hydraulically connected to the nearest site of elevated mercury concentrations in ground water. It is likely that only late 19th- or early 20th-century cemeteries could be sources of contaminants; the lack of detailed, site-specific data precluded detailed evaluation of relations between cemeteries and the 34 sites. However, only three sites appear to be downgradient from cemeteries.

Assessments of the relative contributions of mercury from house paint, from atmospheric deposition, and from use, prior to 1972, of mercurial pesticides and fungicides in agriculture and turf maintenance were derived from calculations of estimated use. These calculations indicate that the maximum amounts present in house paint are large, but the mercury probably is in less soluble form and thus less likely to be found in soils and ground water than mercury from estimated past agricultural applications of mercurial pesticides. Estimated atmospheric contributions of mercury, although not small, are several orders of magnitude less than the amounts estimated to be present in paint, or potentially contributed by pesticides.

Although well-depth data were not available for all the wells in the data base compiled during the study, the vertical distribution of mercury in ground water does not appear to be continuous with depth; elevated mercury concentrations typically were measured at about 50 feet or more below land surface, but generally have not been found in water from shallow (less than 50 feet) wells. The highest concentrations found to date (1993) have been in water tapped at 50 to 125 feet, although concentrations above the U.S. Environmental Protection Agency's maximum contaminant level have been found as deep as 200 feet. This distribution indicates that mercury introduced at the land surface is now found in water several decades old, but generally is not found in elevated concentrations in shallow, recently recharged aquifer water. Such a distribution is indicative of past activities involving mercury that apparently are not occurring presently as important sources.

INTRODUCTION

Since 1982, an increasing number of detections of mercury concentrations in ground water from the Kirkwood-Cohansey aquifer system that exceeded the U.S. Environmental Protection Agency (USEPA) maximum contaminant level (MCL) of 2 µg/L have been reported. The U.S. Geological Survey (USGS), in cooperation with the New Jersey Department of Environmental Protection (NJDEP)[2] Division of Science and Research, and the NJDEP Bureau of Safe Drinking Water (as part of the A280 amendments to the State Safe Drinking Water Act program), began a 2-year study in 1992 to evaluate the extent of mercury-contaminated ground water in the New Jersey Coastal Plain and to propose and evaluate hypotheses regarding possible mercury sources. The initial phase of this study, with which this report is concerned, consisted of compiling available data from State and county agencies on mercury concentrations in ground water and soils, determining mercury distributions in soils, compiling and evaluating data on possible sources of mercury, and developing hypotheses regarding the causes of the observed mercury concentrations in ground water. The second phase consisted of compiling data on other relevant ground-water-quality characteristics, designing and conducting laboratory experiments and evaluating geochemical data in order to investigate further the hypotheses that were developed, and identifying other general areas that might be at risk from mercury-contaminated ground water.

Background

The first phase of the study of mercury in the Kirkwood-Cohansey aquifer system necessitated integrating a complex set of factors, including the history of the

[2] Known as New Jersey Department of Environmental Protection and Energy (NJDEPE) in 1993 and 1994; prior to 1993 and after 1994, known as NJDEP.

discovery of the contamination, the chemistry of mercury, the geology and hydrology of the area in which the contamination had been discovered, the geochemical characteristics of the ground water that was affected, and possible sources of mercury to the environment. Because a previous study by the New Jersey Geological Survey (NJGS) had indicated that the elevated mercury concentrations were unlikely to derive from a natural (lithologic) source (Dooley, 1992), investigation of possible sources has focused on anthropogenic sources.

Historical Ground-Water Contamination

Incidences of mercury-contaminated water (that is, water containing mercury in concentrations greater than the USEPA MCL) from domestic wells in the Kirkwood-Cohansey aquifer system in New Jersey were reported as early as 1982 (unpublished data on file at N.J. Department of Environmental Protection, Trenton, N.J.). Until 1988, however, observations of mercury-contaminated ground water in New Jersey involved few wells, less than 10 in each instance, and were scattered both spatially and temporally. From 1982 to mid-1988 five separate instances of mercury-contaminated ground water involving approximately 23 wells were reported. As a result of the sporadic nature of these early reports and the small number of wells involved, mercury-contaminated ground water was not perceived as a widespread problem in southern New Jersey before 1988.

In 1988, sampling and analysis of ground water in a residential area in Atlantic County resulted in the discovery of a previously unidentified area of mercury-contaminated ground water. State and county agencies were alerted and responded in part by sampling and analyzing water from other domestic wells in the area. As additional sampling and analyses were conducted, additional mercury contamination was found, and the cycle was repeated. By mid-1989, 331 wells used for drinking water in the area had been sampled. Results of analyses showed that 64 of these wells yielded ground-water samples that contained mercury in concentrations exceeding the 2.0-µg/L USEPA MCL (U.S. Environmental Protection Agency, 1991). The discovery of large numbers of wells yielding mercury-contaminated water in a limited area focused attention on the mercury-contamination problem. Individuals and county and State agencies began to sample and analyze ground water more frequently. As the number of instances of mercury-contaminated ground water increased, NJDEP officials recognized the necessity of evaluating the data that had been and were being collected in order to determine possible sources of the contamination. In order to determine the naturally occurring concentrations of mercury in ground water, NJDEP contracted with Skidaway Oceanographic Institute to conduct a study in 1991. Background concentrations of mercury in samples from the Kirkwood-Cohansey aquifer system were found to be less than 10 ng/L (0.01 µg/L) (Windom and Smith, 1992).

In 1991, the USGS was asked to compile all available data on mercury in ground water in the Kirkwood-Cohansey aquifer system, determine possible sources of mercury, and propose and evaluate hypotheses regarding the causes of the contamination. (All data supplied by NJDEP and the counties are not maintained in the USGS electronic data base.) The study began in 1992, and, during the first year, mercury-concentration data for water from more than 2,200 wells had been compiled from the files of State and county agencies. Because the data had been collected initially in residential neighborhoods in response to problems with one or more wells, they are clustered rather than evenly distributed across the region. The instances of

mercury contamination were sufficiently densely clustered in several neighborhoods to prompt a NJDEP survey of the area, and, where more than five wells containing contaminated water were found with 1 mi of each other, a Ground-Water Impact Area Report was prepared. The Ground-Water Impact Area Report defined the area of contaminated ground water, projected the area into which contamination was expected to move over 5 years, and delineated any possible sources of the contamination. Typically, contamination by volatile organic compounds (VOC's) was found at these sites; VOC concentrations also have been measured in ground water from many of the other areas where elevated concentrations of mercury in ground water are present.

As part of the present study, water from private[3] wells containing mercury in elevated concentrations (greater than 1 µg/L) has been identified in 34 distinct areas. As of mid-1993, 2,239 wells have been sampled at these sites and the water analyzed for mercury by State and county agencies or by private, State-certified laboratories. Some wells have been resampled by the USGS. At least one water sample from each of 306 wells has contained mercury concentrations in excess of the MCL. The most recent mercury-concentration data for the 2,239 wells are presented in appendix 1a. The locations of the 34 sites of elevated mercury concentrations in ground water in the New Jersey Coastal Plain are shown in figure 1. A "site" is defined in this report as an area in which one or more wells has yielded water containing mercury in concentrations of 1 µg/L or greater. This concentration was chosen because it is two orders of magnitude greater than the background concentrations determined by Windom and Smith (1992) and is also greater than either the method detection limit or the practical quantitation limit (both hereafter referred to as the reporting limit) used by virtually all the laboratories that generated the data compiled during this study. In this report, mercury concentrations greater than or equal to 1 µg/L commonly are referred to as "elevated" concentrations.

Water from wells at 32 of the 34 sites contained mercury in concentrations in excess of the MCL on at least one sampling occasion. The sites, their approximate area, the number of wells known to have been sampled at each site as of June 1993, and the county in which each site is located are listed in table 1.

Because the wells included in appendix 1a were, in general, sampled in response to a perceived water-quality problem, the areas in which the wells are located were targeted for study and the data do not represent a random sample of water quality in the Kirkwood-Cohansey aquifer system. The current known distribution of sites probably does not represent the true spatial distribution of elevated mercury concentrations in ground water in the Kirkwood-Cohansey aquifer system, and, because little sampling for mercury has been conducted in the areas between the 34 sites, it is not known whether the clustered occurrences of mercury-contaminated ground water accurately represent the distribution of elevated mercury concentrations. The limited mercury-concentration data available for the intersite areas, largely from observation wells but also from some rural domestic and irrigation wells and some commercial wells, indicate that elevated mercury concentrations have not been found in ground water from these areas.

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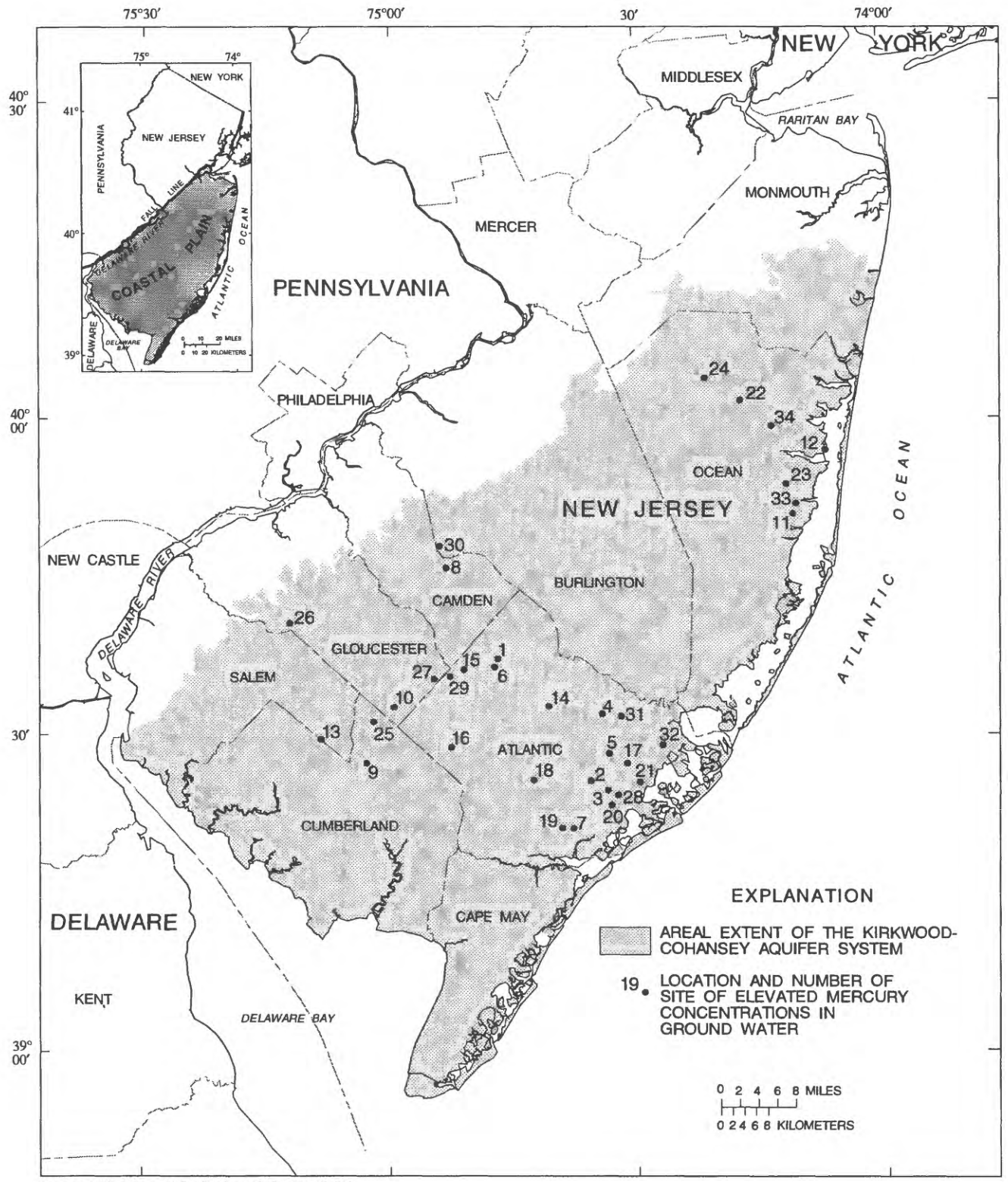
[3] Most of the wells included in the 34 sites are domestic wells; a few are irrigation wells, school wells, commercial wells, or apartment-house wells. Also included are a few observation wells installed on private property. No monitoring wells installed as part of the New Jersey pollutant discharge elimination system (NJPDES) are included among the wells at the 34 sites. Data for the NJPDES monitoring wells are presented in appendix 3.



Base modified from U.S. Geological Survey digital data, 1:100,000, 1983, Universal Transverse Mercator projection, Zone 18

Figure 1. Locations of sites of elevated mercury concentrations in ground water and areal extent of the Kirkwood-Cohansey aquifer system (Inset shows location of the Coastal Plain of New Jersey).

Table 1. Sites at which water from one or more wells contains mercury in concentrations equal to or greater than 1 microgram per liter, approximate site area, number of wells sampled as of June 1993, and county in which each site is located, New Jersey Coastal Plain

Site number	Approximate area of site (square miles)[1]	Number of wells from which water samples have been analyzed for mercury[2]	County
1	0.24	132	Atlantic
2	1.27	242	Atlantic
3	1.64	332	Atlantic
4	.25	76	Atlantic
5	.60	130	Atlantic
6	.45	72	Atlantic
7	.43	77	Atlantic
8	8.35	472	Camden
9	.12	52	Cumberland
10	1.21	31	Gloucester
11	.25	11	Ocean
12	.04	23	Ocean
13	1.56	52	Salem
14	.33	16	Atlantic
15	.15	22	Atlantic
16	1.82	76	Atlantic
17	3.87	83	Atlantic
18	.66	65	Atlantic
19	.11	8	Atlantic
20	.04	8	Atlantic
21	.35	3	Atlantic
22	<.01	1	Ocean
23	.37	2	Ocean
24	.65	9	Ocean
25	.15	30	Cumberland
26	<.01	1	Gloucester
27	<.01	1	Gloucester
28	2.34	81	Atlantic
29	.31	54	Atlantic
30	1.46	6	Burlington
31	2.21	45	Atlantic
32	.12	20	Atlantic
33	.06	2	Ocean
34	.05	3	Ocean

[1]Approximate areas have been calculated on the basis of areas of polygons drawn on U.S. Geological Survey topographic maps.

[2]Number of wells currently (1993) in mercury project site data base. Additional wells may have been sampled since the data base was compiled.

As of 1993, on the basis of available information on well locations, depths, and screens, the mercury contamination in ground water appears to be present in the unconfined part of the Kirkwood-Cohansey aquifer system, where background concentrations of mercury have been determined to be less than 10 ng/L (Windom and Smith, 1992). The aquifer is a major source of water; ground-water withdrawals from the Kirkwood-Cohansey aquifer system averaged 70.32 Mgal/d in 1980 (Zapecza and others, 1987) and were estimated to be 58 Mgal/d in 1990 for public supply wells alone (Nawyn and Clawges, 1995). Because a large number of public supply and domestic wells are screened in this aquifer system, widespread mercury contamination of the southern New Jersey ground-water supply would pose a serious health hazard to residents. Upon confirmation of mercury concentrations that exceeded the MCL, homeowners were either supplied with point-of-entry treatment systems (POETS), or in the case of some communities with many affected wells, connected to an alternate water supply.

Mercury Chemistry

Many heavy metals are relatively immobile in the geochemical environments of many aqueous systems. These metals, which include lead, copper, and mercury, are typically "fixed" in sediments by either sorption to clay minerals, sorption to the charged surfaces of iron and aluminum oxyhydroxides, sorption to sediment organic matter, or precipitation as oxides or insoluble salts (Reimers and Krenkel, 1974; Hirner and others, 1990), although different soils exhibit a range of affinities for metals such as mercury (Amacher and others, 1990). Mobilization of heavy metals from these surfaces is induced by factors, such as changes in pH, that change the properties of the surfaces or by introduction of chemical constituents that create soluble complexes with the metals or that change the redox potential, rendering some metals more soluble than under previous redox conditions. Alternatively, the metals can remain fixed to particles small enough to form colloids and may be transported along with the colloids (Puls and Powell, 1992). Because mercury is volatile, it is also mobile as a vapor; unlike other heavy metals, mercury can volatilize into the atmosphere from solution as well as from solid surfaces.

In most freshwater, the predominant dissolved mercury species are Hg^0, $Hg(OH)_2$, Hg^{2+}, and $HgCl_2$ depending on pH, Eh, and chloride concentrations (Reimers and Krenkel, 1974; Stumm and Morgan, 1981, p. 371; Hem, 1970, p. 21). Equilibrium reactions with these species control the solubility of mercury in water, which for metallic mercury, is about 56 µg/L (0.28 µmoles/L) at 25 degrees Celsius (Merck, 1983, p. 842). Mercury solubility increases in oxygenated and acidic, chloride-rich waters as either $Hg(OH)_2$ or $HgCl_2$ forms (Gavis and Ferguson, 1972, p. 993).

Although considerable research has been done on mercury solubility and speciation in water, relatively little work has been done with regard to its solubility in other solvents. Studies have shown that metallic mercury (Hg^0) is more soluble in hexane than in water and that mercuric chloride ($HgCl_2$) is more soluble in benzene than in water (Gavis and Ferguson, 1972, p. 994; Cotton and Wilkinson, 1980, p. 604). In analytical practices, divalent mercury, including mercury chloride complexes, can be extracted into chloroform and various chlorinated hydrocarbons (Reeves and Brooks, 1978).The effects of relatively dilute organic compounds on mercury mobility in soil

water and ground water currently are unknown, however. Therefore, any interactions between mercury and dilute concentrations of VOC's in ground water are difficult to assess.

The mobilization of mercury can be affected by bacterial activity in both aerobic and anaerobic environments, as mercury can be methylated and demethylated by bacteria (Bothner and others, 1980; Fleischer, 1970; Douglas, 1994). Because examination of methylation reactions is beyond the scope of this report, the reader is directed to reviews of metals in the environment, such as Lindberg (1987), World Health Organization (1990), and studies such as Winfrey and Rudd (1990), Wilken and Hintelmann (1991), Robertson and others (1987), Rogers (1976), and Rogers (1977) for further information on methylation and demethylation reactions.

Introduction of Anthropogenic Mercury into the Environment

Physical and chemical properties, some unique, have made mercury useful in a number of applications in the industrial world. Mercury is used in the manufacture of chlorine and caustic soda; in paint and pesticides (both as an insecticide and as an antifungal agent); in pharmaceuticals; in instruments such as thermometers, barometers, and manometers; in electrical switches and relays; in batteries; in lamps; and in dental amalgams (Moore and Ramamoorthy, 1984). As a result, many opportunities exist for mercury, both elemental and in various compounds, to enter the environment in solution, in the gas phase, and in particulate form.

Industrial emissions are an important source of atmospheric mercury; emissions from incinerators and combustion of fossil fuels also contribute mercury to the atmosphere. Mercury can be deposited in the soil through either dry atmospheric deposition, wet precipitation, or direct application. The mercury inputs by wet and dry deposition generally are relatively small except in areas near ore deposits, smelters, incinerators, or other industrial plants that generate mercury emissions. World production of mercury from minerals and release from fossil fuels rose sharply between 1940 and 1970 (Gavis and Ferguson, 1972, p. 1003). A study of peat cores in Minnesota indicates that atmospheric deposition of mercury reached a peak during the 1950's; studies in Sweden and the United Kingdom indicate a similar pattern, with a peak about 1960 (Douglas, 1994). Researchers do not concur on the percentage of the measured deposition that is anthropogenic, but the steady decrease in deposition rates of mercury since 1960 is presumed to be the result of increasingly vigorous attempts to control mercury emissions (Douglas, 1994).

In 1988, Nriagu and Pacyna (1988) estimated anthropogenic mobilization of mercury to the biosphere at 11,000 metric tons (12,128 tons) per year, which includes emissions discharges to land and water, and land applications, worldwide. In the United States, land applications of mercury compounds have decreased in the past 2 decades. The use of mercury compounds on agricultural crops was banned in 1972 by the U.S. Department of Agriculture (D'Itri, 1972); however, registered use of mercurial compounds has continued in New Jersey as fungicides on golf courses (N.J. Department of Environmental Protection, 1993). Consumer products that contain mercury, such as batteries, thermometers, paint, pigments, and fluorescent and high-

intensity light bulbs, ultimately enter the waste stream, and, if not recycled or incinerated, end up in landfills. No data are available at present that estimate the amount of mercury that currently resides in southern New Jersey landfills.

Previous Studies of Mercury in Soils, Sediments, and Ground Water

The movement of mercury and mercury species in the environment has been examined by many workers, particularly with regard to mercury emissions into the atmosphere and mercury in lakes and streams (for example, Fleischer, 1970; Brosset, 1982; Glass and others, 1991; Lindqvist and others, 1991). Because mercury and its compounds are toxic, beginning at the lowest level of the food chain, emphasis on mercury mobilization continues to focus on the open environments of the atmosphere and surface-water bodies (Grieb and others, 1990; Nriagu, 1990). Of the studies focusing on mercury in soil, many have been concerned with the accumulation of mercury in fruits and vegetables, with less emphasis on subsurface migration of the metal (D'Itri, 1972). Relatively little information is available on mercury in ground water. Recent investigations include a study of low (2-4 ng/L) concentrations in ground-water inflow to and outflow from a lake in Minnesota (Krabbenhoft and Babiarz, 1992); a study of a purported natural source in granitic terrain in Maine (Sidle, 1993), where mercury concentrations ranging from 0.04 to 6.20 µg/L were measured in ground water; and two studies of ground-water contamination in urban and industrialized areas of India (Somasundaram and others, 1993; Srikanth and others, 1993). Earlier studies cited in Hem (1985, p. 143) report "a few micrograms per liter" of mercury in ground water from geothermal and mining areas.

Dooley (1992) studied the possibility of a natural source of mercury in ground water in the New Jersey Coastal Plain. Dooley concludes that elevated levels of mercury in the Kirkwood-Cohansey aquifer system must be anthropogenic in origin as no natural source is known to be present in this primarily quartz sand aquifer. Windom and Smith (1992) analyzed 78 ground-water samples from the New Jersey Coastal Plain, using inductively coupled plasma-mass spectroscopy (ICP-MS), and determined that background mercury concentrations in Coastal Plain ground water were typically a few nanograms per liter; results of this study suggest that the mercury is present as a mercuric chloride complex. Windom and Smith (1992) also resampled wells that were sampled previously by the Atlantic County Division of Public Health (ACHD) and shown to yield water with elevated mercury concentrations. The results of the resampling verify the previous elevated mercury concentrations reported by the ACHD.

The NJDEP undertook a study to determine the contribution of mercury to the atmosphere by New Jersey incinerators (N.J. Department of Environmental Protection, 1993). Greenberg and others (1992) found the mercury concentrations in air near a municipal solid-waste incinerator to have a median value of 2.5 ng/m^3 of air; this value was indicated to be within background levels for mercury in air. NJDEP (N.J. Department of Environmental Protection, 1993a) also developed a generic fate and transport model for mercury to evaluate the effect of emissions from a source such as an incinerator; the model accounts for dispersion of stack emissions, wet and dry deposition to surface water and to land, runoff to surface water, bioconcentration in freshwater fish, and ingestion of those fish.

Purpose and Scope

This report describes the known distribution of mercury in ground water, soils, and sediments of the Kirkwood-Cohansey aquifer system and evaluates possible sources of the mercury. It presents a compilation of results of analyses for mercury in ground-water samples from 2,239 private wells in seven counties in the New Jersey Coastal Plain. The samples were collected at 34 sites where elevated concentrations of mercury have been reported from 1982 through June 1993 and were analyzed by State and county agencies, private laboratories, and the USGS. Results of analyses of water samples from wells where mercury concentrations are not elevated also are presented. Results of analyses for mercury in ground-water samples from four public supply wells in Atlantic County and nine monitoring wells in Camden, Ocean, and Cape May Counties also are included. Results of analyses for total mercury in 42 soil samples and 2 cores of soils and aquifer sediments collected by USGS and NJDEP from areas of known mercury contamination of ground water and from uncontaminated areas in Atlantic, Camden, and Gloucester Counties are reported. Relations between concentrations of mercury in soils from areas of known mercury contamination in ground water and from undisturbed forested areas are discussed. The association between historical land-use data representing the period from 1940 to the present (1993) and concentrations of mercury in ground water and soils also are discussed. Six hypotheses regarding possible sources of mercury are presented. Household contributions of mercury are evaluated. The contributions of mercurial pesticides and atmospherically deposited mercury to the soil and ground water are assessed. Possible point sources of mercury (landfills, military operations, cemeteries, industrial, and commercial sites) are evaluated in light of available hydrologic data. Finally, possible mechanisms of mercury mobilization are discussed.

Description of the Study Area

The study area encompasses the entire outcrop area of the sediments that form the Kirkwood-Cohansey aquifer system (fig. 1) and includes the Cape May Peninsula, where the aquifer system is confined and is overlain by two aquifers--the surficial Holly Beach water-bearing zone and the estuarine sand aquifer.

Physiography

The study area occupies most of the Atlantic Coastal Plain physiographic province in New Jersey. The terrain generally is gently rolling, and topographic relief is low. Elevations typically are between 50 and 150 ft above sea level in the interior of the Coastal Plain, sloping gradually to sea level at the coast. Stream valleys are shallow and broad, and many contain freshwater wetlands. Although several streams drain west and south to the Delaware River and Delaware Bay, the majority of streams drain eastward to the Atlantic Ocean.

Hydrogeology

The New Jersey Coastal Plain is a wedge of unconsolidated sediments that range in age from Cretaceous to Quaternary. These sediments are composed of clay, silt, sand, and gravel that are interpreted mainly as deltaic and marine deposits; the youngest (Quaternary) sediments were deposited by fluvial and aeolian processes

(Rhodehamel, 1979). The sediments strike to the northeast and dip gently seaward at about 10 to 60 ft/mi. The sediment wedge thickens from a thin deposit at the Fall Line to more than 6,500 ft at the southern tip of Cape May County, and unconformably overlies metamorphic rocks of Precambrian age, as well as Triassic and Jurassic sedimentary and igneous rocks.

Sandy soils are developed on the geologic substrate defined by the outcrop of the Cohansey Sand, the upper part of the Kirkwood Formation, and the Cape May Formation. Where the Bridgeton Formation, which contains weathered clay in the matrix, overlies the Cohansey Sand, soils contain some clays (Tedrow, 1979). Because these soils retain moisture better than the extremely sandy soils elsewhere within the study area, agricultural activities commonly have been associated with the areas underlain by the Bridgeton Formation, although many farms have been replaced by residential land use during the past 40 years. The result has been the obliteration of much of the natural soil horizons. Typical natural soil horizons include an organic-rich layer at the surface (O horizon); next, a strongly leached, sandy layer (A horizon); and, lowermost, a sandy layer containing iron hydroxides and clays (B horizon).

The sandy soils within the study area are naturally highly acid and impoverished in plant nutrients (Tedrow, 1979). The pH of surface soils ranges from 3.6 to 4.0, and the pH of deeper horizons ranges from 4.2 to 5.0 (Markley, 1979, p. 92). Sandy soils found at higher elevations are excessively drained to well-drained, and have a low organic-matter content (Markley, 1979, table II, p. 84). Some of the upland soils have been and currently are farmed; generally, these are limed because of the soil acidity, and typically are irrigated (Markley, 1979). Residential land use, with the installation and maintenance of lawns, has continued some degree of soil modification through liming and fertilization.

This report is concerned only with the uppermost of the Coastal Plain sediments, which comprise the unconfined part of Kirkwood-Cohansey aquifer system. These include the Kirkwood Formation, the Cohansey Sand, the Bridgeton Formation, and the Beacon Hill Gravel, all of Miocene age, and parts of the Pleistocene Cape May Formation (fig. 2).

The Kirkwood-Cohansey aquifer system is one of nine major aquifers within the New Jersey Coastal Plain (Martin, in press; Zapecza, 1989). The Kirkwood-Cohansey aquifer system is a largely unconfined sand and gravel system. As illustrated in figure 2, depending upon location within the province, sediments of the Beacon Hill Gravel, the Bridgeton Formation, or the Cape May Formation overlie the Cohansey Sand (Owens and Minard, 1979) and are hydraulically connected to it (Rhodehamel, 1973). In southern Cape May County this system is confined by the estuarine clay facies of the Cape May Formation (Gill, 1962), which is overlain by the estuarine sand aquifer and the Holly Beach water-bearing zone (Zapecza, 1989; Glen Carleton, U.S. Geological Survey, oral commun., 1994). Zapecza (1989) shows two major regional basal surfaces for the Kirkwood-Cohansey aquifer system. Along the coast, in Ocean, Atlantic, and Cape May Counties, some of the Kirkwood Formation sediments are separated by a confining unit and form a confined aquifer known as the Atlantic City 800-foot sand. Inland, the confining unit is absent, and the sediments form a single unconfined aquifer system that ranges up to about 450 ft in thickness (fig. 3).

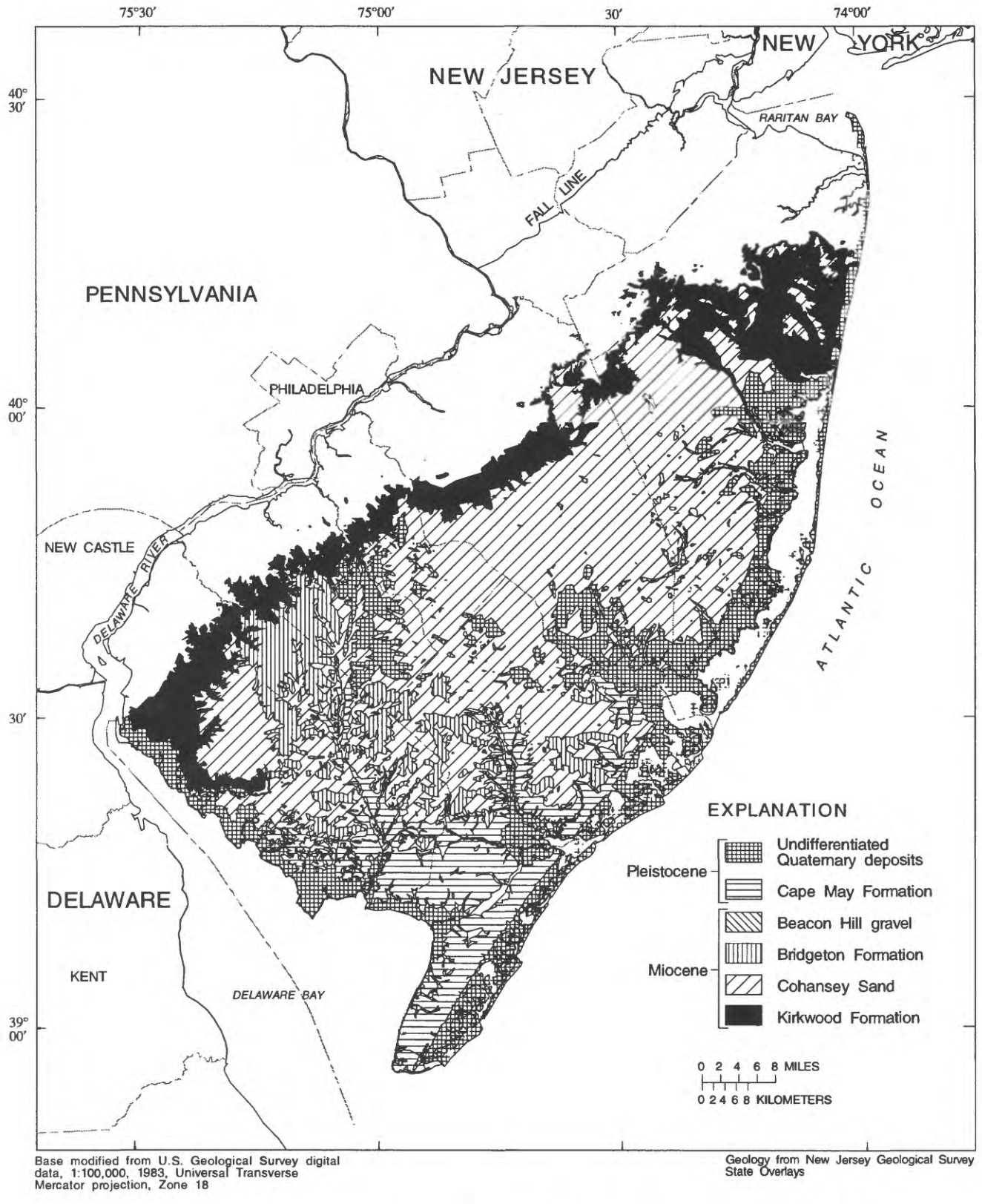


Figure 2. Geologic map of the Miocene through Pleistocene sediments that crop out in the study area, New Jersey Coastal Plain.

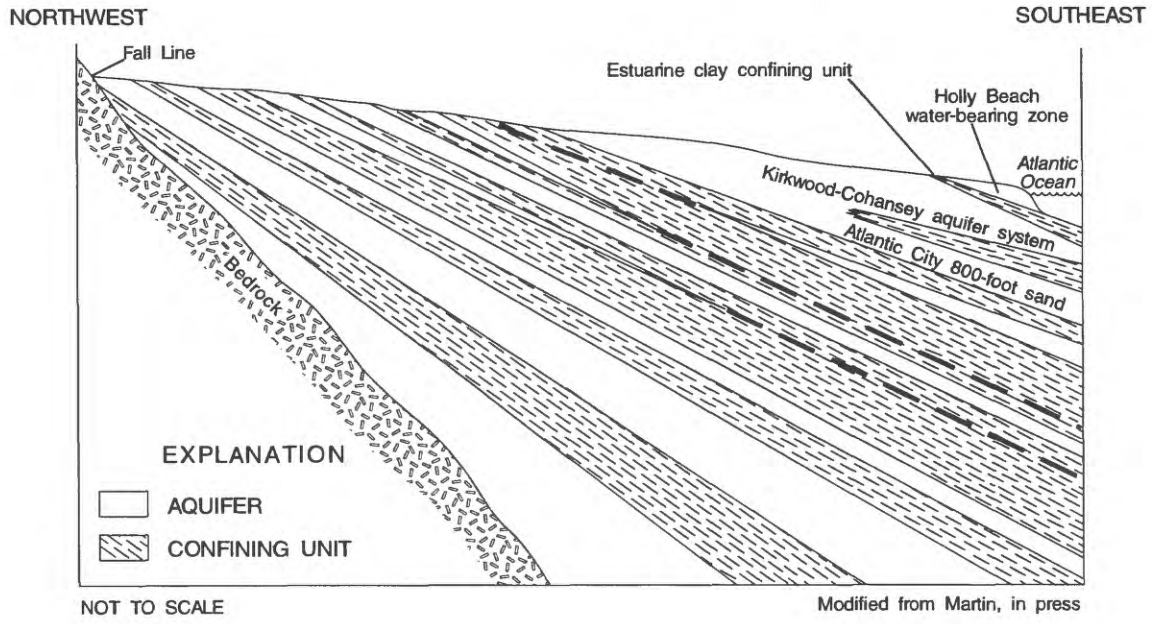


Figure 3. Generalized hydrogeologic section through the New Jersey Coastal Plain.

Ground-Water Flow

Because the Kirkwood-Cohansey aquifer system is primarily an unconfined system, the upper surface of the saturated part of the aquifer known as the water table is, for the most part, in contact with the atmosphere through the pores in sediments and soils that make up the overlying unsaturated zone. Water enters the aquifer system as precipitation moves downward through the unsaturated zone and reaches the water table. The position of the water table fluctuates, depending on the amount of water recharging the aquifer or being lost through discharge to streams, evapotranspiration, or water withdrawals. The water table is not flat, but tends to be higher under topographic highs, and slopes downward toward streams and major rivers, presenting a surface that is sometimes referred to as a subdued replica of the topography. Streams and wetlands typically are ground-water discharge areas where the water table comes in direct contact with the atmosphere. In southern New Jersey, the streams receive most of their water from ground-water discharge (referred to as base flow); Rhodehamel (1979), in a study of the hydrology of the Pine Barrens that cover most of the study area, estimated that 89 percent of streamflow is derived from base flow.

Recharge to the entire system is provided by precipitation. Not all of the water that falls as precipitation enters the ground-water system as recharge, however; evaporation and transpiration by vegetation (collectively known as evapotranspiration) account for about 50 percent of the water being returned to the atmosphere (Rhodehamel, 1979). Most of the recharge to the ground-water system occurs during the late fall, winter, and early spring when evapotranspiration is lowest due to cold temperatures and plant dormancy.

Ground water moves under the force of gravity through connected pores between sand, silt, and gravel grains in the aquifer, flowing from areas of high hydraulic head (typically uplands) to areas of low hydraulic head (typically streams). The path that the ground water takes, although tortuous at the scale of individual sand grains, can, at a larger scale, be described by a series of curves known as flow lines. These lines are vertical or nearly so in recharge areas, become more horizontal within the aquifer, and curve vertically upward as the water approaches a discharge area such as a stream.

Ground-water flow in the unconfined part of the Kirkwood-Cohansey aquifer system can be described at a variety of scales, ranging from regional to local. The same principles apply at any scale, but the direction of travel through the system and the places where the ground water discharges can differ, depending on the scale at which the system is observed.

An idealized section showing the pattern of regional-scale ground-water flow in the Pine Barrens region of southern New Jersey is shown in figure 4 (Rhodehamel, 1970). The deep part of the system is recharged in the upland area along the topographic divide that separates streams draining to the Atlantic Ocean from those draining to the Delaware River. Ground water in the deep system discharges toward the outcrop area of the Kirkwood Formation to the northwest, and toward the ocean and to streams and wetlands along the updip boundary of the confining unit of the Atlantic City 800-foot sand, which is the confined part of the Kirkwood-Cohansey aquifer system that is present along the Atlantic Coast. Localized recharge to the shallow subsystems, and shallow ground-water discharge to local streams and

wetlands are shown in several idealized local systems in figure 4. Ground-water-flow directions, indicated by arrows, diverge at local topographic highs, which are recharge areas to the shallow subsystems, and converge toward local discharge areas, which are streams and wetlands (figs. 4 and 5). Figure 5 shows a diagram of idealized local-scale hydrology for the area in central Burlington, Camden, Gloucester, and Salem Counties, where the Cohansey Sand and Kirkwood Formation are relatively thin and are capped by the Bridgeton Formation. At both the local and the regional scale, ground-water flow diverges at the water-table divide and converges at the wetlands and stream. The upper flow lines depicted follow a much shorter path than do the lower flow lines (figs. 4 and 5). Thus, the water that enters at the divide takes longer to reach the discharge area than does water that enters farther downgradient (nearer the discharge area) and moves through the shallow part of the system. Water in the deepest parts of the Kirkwood-Cohansey aquifer system entered at the water table as recharge hundreds to thousands of years ago.

Because travel times can vary spatially, the distribution of contaminants in an aquifer depends, in part, on the age of the water. Figure 6 shows the cross-sectional output from a numerical model developed by the USGS (Szabo and others, 1993), which simulates ages (equivalent to travel times) of ground water in the same section of the Kirkwood-Cohansey aquifer system depicted in figure 5. The model is designed to represent the aquifer in an area in Salem County where it is much thinner than in the western parts of Atlantic and Cumberland Counties. The model simulates the movement of ground water through the system and the time required to traverse some portion of the aquifer. The results of the simulation show that the age of the ground water generally increases with depth and that length and depth of ground-water flow paths decrease from the divide to discharge areas. The stream lines (or flow lines) indicate the direction of ground-water flow in two dimensions. The stream lines are deflected as water passes through the less permeable silt layer. The stream lines depicted do not cross each other and, consequently, represent boundaries to flow within sections of the aquifer. The stream-function numbers represent fractional amounts of recharge and are cumulative from right to left. For example, the 0.10 stream-function number represents the lower boundary for 10 percent of the recharge entering the aquifer. Another 10 percent of recharge moving through the aquifer is bounded by the stream lines with stream-function numbers 0.70 and 0.80. The dashed lines are lines of equal travel time and are horizontal until the discharge area is approached. Thus, water traveling along any of the depicted stream lines, as well as the infinite number not depicted, is 10 years old when it intersects the 10-year travel-time line. The model agrees well with measured ages of water from the nest of wells depicted; ages of the water samples were determined by the chlorofluorocarbon (CFC) dating method (Szabo and others, 1993). In other areas of the aquifer system where hydraulic properties differ from the area simulated by the model, stream lines may follow slightly different trajectories, and water of the same ages shown in figure 6 may be found at different depths.

Ground-water flow systems are three-dimensional and are only partially described by two-dimensional representations. A map view shows only horizontal ground-water flow directions, but unless the ground-water flow path is completely horizontal, there is both a horizontal component and a vertical component (either up or down) to flow. In this report, however, arrows on maps showing ground-water flow directions show only the horizontal component of flow.

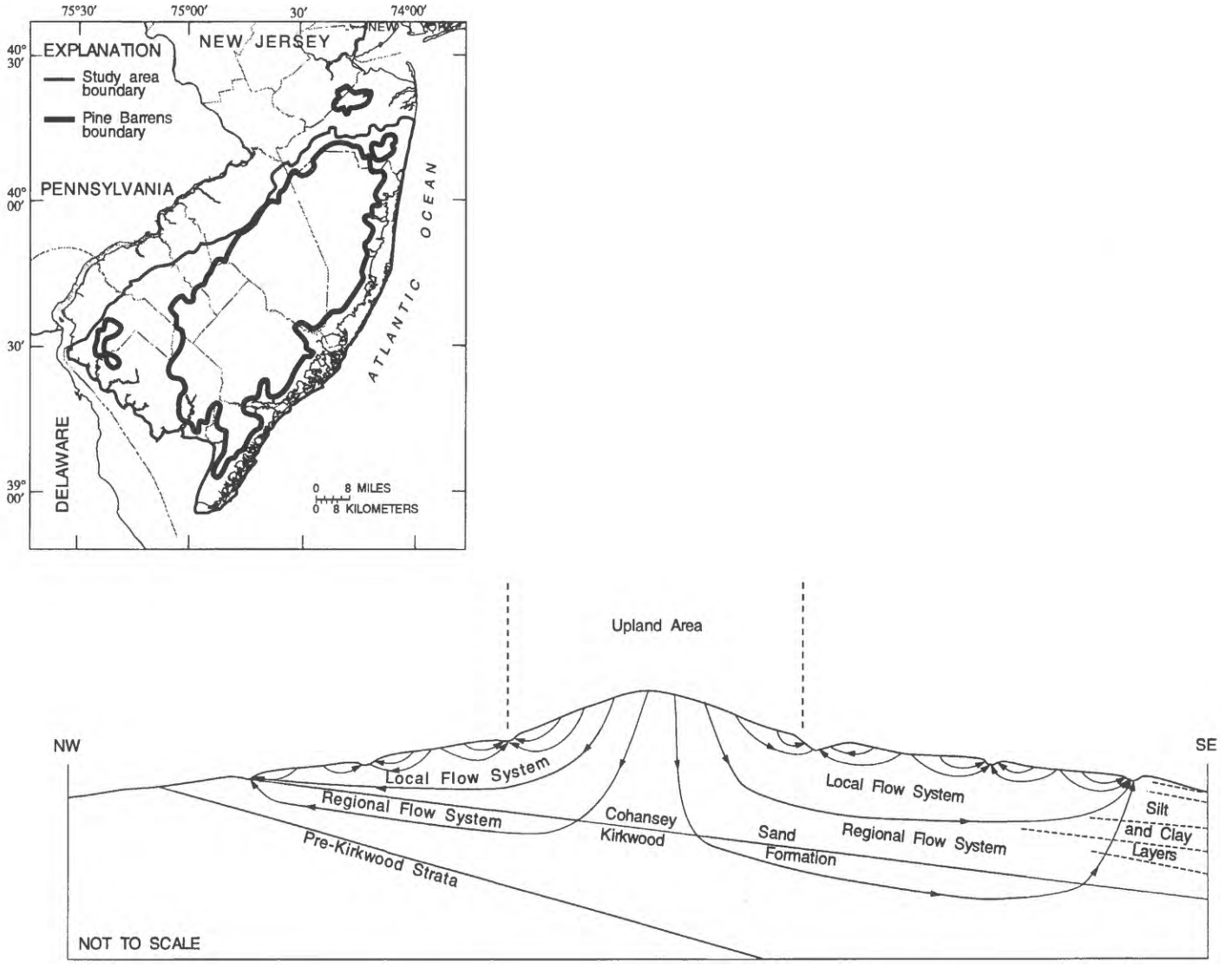


Figure 4. Idealized vertical section through the New Jersey Coastal Plain showing regional ground-water flow in the Pine Barrens region. (Modified from Rhodehamel, 1970, fig. 2).

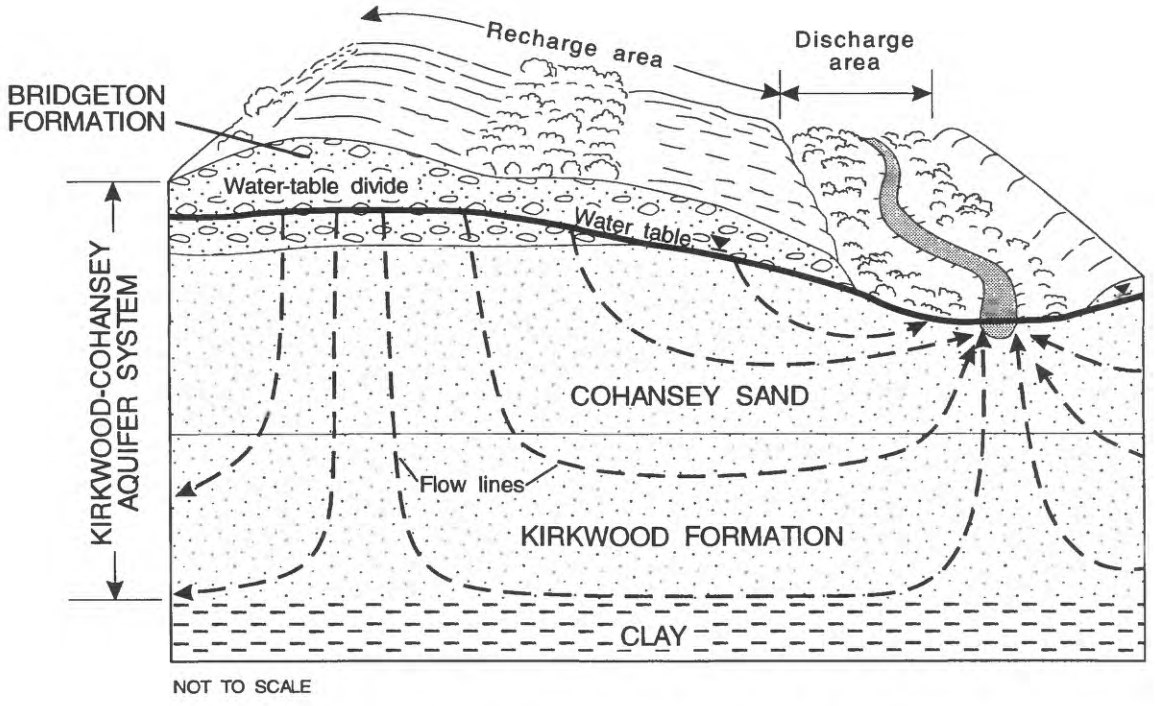


Figure 5. Idealized local-scale ground-water flow paths in central Burlington, Camden, Gloucester, and Salem Counties, southern New Jersey. (From Kozinski and others, 1995).

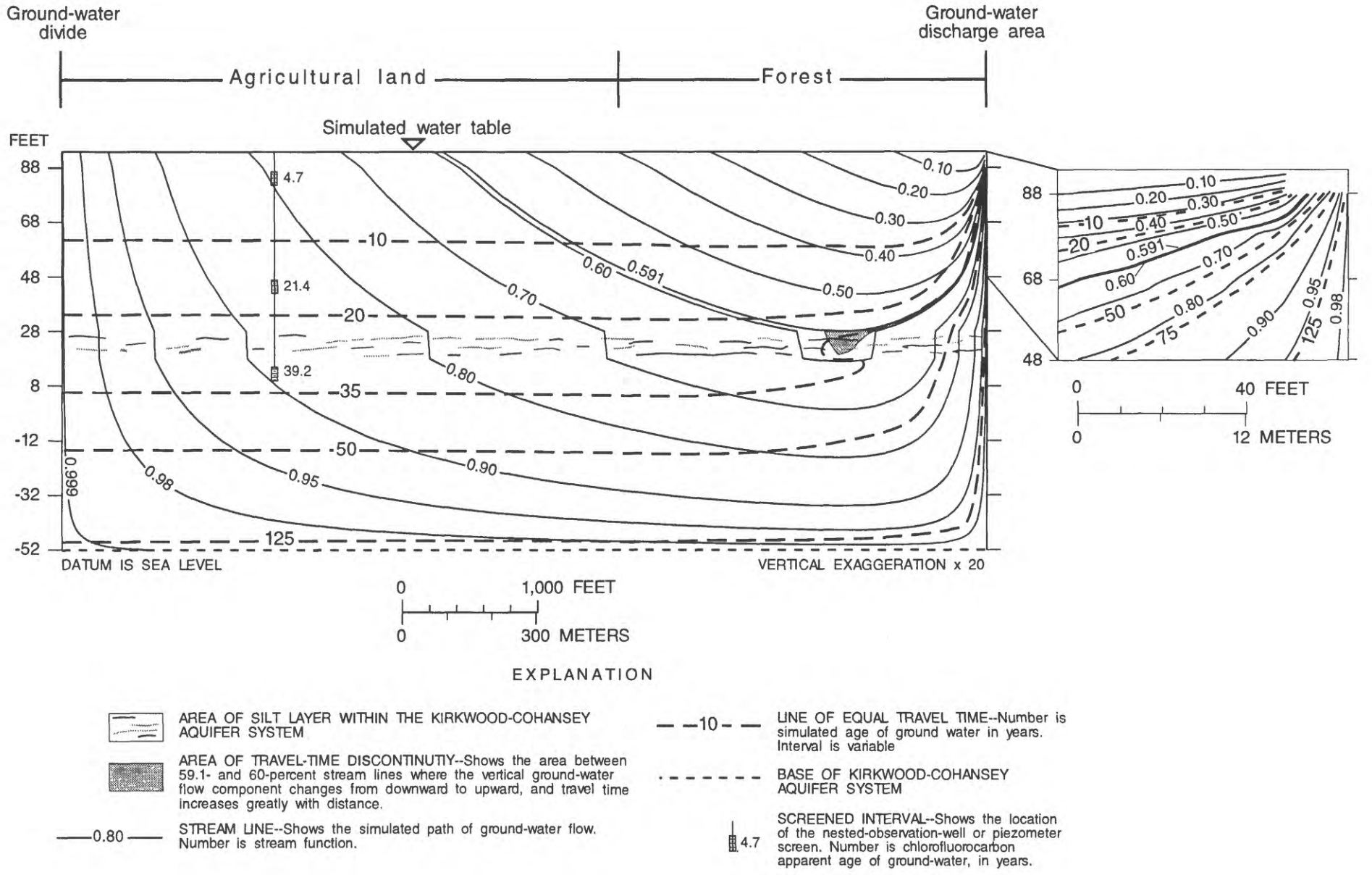


Figure 6. Vertical section showing simulated lines of equal travel time and simulated stream lines from numerical model, and measured chlorofluorocarbon apparent ages of water in nested wells, Salem County, New Jersey. (Modified from Szabo and others, 1993).

Water Quality

Water from the unconfined part of the Kirkwood-Cohansey aquifer system typically is acidic and contains relatively few dissolved constituents, although these characteristics can be altered by introduction of various land-applied substances. A study of ground-water quality in Ocean County, conducted during 1981-82 by the USGS (Harriman and Sargent, 1985), reports a pH range of 3.9 to 9.1, with a median value of 5.3 (table 2); alkalinity typically is low, with a median value of 4 mg/L as calcium carbonate. Of the cations, sodium appears to be predominant. Chloride and sulfate concentrations are relatively low, with medians of 5 and 7 mg/L, respectively. Concentrations of nitrate plus nitrite (as N) are generally less than the reporting limit of 0.01 mg/L (nitrite typically is not detected); the median is less than 1 mg/L, and the concentration in only one sample is reported as exceeding the USEPA MCL of 10 mg/L. The maximum values shown in table 2 for most of the major ions (in particular, sodium and chloride, at 197 and 300 mg/L, respectively) are outliers and represent concentrations in samples from several wells near the coast that tap slightly saline water.

Results of a 1984-86 study in which ground-water quality in Atlantic County was examined were similar. Water-quality data from that study (Barton and others, 1993) and from the USGS data base (table 2) indicate that median values for constituents in ground water from the Kirkwood-Cohansey aquifer system in Atlantic County generally are similar to those from the Ocean County study, although the maximum values generally are somewhat smaller in the Atlantic County data set. An examination of ground-water-quality data in the USGS data base indicates that the water-quality data from Ocean and Atlantic Counties are representative of the ranges of water-quality characteristics of ground water throughout the unconfined part of the Kirkwood-Cohansey aquifer system.

The natural water quality observed in samples from wells tapping pristine ground water can be altered by the introduction of constituents associated with a variety of human activities. Because the data sets from Ocean and Atlantic Counties contain analyses of samples that were collected from wells tapping water underlying a variety of land uses, the statistics reported do not always illustrate clearly the chemical characteristics that can be imparted to water by surficial applications of various compounds such as road de-icing salt, fertilizers and lime, or the constituents introduced into shallow ground water by septic-system effluent.

Studies of sand and gravel surficial aquifers have shown that water quality is affected by human activities. Barringer and Ulery (1988) concluded that background concentrations of chloride in water from the Kirkwood-Cohansey aquifer system were in the range of 3 to 5 mg/L and that elevated chloride concentrations were found in ground water drawn from areas adjacent to major highways. Kozinski and others (1995) found that concentrations of calcium and magnesium as well as nitrate were elevated in water from the Kirkwood-Cohansey aquifer system underlying agricultural areas. Studies of a similar aquifer on Long Island, New York, indicate that elevated ammonium, nitrate, and detergent concentrations are characteristic of ground water in areas where septic systems are used (Buxton and others, 1981). Septic-system effects on Atlantic Coastal Plain ground water have been noted in several investigations of elevated nitrate concentrations and presence of microbes in drinking water (Miller, 1975; Carlile and others, 1981).

Table 2. Medians and ranges of selected chemical characteristics of and constituents in water from wells that tap the Kirkwood-Cohansey aquifer system in Ocean County, New Jersey (1981-82), and Atlantic County, New Jersey (1978-87)

[pH in standard units; specific conductance in microsiemens per centimeter at 25 degrees Celsius; alkalinity in milligrams per liter as calcium carbonate; calcium, magnesium, sodium, potassium, chloride, and sulfate in milligrams per liter; iron and manganese in micrograms per liter; <, less than. Ocean County data are from Harriman and Sargent (1985); Atlantic County data are from Barton and others (1993)]

Characteristic or constituent	Median	Minimum	Maximum	Number of samples
		Ocean County		
pH	4.8	3.9	9.1	242
Alkalinity	4	0	75	240
Specific conductance	56	17	1,030	249
Calcium	1.4	.20	73	211
Magnesium	.60	.21	25	212
Sodium	3.5	.58	197	232
Potassium	.80	.10	10	231
Iron	290	16	27,000	166
Manganese	14	<10	480	166
Chloride	5.0	1.1	300	245
Sulfate	7.0	0	30	246
Nitrate plus nitrite (as N)	.08	<.01	10.5	154
		Atlantic County		
pH	4.9	3.8	8.2	81
Alkalinity	3.0	<1.0	80	75
Specific conductance	55	16	257	79
Calcium	.93	.02	46	81
Magnesium	.90	.01	14	81
Sodium	3.2	1.2	23	81
Potassium	1.0	.1	10	81
Iron	59	<3.0	37,000	81
Manganese	11	<1.0	420	81
Chloride	5.7	.2	43	81
Sulfate	4.9	.2	56	81
Nitrate plus nitrite (as N)	.16	<.10	29	68

Acknowledgments

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APPROACH TO DATA ANALYSIS

Compilation of Available Data

In order to evaluate the extent of known mercury contamination of water from the Kirkwood-Cohansey aquifer system, data on mercury concentrations in ground water, well and sample locations, and well construction were compiled from State, county, and local agency records.

The data base for sites of elevated mercury concentrations in ground water (see appendix 1a) contains total-mercury-concentration data from the Health Departments of Atlantic, Camden, Cumberland, Gloucester, Salem, and Ocean Counties; from Vineland City Health Department; and from the NJDEP, and represents the results of the most recent (as of June 1, 1993) analysis of water from a particular well. A map in appendix 1a shows locations of the municipalities in which ground-water samples were collected. Appendix 1c contains total-mercury-concentration data and well-construction data for 31 additional wells, sampled by State and county agencies, that are not associated with sites of elevated mercury concentrations in ground water, as defined in this report. Appendix 1d contains total-mercury-concentration data from Windom and Smith's (1992) study for wells not associated with sites of elevated mercury concentrations in ground water. The site data base

(appendix 1a) also includes available well-construction information. In order to determine well depth and other pertinent well-construction data, a well-record search of the NJDEP microfiche data base was performed. Because not all well records were registered, letters were sent to well-drilling firms to request any well records from the areas of mercury contamination. Finally, homeowners were asked to supply copies of well records. Well-depth data also were obtained from well-permit records; the data from these do not reflect actual well depths, but the depth to which drilling was permitted. Therefore, these depths are only approximate. Recollections of well depth supplied by homeowners also may be approximate.

Most of the data presented in this report are from Atlantic County, which has established a comprehensive screening program for domestic wells as a result of ground-water contamination problems. Ocean County, which requires ground-water testing at the time of property transfers, maintains an on-line data base in which water-quality data are stored by community. At the time of this study, the Ocean County data base contained total-mercury-concentration data for water from 3,165 wells in 16 communities. The mercury-concentration data in the Ocean County data base were not in the same format, however, in that raw data values were not always reported, but rather concentrations less than a value other than reporting limits. Locational data also were generalized. Although wells yielding water with mercury concentrations that exceed the USEPA MCL can be identified in the Ocean County data base, the differences in data-base format precluded merging all of the Ocean County data with the rest of the data collected. Therefore, these data have been omitted from the data base of the 34 sites (app. 1a) presented in this report, although the number of concentrations of mercury that exceeded the USEPA MCL in the Ocean County data base was determined and is reported here.

The USGS water-quality data base contains dissolved-mercury-concentration data for water from 168 wells tapping the Kirkwood-Cohansey aquifer system; the wells include irrigation wells, observation wells, domestic wells, and public supply wells (school and campground). These data also were compiled and evaluated. The wells in the USGS data base (see appendix 1b) are located in areas other than those of the 34 sites.

Spatial Analysis

Much of the spatial analysis of the data compiled during the study was done by using a geographic information system (GIS). The approximate centerpoint of each of the 34 site locations (which can include more than 100 individual well locations) was digitized so that these locations could be superimposed on regional and subregional data, which consisted of available coverages of generalized land use from the USGS GIRAS coverages of 1972 (Fegeas and others, 1983), and specific land-use features such as landfills, golf courses, and cemeteries, water-table contours, and drainage divides.

The assessment of the various possible sources of mercury to ground water was begun at a regional level, proceeded to a subregional level, and finally was taken to a site-specific level of analysis. This approach was driven by the distribution of the data, which, as discussed earlier, are clustered spatially, rather than evenly distributed. Because it is unlikely that all instances of mercury-contaminated ground water have been discovered, the extent of the problem of mercury contamination

cannot be determined adequately at the regional scale at this time. Nevertheless, working from the regional to the local scale proved effective in eliminating some of the possible sources from consideration.

Regional-scale GIS coverages for land-use factors considered to be possible sources were used to determine distances from site to land-use factor; coverages with locational data were available for landfills, cemeteries, and golf courses. A GIS coverage of locations of New Jersey Pollutant Discharge Elimination System (NJPDES) ground-water sites was created from the NJDEP NJPDES data base; the NJPDES sites and a GIS coverage of hazardous-waste sites, including Superfund sites, also were examined for possible sources in the vicinity of sites of elevated mercury concentrations in ground water. Those possible sources within 3 mi of a site of mercury-contaminated ground water were selected for further consideration. The 3-mi distance was chosen on the basis of research conducted by the USGS at a contaminant plume in a 100-ft-thick sand and gravel aquifer in Cape Cod, Massachusetts; the contaminants (sewage containing metals) had traveled about 2.13 mi from 1936 to 1979 (Garabedian and LeBlanc, 1991) and have since extended nearly another mile (Rea and others, 1991; Metge and Harvey, 1991). For the purposes of the present study, it was assumed that contaminants emanating from a point source 50 years ago would be unlikely to be detected more than 3 mi in a horizontal direction in an aquifer that is substantially thicker than the Cape Cod aquifer, due to vertical movement within the aquifer and dispersion of the contaminants. In a NJDEP investigation of contamination from industrial and commercial septic systems, Charles (1989) found that, for four counties in New Jersey, the mean contaminant-plume length was 0.4 mi, and the longest was 0.74 mi. Therefore, it is unlikely that contaminant plumes longer than 3 mi will be found, and most are likely to be less than 1 mi long.

The possible sources that were within 3 mi of a site of mercury-contaminated ground water were then examined at a subregional scale by using GIS overlays of drainage-basin divides, stream networks, and, where available, ground-water-table contours. At this level of analysis, several assumptions about subregional scale hydrology were made: (1) at a first approximation, the surface-water divides are coincident with ground-water divides (these may diverge seasonally or with pumping); (2) shallow ground water discharges to local streams and wetlands; and (3) at a subregional scale, the aquifer is sufficiently isotropic that the horizontal component of ground-water flow can be considered to be perpendicular to water-level contours (a reasonable assumption for a sand and gravel aquifer). A possible point source that was located in a drainage basin other than the basin in which a site of mercury-contaminated ground water is located was considered an unlikely source because ground-water flow directions would be expected to diverge at the divide; thus water from the possible source would flow away from the contaminated site rather than toward it. Similarly, if a stream intervened between a possible source and a site of mercury-contaminated ground water, the source was considered unlikely to affect the ground water at the site because ground-water flow directions would converge toward the stream. Finally, ground-water flow directions were drawn on water-table maps to determine whether ground-water flow from any possible sources was toward any site of mercury-contaminated ground water. Certain possible point sources were eliminated from consideration at this level of analysis, and sites were then examined at the local scale.

Twelve of the first 13 sites for which data were collected had been studied previously by either the NJDEP or USEPA. Ground-Water Impact Area Reports had been prepared by NJDEP for sites 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, and 12. A USEPA report was available for site 13. Although no formal report had been prepared for site 10, a considerable body of data was available from NJDEP and the Gloucester County Planning and Health Departments. The USGS performed a field reconnaissance of site 10 to determine whether any possible point sources not previously documented might be present.

Local-scale analysis was performed for the 13 sites for which detailed information was available. Since that time, Ground-Water Impact Area Reports have been, or are being, prepared for at least two other sites. For the 13 sites, ground-water-flow direction was determined from available water-table maps or data; where these data are lacking, ground-water-flow directions were estimated from topographic contours. Land-use history was evaluated from information in the reports for the sites, and from aerial photography. Possible point sources for these sites had been assessed by NJDEP, from data in NJDEP files on contamination sites, at the time the Ground-Water Impact Area Reports were written. Subsequently, the NJDEP Site Remediation Program's publication "Known Contaminated Sites in New Jersey" (N.J. Department of Environmental Protection, 1994) was searched for any contamination sites discovered more recently than those already assessed, not only for the 13 original sites, but also for the other 21 sites included in this study.

Detailed historical land use was evaluated by using the State's aerial photography library. Determination of past land use was important because the depths below land surface at which mercury contamination was found indicate that the contaminated water is, in many cases, several decades old. Therefore, features associated with present land use are unlikely to be sources of the mercury contamination unless they are old enough to have been able to introduce contaminants into water that was entering the aquifer system about 20 to 50 years ago.

The library contains aerial photographs dating back to 1932; complete flyovers of New Jersey are done at least once every decade, although not exactly every 10 years. Aerial photographs were examined for the period 1932-91 and past land use was noted for the areas of ground-water contamination. In addition to the determination of changes in land use over areas as large as several square miles, or as small as a few acres, the photographs were searched for evidence of possible point sources of mercury contamination, including small dumps and manufacturing operations. Anecdotal evidence for past land use was gathered by conversations with residents and with State and local officials.

Quality Assurance of the Data Base

Water samples can become contaminated with mercury during collection and during preparation for analysis. Studies have shown that observed environmental mercury concentrations can decrease solely as a function of improved sampling and analysis techniques (Fitzgerald and Watras, 1989; Krabbenhoft and Babiarz, 1992). Therefore, at the time the study reported herein began, efforts by NJDEP and county agencies were underway to determine the validity of the mercury-concentration data that was being collected. Wells that yielded mercury-contaminated water typically were

sampled a second time to confirm the presence of elevated mercury concentrations. At several sites in Atlantic County, wells were sampled many times over periods of a few months or a year to determine variability over time. Splits of some samples were analyzed by different laboratories to determine accuracy of laboratory analyses. Also, natural background concentrations of mercury in ground water were determined, and samples from wells yielding mercury-contaminated water were analyzed by a method specific to mercury to determine whether analytical method interferences had affected earlier results.

A group of 30 wells that had been sampled previously and were found to yield water with mercury in concentrations exceeding the USEPA MCL were resampled by the USGS and by NJDEP with Skidaway Oceanographic Institute (SIO) researchers. The samples collected by NJDEP/SIO were obtained by using "clean" sampling procedures, and analyses were performed by using both cold vapor atomic absorption (CVAA) and ICP-MS, with isotope dilution. Results obtained with the ICP-MS method are not affected by interference from organic constituents that can affect results obtained with CVAA. The results for the resampled wells are similar to those previously reported by the ACHD, indicating that those previous analyses reflect accurate determinations of mercury concentrations in ground-water samples (table 3). Table 3 also includes mercury-concentration values for samples from 16 wells resampled by the USGS, which sampled some of the same wells that were sampled by county health departments.

The USGS samples were filtered through 0.45-μm (micrometer)-pore-size filters; the other samples collected by personnel from State or county agencies were not filtered. Because the vast majority of these samples were collected by filling a sample bottle at a tap, the opportunity for contamination of the sample is substantially less than for samples collected and filtered in the field. Some of the mercury concentrations determined for the USGS samples are slightly lower than those of the State or county samples, in part because the samples were filtered and in part because of temporal variability, but they, nonetheless, are relatively consistent with results obtained by the State and the counties.

In general, analytical results from different New Jersey laboratories varied little for the splits of the same sample, indicating that sample contamination during analysis was not common. All laboratories were certified by the State of New Jersey for mercury analysis, and all used the same protocols, which included a calibration curve prepared from a blank and a series of at least five standards for determining the concentrations in samples. Appendix 2k contains representative examples of analytical records from one laboratory performing analyses for mercury. (See also tables 6 and 7, where the results of point-of-entry treatment-system and filtering experiments, described in "Studies relating to the form of mercury in ground water from the Kirkwood-Cohansey aquifer system," are presented, as well as analyses of splits of samples by different laboratories.)

The researchers at SIO (Windom and Smith, 1992) also sampled ground water in areas believed to be free of mercury contamination by using "clean" sampling procedures; these samples also were analyzed by several methods. In addition to finding that background concentrations of mercury in water from the Kirkwood-Cohansey aquifer system commonly were less than 10 ng/L (0.01 μg/L), Windom and

Table 3. Mercury concentrations in ground water from the Kirkwood-Cohansey aquifer system, New Jersey Coastal Plain, determined by four different laboratories

[Data are from the following institution and agencies: ACHD, Atlantic County Health Department; USGS, U.S. Geological Survey (Princeton University Geology Department Laboratory); SIO, Skidaway Institute of Oceanography; GCHD, Gloucester County Health Department. All mercury (Hg) concentrations are in micrograms per liter (µg/L Hg); ICP/MS, inductively coupled plasma mass spectrometry; CVAA, cold vapor atomic absorption; <, less than; -, no analysis by that laboratory]

Well identification number	Date sampled	µg/L Hg, ACHD	Date sampled	µg/L Hg, USGS*	Date sampled	µg/L Hg, SIO (ICP/MS)	µg/L Hg, SIO (CVAA)	Date sampled/ reported	µg/L Hg, GCHD
1037	11/04/91	2.38	11/30/92	0.1					
	12/03/91	.61							
	01/13/92	.85							
	04/08/92	.31							
1050	10/23/91	2.31	12/01/92	.1					
	11/20/91	<.2							
	01/07/92	1.09							
1084	09/25/91	5.7	11/30/92	4.5					
	10/09/91	4.47							
1114	10/30/91	4.07	12/02/92	0.2					
	12/09/91	<.2							
	01/21/92	<.1							
	03/25/92	.16							
1117	10/30/91	3.15	12/02/92	1.3					
	12/10/91	1.77							
	01/06/92	2.49							
2015	09/27/90	2.9			10/15/91	.42	.03		
	06/24/92	0.43							
2046	06/25/90	1.28			10/16/91	1.50	.03		
2109	09/04/90	9.2			10/15/91	1.65	1.22		
2124	10/24/90	5.27			10/15/91	4.14	6.75		
	06/24/92	6.73							
	08/12/92	6.52							
2139	05/23/91	13.9			10/16/91	11.5	23.5		
2140	07/31/90	3.19			10/16/91	3.42	6.75		
4001	09/17/90	12	11/17/92	12.5					
	12/03/90	5.02							
	03/04/92	10.2							
4002	10/10/90	<.1			10/16/91	.089	.17		
4011	10/10/90	<.1			10/16/91	.012	.042		
4040	09/17/90	<.1			10/16/91	.024	.042		
	10/22/91	<0.1							
	05/20/92	0.61							
4044	10/17/90	7.31			10/16/91	6.45	6.11		
	10/08/91	5.27							
	10/23/92	9.51							
4047	10/17/90	5.64	11/18/92	11.3	10/16/91	5.8	8.9		
	01/10/91	6.5							
4048	10/03/90	2.9	11/17/92	3.4	10/16/91	2.7	4.7		
	01/22/91	3.14							
4049	02/20/91	12.53			10/16/91	10.5	17.0		
	01/29/91	13.87							
	09/01/92	<0.1							
4050	10/03/90	4.5	11/18/92	3.7					
	03/10/92	2.00							
5041	06/12/90	2.7			10/15/91	2.79	4.00		
5087	05/02/90	2.79			10/15/91	1.45	.97		

Table 3. Mercury concentrations in ground water from the Kirkwood-Cohansey aquifer system, New Jersey Coastal Plain, determined by four different laboratories--Continued

Well identification number	Date sampled	µg/L Hg, ACHD	Date sampled	µg/L Hg, USGS*	Date sampled	µg/L Hg, SIO (ICP/MS)	µg/L Hg, SIO (CVAA)	Date sampled/ reported	µg/L Hg, GCHD
5092	05/15/90	4			10/15/91	6.80	10.1		
	06/06/90	5.90							
5098	05/15/90	4.3			10/15/91	3.30	4.70		
	05/22/90	4.1							
	08/14/90	4.2							
6023**	11/12/91	34.6			03/26/92	36.1	-		
6045	03/06/92	6.96			03/26/92	7.22	-		
6054	11/13/91	.81			03/26/92	.65	-		
10001			12/21/92	18.6				06/23/89	7.1
								09/14/89	8.2
10011			08/19/92	<.2				02/26/90	<.1
10012			8/20/92	2.5				02/26/90	5.9
								02/26/90	5.4
10013			8/19/92	<.2				02/26/90	<.1
10014			08/20/92	.4				02/26/90	<.1
10019			08/19/92	<.2				02/26/90	<.1
10022			08/20/92	<.2				02/26/90	<.1
10029			08/21/92	<.2				02/26/90	<.1
10030			08/20/92	2.0				02/26/90	15
16034	09/09/91	30.99			10/17/91	21.3	31.7		
					10/17/91	21.7	29.7		
16035	09/09/91	1.11			10/17/91	.035	.080		
16040	02/04/92	11.28			10/17/91	4.35	5.85		

*USGS samples were filtered through 0.45-micrometer-pore-size filters; other samples were not filtered.

**Well 6023 was sampled 19 times; complete mercury-concentration data are presented in table 8.

Smith (1992) found method variability for some analyses, particularly for those of samples containing mercury in low concentrations. The ICP/MS method used by Windom and Smith tended to produce lower results than did the USEPA CVAA method. The USEPA method (245.1) also has the potential for interference by some organic compounds, which may produce false positive results. Although a variety of VOC's were detected in some ground-water samples at many of the sites, relatively few of the samples containing mercury in detectable concentrations also contained detectable concentrations of VOC's. The interference from organic compounds is not present in the ICP/MS method used by Windom and Smith (1992); their results validate those obtained by the ACHD for the same wells, indicating that, in general, interferences from VOC's appear to be negligible or absent.

The variations in sampling and preserving protocols investigated by the USGS (app. 2a) resulted in 3 low detections of mercury out of 40 analyses (0.2, 0.3, and 0.4 μg/L). Whether this represents contamination during sampling or analysis or analytical error is not known at this time. Such occurrences indicate that low-level detections on the order of a few tenths of a microgram may represent contamination or analytical error in a small percentage of the analytical results obtained during this study. In general, however, the quality-assurance measures taken as the elevated mercury concentrations were discovered have served to validate the analytical results. The reproducibility of results from different laboratories and the consistency of results obtained with repeated sampling of the same well by different investigators generally indicate the presence of mercury-contaminated ground water in the Kirkwood-Cohansey aquifer system rather than contamination of individual samples during collection, processing, and analysis.

OCCURRENCE AND DISTRIBUTION OF MERCURY IN THE KIRKWOOD-COHANSEY AQUIFER SYSTEM

As noted earlier in this report, the data compiled during the course of this study indicate that elevated mercury concentrations in ground water are, for the most part, spatially clustered. This is because the wells sampled initially were those in the vicinity of a well in which mercury contamination was found. Whether mercury would be found in ground water in the areas between those in which samples were collected is not known in detail, although data from the USGS data base for 168 wells scattered across the study area indicate that mercury has not been commonly detected in ground-water samples from forested areas, some agricultural areas, and some low-density residential areas. Mercury has been detected at concentrations above background levels in water from a few wells in the USGS data base, but no well has consistently yielded water with mercury concentrations above the USEPA MCL (fig. 7). One well in an agricultural area yielded water with a mercury concentration of 3.4 μg/L, but when the well was sampled a year later, no mercury was detected. Unlike nearly all the samples of ground water collected by State and county agencies, the samples recorded in the USGS data base were filtered through 0.45-μm-pore-size filters. Concentrations may be lower in filtered than in unfiltered samples (see table 7). Total (unfiltered) mercury-concentration data collected by Windom and Smith (1992) (see appendix 1d) for water from wells not located at sites of mercury-contaminated water tend to confirm the absence of elevated mercury in inter-site areas that is suggested by the USGS data, however. Still, because mercury-concentration data for the areas between the sites of elevated mercury concentrations in ground water identified by State and county agencies are sparse, it is not yet possible to determine conclusively whether the pattern of sporadic occurrences of elevated mercury

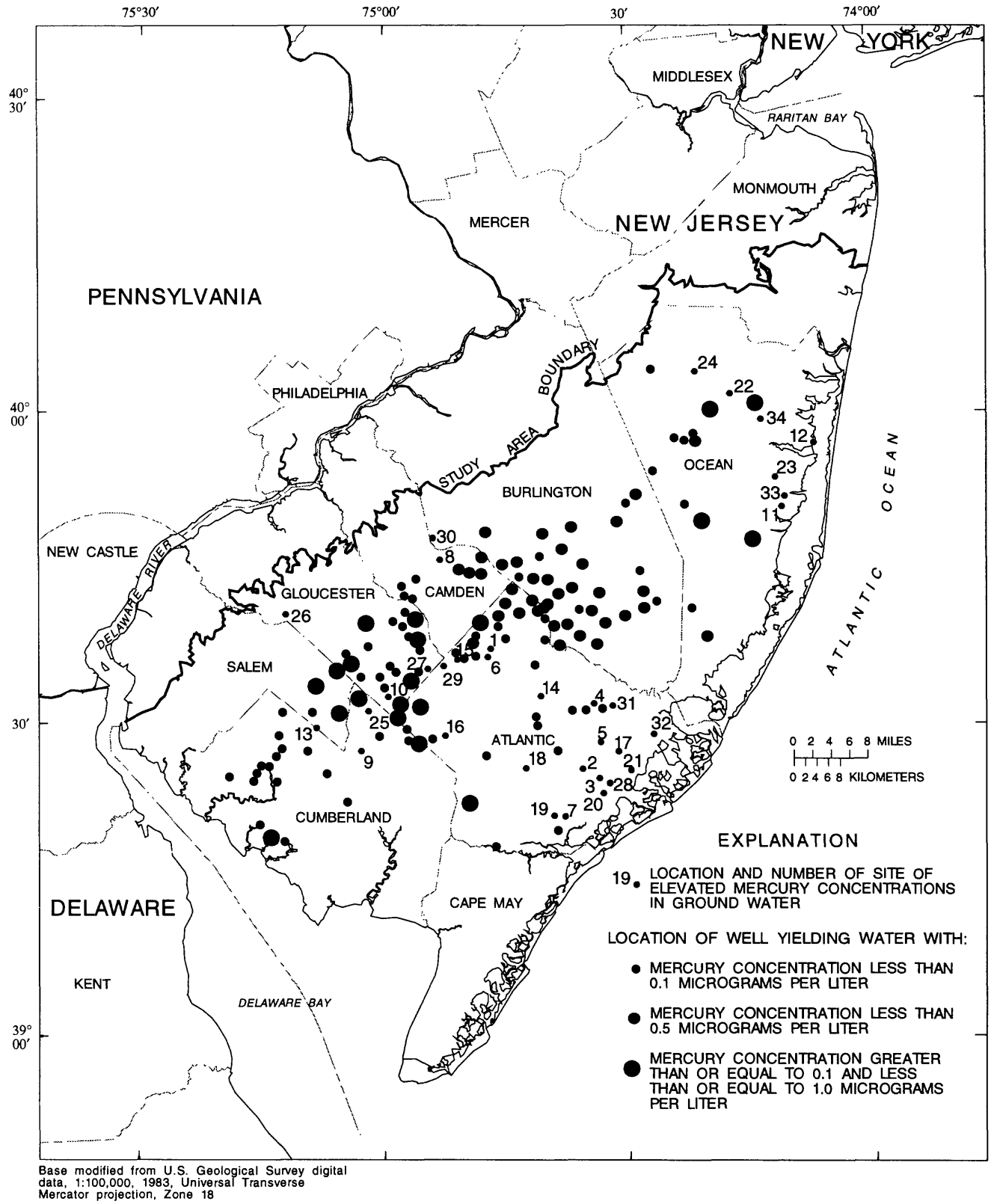

Figure 7. Locations of wells in the New Jersey Coastal Plain from U.S. Geological Survey data base not associated with sites of elevated mercury concentrations in ground water and concentrations of dissolved mercury determined in samples of water from these wells. (Reporting limit for samples collected during the 1970's is 0.5 micrograms per liter. Reporting limit for samples collected during the 1980's and early 1990's is 0.1 micrograms per liter.)

concentrations is an accurate representation of the areal distribution of mercury-contaminated ground water or whether it is, in part, an artifact of the way the problem was revealed and data were collected.

Regional Occurrence of Mercury in Ground Water in Seven Counties

As of June 1993, 32 sites have been identified where one or more private wells have yielded water that contained mercury in concentrations exceeding the USEPA MCL of 2 µg/L at least once; at two additional sites, one or more wells have yielded water containing mercury in concentrations between 1.0 and 1.5 µg/L. The sites are located in seven counties: Atlantic, Burlington, Camden, Cumberland, Gloucester, Ocean, and Salem (fig. 1). The individual municipalities in which the sites are located are shown in figure 1a of the site data base in appendix 1a.

Because only a few data on mercury in ground water, collected during a NJDEP study, are available for a group of wells in Burlington County, the extent of contamination in that county is not well known. Data from several wells tapping the surficial aquifer (the Holly Beach water-bearing zone) in Cape May County show that only one well, associated with a Superfund[4] site, yielded water with a concentration of mercury greater than 1 µg/L.

Of the 2,239 private wells in the mercury-site data base (app. 1a) that were sampled for mercury, at least one water sample from each of 306 wells has contained mercury in concentrations that exceed the USEPA MCL of 2 µg/L. Only 927 wells in the site data base were found on the most recent sampling to yield water with no detectable levels of mercury. (The reporting limit generally was either 0.2 or 0.5 µg/L, although both lower and higher reporting limits were encountered.) Tables 4 and 5 contain summaries of analytical results for the most recent sampling of the 2,239 wells in the data base of sites of elevated mercury concentrations in ground water. The concentrations of mercury detected in the ground water ranged from the reporting limit to 72 µg/L at a site in Atlantic County and 240 µg/L at the site in Salem County (see table 8). At least one water sample from more than half (about 1,300) of all 2,270 of the wells sampled by State and county agencies yielded water containing mercury at some detectable level (app. 1a and 1c; table 8).

Atlantic County

Nineteen of the 34 sites at which elevated concentrations of mercury were found in ground water are located in Atlantic County (fig. 1). Mercury-concentration data for Atlantic County were supplied by the Atlantic County Division of Public Health (ACHD) and by NJDEP, which had completed Ground-Water Impact Area Reports for several of the sites and was working on others during the present USGS study. Several of the sites are in Egg Harbor and Galloway Townships (fig. 8), although elevated mercury concentrations also have been found in ground water in Absecon City, Buena Vista Township, Folsom Borough, Hamilton Township, and Hammonton Town. The ACHD continues to sample the ground water in wells in this area that were not sampled previously to determine more fully the extent of contamination.

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[4]No data from wells sampled solely as part of a Superfund investigation have been used to delineate a "site" as defined in this report. Therefore, these data from Cape May County are not included in the data base in appendix 1a. Data from wells sampled as part of a Superfund investigation are included in the data base only if they fall within an area defined as a "site" on the basis of data from other wells.

Table 4. Number of wells* sampled for mercury; yielding water containing mercury in concentrations greater than the U.S. Environmental Protection Agency maximum contaminant level; and yielding water containing mercury in concentrations greater than the laboratory reporting limit but less than or equal to the maximum contaminant level, New Jersey Coastal Plain

[Hg, mercury; >, greater than; ≤, less than or equal to; MCL, maximum contaminant level in drinking water (2 micrograms per liter)]

County	Number of wells	Number of wells yielding water samples with Hg > MCL	Number of wells yielding water samples with Hg > reporting limit ** and ≤ MCL	Number of wells yielding water samples with no Hg detected
Atlantic	1,543	202	904	437
Burlington	6	1	0	5
Camden	472	21	83	368
Cumberland	82	9	16	57
Gloucester	33	7	5	21
Ocean	51	19	14	18
Salem	52	6	27	21
Total	2,239	265	1,047	927

*Well in project data base (appendix 1a). Does not include Ocean County data base, which contains 3,165 wells.

**Reporting limit ranges from 0.1 to 2.0 micrograms per liter; 0.5 is the more common reporting limit. Burlington County samples were analyzed with detections at less than 10 nanograms per liter but are shown in the data base as less than 0.01 micrograms per liter.

Table 5. Distribution of mercury in water from wells screened in the Kirkwood-Cohansey aquifer system in the New Jersey Coastal Plain, by county

[Data are for 2,239 wells; Hg, mercury; <, less than; µg/L, micrograms per liter]

County	Number of wells	Number of sites	Median* Hg concentration (µg/L)	Maximum Hg concentration (µg/L)	Minimum Hg concentration (µg/L)
Atlantic	1,543	19	0.28	34.5	0.01
Burlington	6	1	<.01	3.53	<.01
Camden	472	1	.50	21.7	<.10
Cumberland	82	2	1.00	14.0	<.10
Gloucester	33	3	.20	20.6	<.20
Ocean	51	7	1.10	17.0	<.20
Salem	52	1	.50	42.0	<.20

*For the statistical summary of the data, concentrations shown as "less than" were given the value of the minimum laboratory reported concentrations. For example, <0.10 was given the value 0.10.

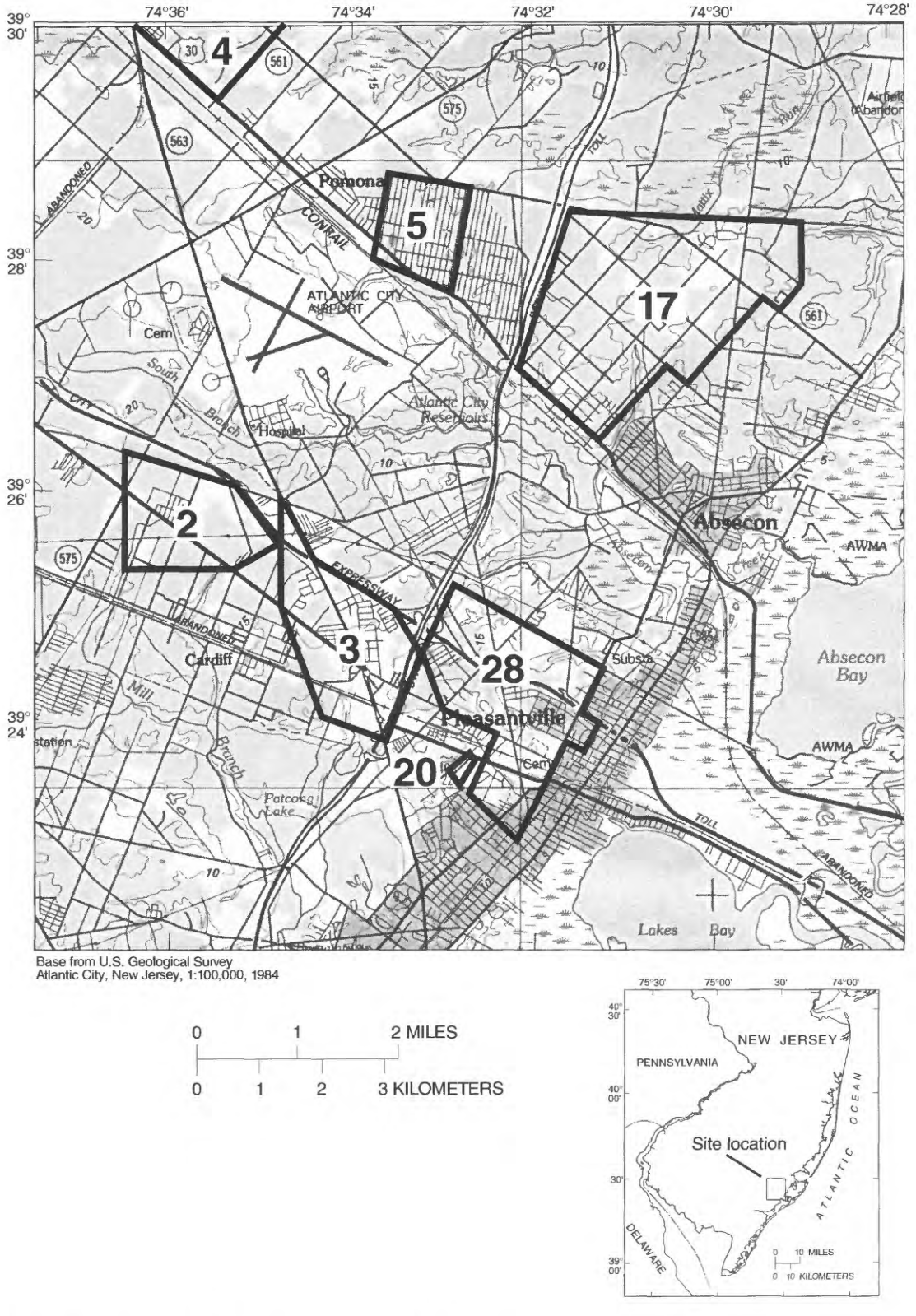


Figure 8. Distribution of residential sites of elevated mercury concentrations in ground water in Egg Harbor and Galloway Townships, Atlantic County, New Jersey. (Part of site 4, in Galloway Township, is shown at the northwestern corner of the map, about 2.4 miles northwest of site 5.)

Water from 749 wells in Egg Harbor Township has been analyzed for mercury; 111 wells yielded water that contained mercury in concentrations that exceeded the USEPA MCL at the most recent sampling. As of February 1993, the number of wells sampled in Galloway Township was 354; 29 wells yielded water with mercury in concentrations that exceeded the MCL at the most recent sampling. In Absecon City, results for samples from three wells had been reported to the ACHD and all three were found to contain mercury in concentrations exceeding 2 μg/L. In Mullica Township, 1 well of 16 sampled yielded water with a mercury concentration above the MCL. Mercury was detected in all but one of the remaining wells. Within Buena Vista Township, in an area adjacent to Folsom Borough, water from 2 of a total of 54 wells sampled for mercury was found to yield water with mercury concentrations that exceeded the MCL. In another part of Buena Vista Township, 9 of a group of 76 wells sampled for mercury yielded water with mercury concentrations above the MCL. In Folsom Borough, 2 of 22 wells sampled were found to yield water with mercury concentrations that exceeded the MCL. Two of the 65 wells sampled in Hamilton Township were found to yield water containing mercury concentrations greater than the MCL. In Hammonton Town, two sites of elevated mercury concentrations in ground water have been identified within a 2-mi^2 area; of a total of 230 sampled wells at these sites, 42 were found in the most recent sampling to yield water with mercury concentrations in excess of the MCL. Some of the highest concentrations of mercury have been reported in water from a homeowner's well in Hammonton Town (see table 8, well number 6023).

Burlington County

The Burlington County Health Department does not archive results of sampling for mercury; therefore, no data were available from that source. Six wells in a residential area of Evesham Township were sampled during the cooperative study by NJDEP, NJGS, and Skidaway Institute of Oceanography to determine background concentrations of mercury in ground water from the Kirkwood-Cohansey aquifer system. Five of the wells yielded water with background concentrations of less than 10 ng/L; the sixth yielded water with a mercury concentration above the MCL.

Camden County

Mercury has been reported in ground water in areas in Waterford Township, Camden County. Data on mercury concentrations in ground water in Camden County were supplied by NJDEP, which had completed a Ground-Water Impact Area Report for the Atco area, and by the Camden County Health Department. As of February 1993, the Camden County Health Department and NJDEP had received mercury-analysis data for water from 472 homeowners' wells. Of these wells, 21 were found in the most recent sampling to yield water with mercury concentrations in excess of the MCL. No data from other townships were available at the time of this study.

Cumberland County

Mercury was detected in ground water at two sites in Cumberland County within the municipality of Vineland. The data were supplied by the Cumberland County Health Department, the Vineland City Health Department, and NJDEP, which had completed a Ground-Water Impact Area Report of one of the sites at the time of this study. Nine of the 82 wells sampled at the two sites yielded water with mercury concentrations above the MCL. A third site, located partly in Salem County (and listed

as such in appendix 1a) extends over the county line into Deerfield Township, Cumberland County. This site is discussed in the Salem County section that follows.

Gloucester County

Mercury concentrations exceeding the MCL have been identified in ground water at three sites. The data were supplied by the Gloucester County Planning Department and Gloucester County Health Department. These sites are located in Franklin, Elk, and Monroe Townships. In Franklin Township, 6 of 31 wells sampled were found to yield water with mercury concentrations greater than the MCL. The USGS resampled 10 wells; results confirmed earlier findings for 5 wells. Two wells, one each in Elk and Monroe Townships, have been sampled by the homeowner and the County Health Department, and both yielded water with elevated mercury concentrations.

Ocean County

Appendix 1a contains data for 51 wells in Ocean County that are associated with sites of elevated mercury concentrations in ground water. These data were supplied by the Ocean County Health Department and by NJDEP, which had conducted investigations and completed Ground-Water Impact Area Reports for two sites at the time of this study. Water from wells at seven sites, one each in Berkeley, Jackson, and Manchester Townships and two each in Lacy and Dover Townships, has been found to contain mercury in elevated concentrations. In a densely populated residential area of Dover Township, 5 of the 23 wells sampled in one area yielded water with mercury concentrations in excess of 2 μg/L. Three wells in a second area yielded water with mercury concentrations at or above the MCL. In Lacy Township, 5 of 11 wells in a residential area yielded water with mercury concentrations in excess of the MCL. Two wells in a nearby area yielded water with mercury concentrations above the MCL. At the site in Jackson Township, two of the nine wells sampled for mercury yielded water with mercury concentrations above the MCL. One well in Manchester Township and two in a densely populated residential area of Berkeley Township were found to yield water with mercury concentrations in excess of the MCL.

In Ocean County, ground water is tested routinely for various constituents. A testing program is in place upon transfer of real estate; mercury has been one of the constituents analyzed. Of 3,165 wells in the Ocean County Health Department data base sampled for mercury between 1987 and spring 1991, 82 have been found to yield water with elevated mercury concentrations at the first sampling. The Ocean County Health Department data base lists many mercury concentrations as above or below the MCL, however, and because the format of both the mercury-concentration data and locational data was not always compatible with the format of the other data compiled, some of the Ocean County data have not been included in the data base in appendix 1a.

During 1991, the Ocean County data base was expanded to include water-quality data for about 11,000 wells. The most recent version of the data base was downloaded to the USGS computer after the present study was completed; of more than 12,000 samples analyzed for mercury, 106 were found to contain mercury in concentrations greater than the MCL (M.A. Ayers, U.S. Geological Survey, written commun., 1995).

Salem County

Elevated mercury concentrations have been reported in ground water from a site that encompasses part of Pittsgrove Township in Salem County and a small part of adjacent Deerfield Township in Cumberland County. Data were supplied by Salem County Health Department and NJDEP; many of the data are contained in a USEPA memorandum from 1989 (unpublished data on file at N.J. Department of Environmental Protection, Trenton, N.J.). Of the 52 wells sampled at the site in Pittsgrove and Deerfield Townships, 7 initially were found to yield water with mercury concentrations that exceeded the MCL. Of the seven wells, six yielded water with mercury concentrations above the MCL in subsequent sampling. The highest concentration encountered in the most recent sampling was 42 μg/L. Two very high concentrations (200 and 240 μg/L) were reported for water samples from two wells in the initial sampling (1984) at this site (see table 8).

Studies Relating to the Form of Mercury in Ground Water from the Kirkwood-Cohansey Aquifer System

As discussed in the section "Mercury Chemistry," mercury can be mobile either as a dissolved species or sorbed to colloids. The form of mercury being measured in ground water in southern New Jersey was not known and has yet to be resolved. Several investigations were aimed at providing information about the form or forms of mercury present in the ground water.

Point-of-Entry Treatment System Study

In response to the detection of mercury in ground water in several counties in New Jersey, State and county agencies initiated a program to provide uncontaminated drinking water to the affected communities. Where it was not feasible to connect homes to public water mains, the viability of point-of-entry treatment systems (POETS) was examined; in the process, important information about the nature of the contamination was discovered.

The ACHD performed a study cooperatively with NJDEP during 1990-91 to determine the most effective measures for removing mercury from tap water. Ground-water samples from four homes at site 2 in Atlantic County were passed through various media, including activated charcoal and exchange resins, and also were collected unfiltered (raw). Water from all four homes had been found to contain substantial concentrations of mercury. The results of this study are presented in table 6. Of the various media through which the samples were passed, all but the strong-cation-exchange resin reduced the concentration of mercury in the sample.

The initial results of the study of the various media indicated that the mercury could be present as a negatively charged entity in the ground water at site 2. The effectiveness of the POETS, which contain an anion resin, at removing mercury from ground water at sites other than site 2 indicates that the mercury may be present in a negatively charged form in the aquifer water. Passing water samples from one of the four wells through 0.45-μm membrane filters also reduced mercury concentrations (table 7). Whether the mercury is present as a dissolved complex or is sorbed to colloidal particles, or both, is unclear. Windom and Smith (1992) surmised, on the basis of thermodynamic considerations, that the mercury species present in ground water in the Kirkwood-Cohansey aquifer system is probably a chloride complex $HgCl_2^\circ$, or $HgCl_4^{2-}$ where the water contains sufficiently high concentrations of chloride.

Table 6. Mercury concentrations in raw and filtered water samples from four wells in Egg Harbor Township, Atlantic County, New Jersey

[Samples were collected through various media. ACHD, Atlantic County Health Department laboratory; NJDOH, New Jersey Department of Health; BRIAS, Bureau of Radiation and Inorganic Analytical Services of the New Jersey Department of Environmental Protection; Hg (µg/L), mercury concentration in micrograms per liter; -, no data; <, less than]

Well identification number	Date sampled	ACHD Hg (µg/L) raw	ACHD Hg (µg/L) filtered*	NJDOH Hg (µg/L) raw	BRIAS Hg (µg/L) raw
2062	11/15/90	23.2	1.0,[a] 0.6[a]	21.8	-
	11/21/90	24.3	23.0[b], 23.0[b]	24.2	-
	11/29/90	6.0	0.4[c], 0.1[c]	20.8	18.7
	12/06/90	0.29	0.19[c], 0.19[c]	22.7	-
	12/14/90	25.78	0.49[d], <0.1[d]	21.5	18.7
	12/20/90	21.37	<0.1[e], <0.1[e]	21.6	-
	12/27/90	18.44	<0.1[f], <0.1[f]	20.4	18.3
	01/03/91	17.39	0.98[f], 0.43[f]	-	-
	01/10/91	19.59	<0.1[g], <0.1[g]	-	19.7
	01/17/91	19.57	0.2[a], 0.1[a]	-	-
	01/31/91	19.24	0.59[a], 0.77[a]	20.6	17.3
	02/14/91	20.48	1.59[a], -	13.9	-
	02/28/91	27.74	- , 1.02[a]	18.5	18.1
	03/14/91	22.35	- , 2.06[a]	18.9	-
	03/28/91	23.9	0.63[c]	19.7	20.7
	04/11/91	26.25	0.38[c]	25.9	-
	04/25/91	22.06	0.77[c]	25.1	22.2
	05/09/91	23.5	1.0[g]	22.9	-
	05/23/91	22.5	0.12[g]	17.6	19.6
	06/06/91**	19.2, 21.1	0.66[g], 0.69[g]	20.1	-
	06/20/91	14.8	0.87[g]	18.3	-
	07/11/91	11.42	0.4[g]	-	-
2139	11/15/90	11.4	0.5[a], 0.5[a]	11.1	-
	11/21/90	10.2	9.8[b], 10.6[b]	10.9	-
	11/29/90	11.7	0.3[c], <0.1[c]	11.0	11.1
	12/06/90	12.98	0.41[c], 0.91[c]	10.5	-
	12/14/90	12.66	0.39[d], 37.0[d]	11.0	9.9
	12/20/90	11.12	0.79[e], 1.1[e]	11.5	-
	12/27/90	11.3	<0.1[f], <0.1[f]	12.5	9.5
	01/03/91	9.71	0.76[f], 0.65[f]	-	-
	01/10/91	12.16	<0.1[g], <0.1[g]	10.3	-
	01/17/91	9.31	0.1[a], 0.1[a]	-	-
	01/31/91	9.19	0.51[a], 0.42[a]	11.1	9.8
	02/14/91	9.3	0.83[a], -	8.8	-
	02/28/91	10.91	- , 0.46[a]	7.6	9.4
	03/14/91	8.06	- , 0.38[a]	7.6	-
	03/28/91	9.21	1.43[d]	7.1	8.5
	4/11/91	8.49	0.3[d]	8.3	-
	04/25/91	9.85	0.45[d]	8.4	8.9
	05/09/91	12.4	0.6[f]	10.6	-
	05/23/91	13.92	0.23[f]	9.4	9.8
	06/06/91**	13.5, 13.58	0.69[f], 0.61[f]	12.7	-
	06/20/91	16.16	0.4[d]	14.9	-
	07/11/91	6.17	0.4[d]	-	-
	07/25/91	12.08	1.04[d]	-	-

Table 6. Mercury concentrations in raw and filtered water samples from four wells in Egg Harbor Township, Atlantic County, New Jersey--Continued

Well identification number	Date sampled	ACHD Hg (µg/L) raw	ACHD Hg (µg/L) filtered*	NJDOH Hg (µg/L) raw	BRIAS Hg (µg/L) raw
2199	11/15/90	11.0	0.4[a], 0.3[a]	9.9	-
	11/21/90	13.5	10.6[b], 11.3[b]	12.1	-
	12/06/90	16.26	0.52[c],0.41[c]	13.9	-
	12/14/90	18.96	0.28[d], <0.1[d]	14.2	12.3
	12/20/90	14.74	0.38[e], 0.38[e]	14.1	-
	12/27/90	13.04	<0.1[f], <0.1[f]	13.7	12.8
	01/03/91	12.11	0.21[f], 0.43[f]	-	-
	01/10/91	13.38	<0.1[g], <0.1[g]	11.8	-
	01/17/91	16.95	0.62[a], 0.1[a]	-	-
	01/31/91	11.34	0.51[a], 0.42[a]	11.7	10.3
	02/14/91	10.9	0.75[a], -	9.2	-
	02/28/91	12.16	- , 0.32[a]	9.5	11.2
	03/14/91	11.94	0.63[a]	10.4	-
	03/28/91	15.0	0.73[d]	11.9	12.8
	04/11/91	12.59	0.47[d]	13.9	-
	04/25/91	16.64	1.08[d]	14.4	12.7
	05/09/91	16.3	0.8[f]	13.6	-
	05/23/91	11.27	0.63[f]	7.3	6.4
	06/06/91	8.0	0.69[f]	7.0	-
	06/20/91	8.61	0.21[e]	7.9	-
	07/11/91	5.65	0.19[e]	-	-
2200	11/15/90	17	0.6[a], 0.68[a]	16.9	-
	11/21/90	17.3	16.7[b], 16.1[b]	15.6	-
	11/29/90	14.8	0.4[c], 2.2[c]	19.5	-
	12/06/90	19	1.5[c], 0.68[c]	14.9	-
	12/14/90	16.86	0.60[d], 0.35[d]	14.0	12.1
	12/20/90	13.71	0.17[e], <0.1[e]	13.7	-
	12/27/90	14.16	<0.1[f], <0.1[f]	14.7	11.7
	01/03/91	11.56	0.54[f], 0.65[f]	-	-
	01/10/91	14.4	0.16[g], <0.1[g]	12.3	-
	01/17/91	10.15	0.2[a], 0.1[a]	-	-
	01/31/91	10.48	0.42[a], 0.34[a]	12.0	11.9
	02/14/91	6.93	0.58[a], -	22.1	-
	02/28/91	13.73	- , 0.46[a]	9.6	-
	03/14/91	11.77	0.21[a]	10.8	-
	03/28/91	13.1	1.53[c]	11.2	11.1
	04/11/91	9.92	0.65[c]	12.6	-
	04/25/91	11.42	2.54[c]	9.9	9.8
	05/09/91	11.4	0.6[g]	10.9	-
	05/23/91	9.51	0.33[g]	2.9	5.9
	06/06/91	6.66	0.69[g]	6.5	-
	06/20/91	5.75	0.4[e]	5.5	-
	07/11/91	4.07	0.5[e]	-	-

* If two values are given, the second is a faster pumping rate (5 gallons per minute). The first entry is 3 gallons per minute pump rate.

a Granular activated carbon

b Strong sodium cation resin

c Strong base anion resin

d Copper/zinc-specific resin

e Mercury-specific resin

f Weak base anion resin

g Weak acid cation resin

** Only one pump rate (3 gallons per minute) was used on this sampling date. Two entries represent plastic bottles (first entry) and glass bottles (second entry) used for sampling.

Filter Study

Most of the water samples collected by State and county agencies and analyzed for mercury were not filtered. NJDEP and ACHD collaborated on a study of filtered and unfiltered water samples from a selected well at site 2 in 1991. The pore size of the filters used was 0.45 μm. The results, given in table 7, indicate that substantial amounts of mercury are removed by filtering, and thus, it is likely that some of the mercury measured in ground-water samples is sorbed to colloids, rather than being present as one or more dissolved species.

Mercury-Speciation Study

In addition to the exchange-resin and filter studies, Windom and Smith (1992) treated ground-water samples to isolate various fractions or forms of mercury. Their results indicate that the preponderance of the mercury in ground water is what they term "reactive," which includes inorganic forms such as mercury salts and ion pairs. Some of this mercury may be adsorbed to particles. Windom and Smith also analyzed some ground-water samples for methylmercury and found that this organic form constituted less than 10 percent of the mercury present.

Table 7. Mercury concentrations in unfiltered and filtered ground-water samples from site 2, Egg Harbor Township, Atlantic County, New Jersey

[Hg, mercury; μg/L, micrograms per liter; location of site 2 shown in fig. 1]

Well identification number	Date of sampling	Time of sampling[1]	Total Hg concentration (μg/L)	Dissolved[2] Hg concentration (μg/L)
2062	06-13-91	0830-0850	17.8	8.2
2062	06-13-91	0950	18.6	9.9
2062	06-13-91	1135-1150	18.9	12.1
2062	06-13-91	1220	18.8	11.6

[1]Military time

[2]Operationally defined, sample passed through 0.45-micrometer-pore-size filter.

Distribution of Mercury in Ground Water

Temporal Distribution

At most of the known sites of elevated mercury concentrations in ground water, sampling was conducted over a period of a year or longer. Variations in mercury concentrations over time may be the result, in part, of changes in the flow field from pumping in the area, but this cannot be ascertained conclusively. Other causes of temporal variability may include transport in ground-water flow under natural conditions or changes in ground-water chemistry that affect mercury mobility.

Although most of wells in the site data base in appendix 1a (which reports the most recent analysis results for a given well) were not sampled more than once, several wells in Atlantic County, primarily at sites 2 and 6, were sampled repeatedly to compare various laboratories' results (table 3), to determine the efficacy of various treatment systems (see table 6), and to determine variability over time. Of those wells that were sampled more than once, most were sampled twice, mainly to verify previous analytical results. These data, presented in table 8, indicate that, in many instances, wells continued to tap mercury-contaminated water and that the concentrations commonly did not change substantially over time. Although subsequent samplings of many wells resulted in similar measured mercury concentrations, in some cases mercury was initially detected, but concentrations had decreased to below detection upon resampling. Whether these latter cases represent shifts in the locations of lenses of mercury-contaminated water with differing pumping regimes, shifts because of contaminant transport by ground-water flow over time, or occasional instances of the initial samples having been contaminated during collection or analysis cannot be determined from the data.

Because the sampling was conducted in response to a concern about the presence of mercury in drinking water, most of the wells that were resampled were those yielding water in which mercury was initially detected rather than those yielding water in which mercury was not detected. Therefore, because most of the wells yielding water in which mercury was not detected were not resampled, it is not possible to know whether mercury would have been found in water from these wells at a later date.

Vertical Distribution

No relation between mercury concentration in well water and well depth is apparent, although the observed vertical distribution of mercury in the aquifer is probably a function of the data distribution (fig. 9). Well records or other data relating to well depth were found for only 456 (about 20 percent) of the 2,239 wells sampled at the 34 sites of elevated mercury concentrations in ground water. Nearly all the wells sampled by State and county agencies for which depths are known are drilled to depths between 50 and 120 ft. A few were found to be deeper than 120 ft, and a few are shallower than 50 ft. Well depths are nearly normally distributed (range, 25-200 ft; mean, 89.56 ft; median, 85 ft). If the 456 wells are assumed to be a representative subsample, then most of the wells for which no depth data were available also were drilled to depths ranging from 50 to 120 ft. No significant correlation of mercury concentration with well depth was found by using Pearson's or Spearman's tests. The maximum concentrations detected were in water from wells 60 to 120 ft deep, which also is the depth range for which the data density is greatest.

Table 8. Mercury concentrations in water from wells sampled more than once,* 1988-92, New Jersey Coastal Plain

[Hg, mercury; µg/L, micrograms per liter; <, less than]

Well identification number	Sample date	Hg concentration (µg/L)	Well identification number	Sample date	Hg concentration (µg/L)	Well identification number	Sample date	Hg concentration (µg/L)
Atlantic County			**Atlantic County—Continued**			**Atlantic County—Continued**		
1019	12/11/91	13.60	1090	09/23/91	5.09	2140 cont.	08/22/90	5.60
	01/13/92	.73		10/28/91	4.23	2144	06/14/90	7.80
1021	10/03/91	2.60	1110	10/23/91	.28		08/28/90	9.22
	10/29/91	2.23		10/28/91	<.2	2146	06/13/90	.10
1028	10/18/91	.37	1116	10/08/91	5.5		07/02/90	<.10
	01/06/92	6.01		11/05/91	.42	2151	06/20/90	<.10
1030	10/03/91	1.93		12/02/91	7.76		11/07/90	.13
	10/30/91	1.03	1129	11/04/91	.42	2155	01/02/91	5.31
1032	11/04/91	2.38		02/05/92	.27		05/15/91	5.61
	12/02/91	.89		10/20/92	.17	2165	11/27/90	<.1
1038	10/29/91	13.00	2014	06/26/90	1.23		03/12/91	.21
	11/19/91	6.99		10/31/90	.14	2169	06/15/90	<.1
1040	10/16/91	9.86	2015	09/27/90	2.90		04/24/91	.31
	11/12/91	8.37		02/03/92	1.87	2179	06/18/90	2.61
1041	09/25/91	8.56		06/24/92	.43		08/08/90	2.60
	10/28/91	7.24	2026	05/11/90	.28	2206	06/21/90	5.00
1042	09/26/91	2.2		06/25/90	<.1		08/08/90	4.10
	10/04/91	3.0	2034	06/13/90	<.1	2215	12/19/88	<.50
1043	11/04/91	8.86		03/19/91	<.1		01/11/89	.55
	12/16/91	8.8	2042	07/18/90	2.80		05/05/89	.12
1046	10/08/91	2.87		11/20/90	2.30		06/12/90	.10
	10/30/91	3.15	2044	06/18/90	10.00	2219	06/19/90	<.1
1047	10/16/91	5.1		07/24/90	4.43		10/10/90	<.1
	11/18/91	2.71	2047	06/15/90	1.03	2241	01/11/91	1.5
1048	10/23/91	6.36		06/22/90	1.03		03/18/91	1.6
	12/02/91	12.51		05/28/91	1.20		06/20/91	2.2
1049	11/08/91	11.8		05/13/92	3.00		07/23/91	2.02
	12/23/91	18.2		06/04/92	2.00		09/03/91	4.3
1051	10/16/91	3.91	2053	09/26/90	2.4	2247	06/02/92	30.0
	11/04/91	2.48		05/29/91	1.9		10/10/92	34.5
1052	10/22/91	0.55	2073	06/01/90	<.1	2249	06/06/90	.31
	01/13/92	0.97		06/11/90	<.1		06/16/92	1.14
1055	10/22/91	3.21	2094	06/18/90	3.90	2251	06/03/92	0.22
	11/13/91	3.16		07/19/90	2.60		07/11/92	<.10
1056	10/16/91	3.12	2095	05/29/90	.57	3008	12/07/88	2.90
	11/06/91	2.48		06/21/90	.60		01/10/89	3.71
1058	10/22/91	2.56	2097	06/13/90	7.70	3020	12/05/88	<.1
	12/04/91	2.17		08/28/90	6.36		01/10/89	1.34
1073	10/08/91	3.27	2111	09/13/90	2.02	3029	12/12/88	<.1
	10/29/91	3.43		09/25/90	2.40		01/10/89	<.1
1074	11/04/91	8.52		06/24/92	2.32	3032	12/05/88	1.00
	12/02/91	<.2	2113	11/14/90	.30		01/10/89	2.08
1077	10/09/91	2.87		04/17/91	<.1	3045	12/07/88	1.30
	10/28/91	3.73	2121	06/14/90	6.30		01/10/89	2.09
1082	09/11/91	5.35		06/29/90	5.50	3055	01/19/89	11.13
	09/24/91	13.52	2122	03/01/91	1.90		02/08/89	.76
1083	10/09/91	3.27		02/18/91	.50	3060	12/07/88	.50
	10/29/91	2.73		02/22/91	1.90		01/10/89	.41
1085	09/23/91	5.2	2124	10/24/90	5.27	3067	12/12/88	.25
	10/15/91	3.54		06/24/92	6.73		01/10/89	<.10
1088	10/16/91	2.32		08/12/92	6.52	3126	01/24/89	.17
	12/09/91	3.04	2140	07/31/90	3.19		10/03/89	2.58

*Data for wells sampled more than once for quality assurance or water filter studies are listed in tables 3 and 6.

Table 8. Mercury concentrations in water from wells sampled more than once,* 1988-92, southern New Jersey--Continued

Well identification number	Sample date	Hg concentration (µg/L)	Well identification number	Sample date	Hg concentration (µg/L)	Well identification number	Sample date	Hg concentration (µg/L)
Atlantic County--continued			Atlantic County--continued			Atlantic County--continued		
3133	12/19/88	0.25	3328	12/08/88	1.20	5067	05/08/90	1.0
	01/10/89	2.00		01/10/89	2.09		07/25/90	.88
3134	12/09/88	2.20	4003	10/23/90	2.33	5070	10/11/90	4.10
	01/11/89	.62		08/19/92	2.99		07/18/90	2.70
3142	12/08/89	7.20		09/03/92	2.75	5072	05/28/91	<1.0
	01/10/89	6.54	4007	05/15/90	<.1		05/31/91	8.87
3147	12/07/88	<.10		05/28/91	<.5	5073	05/03/91	6.90
	01/10/89	1.00	4015	09/21/92	6.11		05/16/91	7.91
3153	12/05/88	1.00		10/27/92	8.99		10/09/91	.39
	01/11/89	1.18		11/10/92	5.16	5082	05/08/90	<.1
3185	12/12/88	5.20	4021	08/28/90	11.00		05/30/91	<.5
	01/10/89	7.34		08/15/91	7.60	5090	05/02/90	2.66
3203	12/06/88	.50	4025	10/10/90	4.57		12/18/90	<.1
	01/10/89	3.43		08/19/92	2.66	5097	07/11/90	1.2
3210	12/07/88	32.00	4036	02/04/92	3.28		06/05/91	1.4
	01/10/89	15.79		08/25/92	3.62			
3213	01/23/89	.75	4045	08/06/91	2.90	5106	08/28/89	.20
	03/16/89	.21		08/22/91	1.96		07/11/90	<.1
3218	12/05/88	<.10		10/15/91	1.61	5109	05/31/90	<.1
	01/10/89	1.01		12/16/91	6.50		05/14/91	.46
3222	12/06/88	7.20		08/25/92	3.74	5111	06/21/90	<.1
	01/11/89	10.25		09/15/92	4.21		02/05/91	.56
3232	12/07/88	<.10	4053	10/02/90	1.00	5114	11/01/88	3.90
	01/10/89	<.10		07/02/91	<.10		08/28/89	3.60
3243	12/06/88	1.50	4055	10/02/90	.50		05/02/90	1.80
	01/10/89	4.30		11/10/92	<.10	5115	08/28/89	3.80
3246	12/06/88	1.10	4059	11/07/90	2.96		05/02/90	3.90
	01/10/89	1.40		01/02/91	1.63	5116	05/09/90	4.20
3250	03/13/89	.17		04/16/91	2.17		08/01/90	2.73
	03/16/89	.21		08/19/92	.30	5124	04/09/90	.1
3254	12/06/88	1.10	4063	10/10/90	<.10		03/27/91	.33
	01/12/89	.30		08/27/92	.21	5129	08/28/89	.20
3255	12/06/88	<.10	4066	01/10/92	11.00		05/02/90	<.1
	01/10/89	1.32		01/29/92	8.18	5130	11/01/88	.20
3269	02/08/89	.31		02/06/92	5.10		08/28/89	.20
	02/23/89	.43	4070	11/07/90	2.20	5146	04/01/92	2.50
3270	12/09/88	4.60		12/03/91	1.49		05/20/92	.27
	01/10/89	7.43		08/19/92	2.21		08/20/92	<.1
3271	12/27/88	13.20		09/15/92	2.71	5160	09/19/90	<.1
	10/03/89	3.22	5001	11/01/88	3.00		09/27/91	<.5
3276	12/09/88	.16		08/28/89	1.00	6001	09/17/92	2.60
	01/10/89	<.10		06/12/91	.70		12/08/92	2.23
3283	12/08/88	5.50	5004	11/01/88	.90	6017	11/19/91	3.01
	01/10/89	6.22		08/28/89	1.20		12/09/91	6.71
3296	12/05/88	2.60	5022	08/21/90	.22		04/20/92	7.00
	01/10/89	5.66		04/08/91	<.2		05/27/92	6.20
3300	12/07/88	<.10		04/15/91	<.2		06/07/92	8.60
	01/10/89	<.10	5043	05/08/90	4.40		07/02/92	7.40
3304	12/08/88	1.00		07/02/90	3.00		09/28/92	8.60
	01/10/89	1.26		09/05/90	<.1		11/06/92	3.20
3310	12/12/88	20.00	5053	05/02/90	.20	6019	10/22/91	4.49
	01/10/89	3.99		07/11/90	<.1		11/19/91	3.00

Table 8. Mercury concentrations in water from wells sampled more than once,* 1988-92, southern New Jersey--Continued

Well identification number	Sample date	Hg concentration (µg/L)
Atlantic County--continued		
6019 cont.	04/30/92	2.80
	06/04/92	1.10
	07/10/92	1.70
	10/02/92	1.30
6022	01/21/92	4.19
	02/18/92	2.86
	05/22/92	.90
	06/04/92	<.2
	09/29/92	1.50
6023	11/12/91	34.60
	12/03/91	39.63
	01/03/92	41.40
	01/08/92	27.40
	01/10/92	27.60
	01/31/92	34.10
	02/06/92	41.90
	02/13/92	37.70
	02/28/92	60.70
	03/06/92	35.40
	03/06/92	42.60
	03/06/92	25.80
	04/15/92	36.00
	04/29/92	36.90
	05/28/92	26.20
	06/30/92	19.00
	08/07/92	22.00
	10/21/92	72.00
	10/22/92	2.20
6027	12/10/91	2.64
	01/06/92	2.07
	04/30/92	.30
	05/27/92	.40
	07/01/92	<.20
	11/04/92	2.10
6033	11/13/91	2.91
	12/03/91	1.09
	01/06/92	3.23
	05/14/92	2.20
	06/23/92	.30
	06/06/92	.85
	10/09/92	.66
6034	02/05/92	.17
	09/17/92	<.20
6060	11/19/91	<.1
	05/12/92	<.1
6062	06/25/92	7.72
	09/17/92	6.10
	09/23/92	7.14
7024	07/19/90	<.1
	03/20/91	<.1
7057	06/21/90	2.00
	07/02/90	2.40
7057 cont.	08/07/90	1.60
7065	07/19/90	<.1
	12/05/90	.08
	05/07/91	.47
7069	07/12/90	3.10
	07/25/90	2.50
7075	07/19/90	1.50
	04/10/91	3.50
7093	06/19/90	.65
	04/03/91	1.40
7097	04/30/91	1.23
	05/28/91	1.70
7104	06/20/90	<.1
	08/21/91	.81
Camden County		
8004	01/06/92	2.00
	02/08/92	2.80
8006	12/12/91	<1.0
	02/22/92	<.5
8040	04/23/91	<1.0
	06/24/91	<1.0
8041	12/13/90	<0.2
	02/27/91	<1.0
	03/08/91	<1.0
8043	11/26/91	<.5
	01/02/92	<.5
8044	11/19/91	<.5
	12/17/91	<.5
8069	12/17/91	1.10
	03/19/92	<.5
8076	02/22/92	5.80
	04/25/92	2.50
8088	12/11/91	3.30
	01/23/92	3.60
8114	11/29/91	3.00
	02/01/92	2.30
8124	12/10/91	<.5
	12/13/91	<1.0
	01/07/92	<.5
8129	12/05/91	2.0
	12/23/91	<.5
	01/29/92	1.7
8147	12/11/91	<.5
	01/02/92	<.5
8148	11/21/91	<.5
	12/24/91	<.5
8193	01/06/92	16.90
	02/12/92	20.90
8220	11/22/91	<.5
	12/19/91	<.5
8229	11/11/91	17.10
	12/04/91	20.40
	12/18/91	<.5
	03/18/92	2.0
8231	03/19/92	15.80
	04/06/92	21.70
8232	02/25/92	2.00
	04/22/92	2.10
8233	11/27/91	25.80
	12/26/91	<.5
8244	12/19/91	2.90
	01/29/92	<.5
	12/12/92	<.5
8253	12/13/91	<1.0
	05/07/92	8.3
8254	11/22/91	9.90
	12/28/91	7.30
8260	12/12/91	<1.0
	02/15/92	<.5
8283	11/07/91	3.00
	11/21/91	3.80
	12/30/91	5.30
	03/18/92	2.90
8301	12/06/91	1.90
	12/19/91	<.5
	01/07/92	8.10
	03/09/92	1.10
8309	12/10/91	.7
	12/12/91	<1.0
8310	11/15/91	<.1
	12/17/91	<.1
8311	12/11/91	<.5
	12/30/91	<.5
8352	11/26/91	2.80
	12/28/91	2.80
8420	12/10/91	<.5
	12/13/91	<.5
8522	07/13/90	<.2
	05/08/91	<.2
8584	01/10/92	<.2
	02/13/92	2.00
8588	12/10/91	4.10
	01/28/92	5.00
Cumberland County		
9002	04/19/91	<2.0
	07/09/91	<1.0
9003	04/19/91	2.55
	05/10/91	<2.0
9008	04/19/91	4.38
	05/10/91	4.70

Table 8. Mercury concentrations in water from wells sampled more than once,* 1988-92, southern New Jersey--Continued

Well identification number	Sample date	Hg concentration (µg/L)
Cumberland County--continued		
9008 cont.	02/13/92	0.32
9014	04/19/91	2.14
	05/10/91	<2.0
9021	08/28/87	<1.0
	08/03/90	3.5
	10/24/90	3.0
	02/13/92	1.13
9023	04/19/91	<2.0
	07/09/91	<1.0
9039	04/19/91	2.83
	05/10/91	<2.0
Ocean County		
11003	06/23/88	4.9
	08/25/88	3.8
11008	07/05/88	2.8
	08/25/88	4.3
12011	03/01/88	4.5
	03/15/89	4.8
Salem County		
13007	12/05/83	5.0
	01/05/84	4.0
	01/23/84	5.4
	02/20/86	4.6
	12/10/87	3.3
	03/18/88	4.0
13009	01/23/84	.9
	02/18/86	1.4
	01/13/88	5.2
	03/18/88	.9
13010	02/28/84	<.2
	02/18/86	<.2
13011	02/28/84	.4
	02/18/86	<.2
	03/18/88	.63
13012	02/18/86	<.2
	03/18/88	<.2
13013	02/16/84	1.0
	03/08/84	.8
	02/19/86	3.2
	03/18/88	.34
13014	01/17/84	4.0
	02/10/84	1.0
	02/18/86	.65
	03/18/88	<.2
13036	02/19/86	<.2
	12/10/87	<.2
	12/10/87	.3
	03/18/88	<.2
Salem County--continued		
13037	03/08/84	240.0
	11/07/84	43.3
	02/28/85	36.0
	05/08/85	36.1
	02/18/86	29.0
13039	03/08/84	.3
	03/23/84	.3
	02/20/86	<.2
	03/18/88	<.2
13040	02/19/86	<.2
	03/18/88	<.2
13041	12/02/85	8.3
	02/19/86	9.4
	03/18/88	6.9
13043	02/24/86	<.2
	03/18/88	<.2
13044	01/16/84	5.0
	01/23/84	2.3
	05/08/85	.65
	02/18/86	<.2
	12/10/87	1.2
	03/18/88	1.1
13046	12/10/87	<.2
	12/10/87	.3
	03/18/88	<.2
13047	03/13/84	.2
	02/18/86	<.2
	03/18/88	<.2
13048	12/10/87	.5
	03/18/88	.79
13050	03/08/84	59.0
	11/07/84	39.5
	02/28/85	41.0
	12/10/87	43.3
	03/18/88	42.0
13051	03/08/84	200.0
	11/07/84	6.9
	02/28/85	19.0
	05/08/85	11.3
	02/18/86	16.0
	12/10/87	10.7
	03/18/88	6.6
13052	12/10/87	.9
	03/18/88	<.2
Atlantic County		
16002	02/18/92	4.76
	03/25/92	4.16
16012	05/08/91	.86
	04/14/92	1.06
16027	09/18/91	5.91
Atlantic County--continued		
	11/06/91	0.22
	12/04/91	.3
	12/18/91	<.2
16032	08/27/91	4.28
	09/04/91	4.16
16040	09/18/91	.70
	02/04/92	11.28
16042	09/24/91	.19
	02/03/92	<.10
16059	07/28/92	4.66
	08/12/92	3.68
16063	08/18/92	8.39
	09/08/92	5.73
16071	09/24/92	4.60
	10/20/92	5.05
17102	10/24/90	<.1
	08/07/91	.68
18005	06/10/91	<.1
	09/03/91	<.5
	09/09/92	<.1
18016	07/03/91	<.1
	08/20/91	<.1
18020	07/23/91	.15
	03/04/92	<.2
18021	07/31/91	4.00
	08/14/91	.10
	10/09/91	.27
18026	06/25/91	.78
	03/12/92	8.52
18027	06/10/91	2.70
	06/25/91	2.75
18030	06/19/91	< .1
	03/23/92	.71
18034	06/11/91	.80
	03/25/92	.16
18036	09/17/91	<.1
	08/21/91	.81
	10/08/91	<.1
18041	09/10/87	<.2
	05/15/91	.46
	06/19/91	.16
	05/19/92	.61
18042	07/03/91	.77
	07/31/91	<.1
18045	05/07/91	.23
	06/25/91	<.1
18054	05/28/91	13.30
	06/14/91	12.90
	06/11/91	4.80
	07/10/91	1.97
18063	07/25/91	<.5
	02/24/92	<.1
20003	09/09/92	2.95

Table 8. Mercury concentrations in water from wells sampled more than once,* 1988-92, southern New Jersey--Continued

Well number	Sample date	Hg concentration (µg/L)
Atlantic County--continued		
20003 cont.	09/29/92	2.70
20005	09/09/92	9.21
	09/29/92	9.40
Ocean County		
22001	06/01/91	2.4
	06/10/91	2.4
	06/17/91	1.7
23002	08/04/87	4.0
	09/01/87	3.0
24001	01/23/91	2.7
	02/04/91	5.2
Cumberland County		
25001	09/13/87	17.0
	11/17/87	14.0
	02/02/88	13.4
25003	04/28/89	2.2
	07/19/89	1.0
25007	03/17/89	4.2
	04/28/89	3.8
Atlantic County		
28005	04/05/88	.42
	04/02/91	3.25
28012	04/19/89	.19
	01/09/90	<.1
28021	04/19/89	.33
	06/06/90	<.1
28029	04/19/89	.22
	04/10/91	.12
28056	04/09/89	.13
	06/19/89	.19
29013	02/24/92	1.91
	03/30/92	2.88
31019	09/18/91	3.97
	10/16/91	2.96
32002	08/12/91	5.22
	08/12/91	.33
	10/09/91	.39
Ocean County		
33002	02/29/88	2.3
	03/16/88	2.7
	03/17/88	3.9

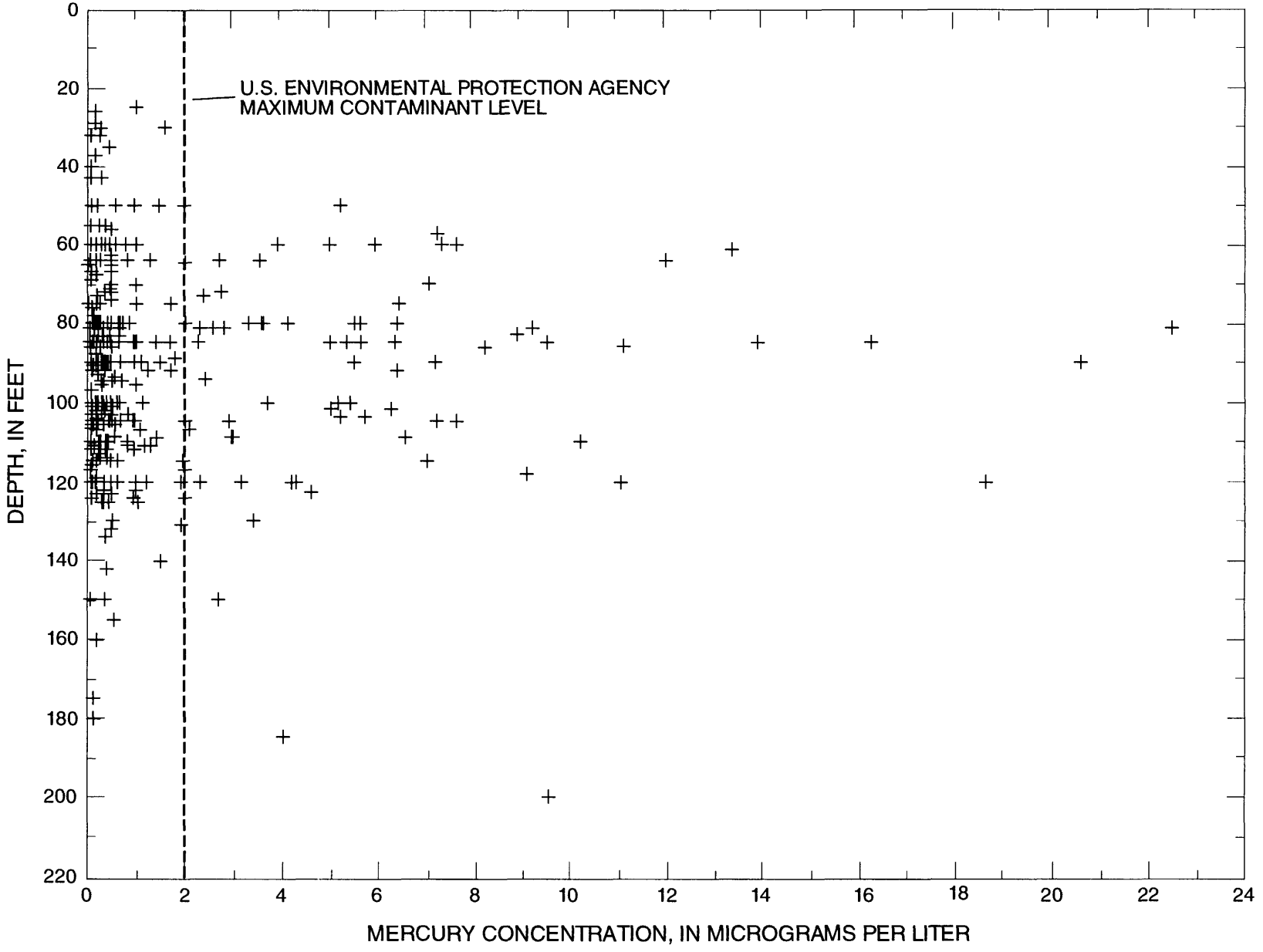


Figure 9. Relation of mercury concentrations to depth for 456 private wells screened in the Kirkwood-Cohansey aquifer system, New Jersey Coastal Plain.

Of the 456 wells in the data base for which depths are known, only 12 are less than 50 ft deep and, thus, are tapping water on the order of 8 to 10 years old. Mercury typically was not detected in water from these shallow wells, or concentrations were less than the USEPA MCL. The number of these shallow wells is too small to determine whether the mercury values are a representative sample. The median mercury concentration (0.2µg/L) for the shallow wells is less than or equal to the median concentrations for all wells in the site data base, by county, except for the six wells in Burlington County (table 5).

The mercury concentrations that exceeded the USEPA MCL were found in water from depths of 50 to about 200 ft, which indicates that much of the mercury entered the aquifer system from 10 to about 60 years ago, if an average depth to water of 25 ft at the sites and the distribution of time lines shown in the model (fig. 6) of Szabo and others (1993) are assumed.

Of the 168 wells in the USGS data base (see appendix 1b) not associated with the 34 sites of mercury-contaminated water, 47 were less than 50 ft deep. Mercury was detected in water from only three of these wells. Thirty of the wells were greater than 120 ft deep. Mercury was detected in water from only three of these wells, also. Because the concentrations of mercury detected in the water samples recorded in the USGS data base were, for the most part, collected during 1974-88, before ultra-clean sampling techniques were instituted, it is not known whether these concentrations accurately represent water quality at that time. Further, because most of the water samples in this data base were filtered before analysis, the mercury concentrations may be lower than they would have been had the samples been unfiltered.

In order to better determine whether mercury was currently detected in water from wells shallower or deeper than most of the affected wells in the data base, two USGS observation wells next to the Garden State Parkway in Ocean County, screened between 18 and 21 ft and 306 and 316 ft, and four Atlantic County municipal public supply wells, all screened at similar depths between 130 and 184 ft, were sampled by the USGS (data and locations are in appendix 2h). The public supply wells are located within 2 mi of several known sites of elevated mercury concentrations in ground water. Dissolved mercury was not detected in water from any of these wells. Four observation wells, two shallow (35 and 41 ft) and two deep (150 and 166 ft), in Wharton State Forest also were sampled during this study. None of these wells yielded water with detectable dissolved-mercury concentrations. In addition, the USGS resampled two monitoring wells, both less than 30 ft deep, at site 10 in Franklin Township, Gloucester County; dissolved mercury was not detected.

Twenty-two public supply wells in Atlantic, Camden, Cumberland, Gloucester, and Ocean Counties were sampled by the USGS in 1993. Of these 22 wells, 6, finished at depths ranging from 36 to 160 ft below land surface, yielded water in which mercury was detected in filtered water samples (Ivahnenko and others, 1996). It is possible that total-mercury concentrations in unfiltered samples would have been higher.

Although concentrations of mercury generally do not appear to be elevated in water from shallow wells or from very deep wells, this observation could, in some

cases, be an artifact of screen size and pumping rate. If contamination is localized at a particular depth, a large-capacity well with a screen larger than the vertical extent of contamination, or that draws from a larger volume of water than the contaminated volume, is likely to produce water in which the contaminant is diluted. Of the shallower wells sampled, the observation and monitoring wells typically have screened intervals of 10 ft or less, and draw water from a relatively small volume of the aquifer. The irrigation wells that have been sampled for mercury have screened intervals that exceed 10 ft in length; these wells typically are pumped at higher rates than are observation wells, monitoring wells, or domestic wells, and consequently draw water from a larger volume of the aquifer. The deep observation wells, like the shallow observation wells, have 10-ft screens and draw water from a relatively small volume of the aquifer. The public supply wells sampled during this study, which are deeper than most of the domestic wells sampled, have screened intervals of about 50 ft and pump at high rates, integrating water from a larger volume of the aquifer than do typical domestic wells, which commonly have screened intervals of 5 or 10 ft and pump sporadically at a lower rate.

Of the 211 wells from the 34 sites for which the screened interval is known, most of the wells yielding water in which mercury concentrations are elevated have screened intervals of 5 or 10 ft. Of the public supply wells sampled in 1993, the six yielding water with detectable concentrations of mercury had screened intervals ranging from 10 to 30 ft (Ivahnenko and others, 1996). The well yielding water with the highest concentrations (1.0 and 1.1 µg/L) was the shallowest (36 ft) and had the smallest screened interval (10 ft). This well is about 1 mi from site 34; another of the six public supply wells yielding water with detectable mercury is located adjacent to site 34, and a third is less than 1 mi from site 25.

Pumping from large-volume wells also may draw mercury-contaminated ground water deeper into the aquifer. At an apartment complex where the concentration of mercury in the ground water exceeded the USEPA MCL, a new, deeper well was drilled to 225 ft in 1989. Although this well initially yielded water with concentrations of mercury below the MCL, subsequent sampling after 6 months revealed that mercury concentrations had increased to slightly above the MCL (unpublished data on file at Atlantic County Division of Public Health, Northfield, N.J., and N.J. Department of Environmental Protection, Trenton, N.J.). (These data, which were received after the data base was constructed, are not included in appendix 1.)

Distribution of Mercury in Soils and Sediments

Soils and aquifer sediments in the study area were analyzed for mercury to determine differences between soils in undeveloped and developed areas (table 9) as well as the distribution of mercury. In undeveloped areas, which included Wharton State Forest, and a wooded area at site 2 (figs. 1 and 10), the soils are sands with well-defined horizons that typically include blackish, organic-rich sands at the surface (O horizon); coarser bleached, gray sand (A horizon); and orange to brown pebbly sand with some clay at depth (B horizon). In developed areas, some soils are composed of fill with the original soil horizons either buried or obliterated. The fill typically is a reddish-brown, iron-rich clayey sediment with some coarse pebbles. Soil profiles at some of the sites in residential areas showed evidence of poorly developed horizons, with organic matter in the surface soils and clayey sands beneath. Other profiles lacked an O

Table 9. Description of soil-sampling sites, New Jersey Coastal Plain

[-, no site number]

Sample number	Site number	Number of samples	Description of sampling site
1 -1	1	2	Residential area, roadside, Moss View Lane
1 - 2	1	2	Residential area, roadside, Lakeview Drive
1 - 3	1	1	Hammonton Lake, surficial sediments
1 - 4	1	1	Hammonton Lake, sediment near pumphouse
1 - 5	1	2	Residential area, roadside, corner of Moss View and Poplar
2 - 1	2	3	Open area with woods
2 - 3	2	2	Field across from residential area, Tremont Street
2 - 11	2	4	Drainage basin in commercial area
2 - 12	2	3	Wooded lot along Ridge Avenue
3 - 4	3	5	Athletic field
4 - 1	4	2	Cornfield belonging to organic farmer
4 - 6	4	2	Homeowner's yard, Birch Street
4 - 7	4	2	Homeowner's yard, Jackson Avenue
8 - 1	8	3	Yard of funeral home
8 - 2	8	3	Yard of dress factory
8 - 3	8	6	Backyard of homeowner
10 - 1	10	4	Backyard of former thermometer factory
WF - C1	-	core	Wharton State Forest
WF - 2	-	4	Wharton State Forest

horizon, organic matter from which appeared to be mixed with vestiges of an A horizon, indicating past disturbance. Because soil samples for mercury analysis were taken from points in the soil profile where characteristics such as color and texture showed changes from overlying soils, the samples were not collected at similar depths from location to location. This method of sampling gives a clear picture of changes in mercury concentration with change in soil characteristics, but makes comparison of concentrations as a function of depth between sampling locations difficult.

The aquifer sediments analyzed were from a core from site 6 and the deeper part of a core from site 10 (fig. 1). These sediments consisted primarily of sands, but clay lenses encountered during coring were analyzed as well. The site 6 core extended from land surface to a depth of 85 ft; the saturated zone was encountered between 7 and 8 ft below the land surface. The core at site 10 extended from land surface to a depth of 20 ft, and intersected the water table.

Undeveloped Areas

Four groups of soil samples were collected from what appeared to be undeveloped areas: two groups of samples from Wharton State Forest (samples WF-C1a,b,c,d, and e, and WF-2a,b,c, and d) (table 9 and fig. 10), and two groups from wooded lots at site 2 in Egg Harbor Township (samples 2-1a, b, and c, and 2-12a, b, and c) (table 9 and fig. 10)). The soils at Wharton State Forest, which were sampled by coring and by trenching, had well-developed soil horizons typical of the Lakewood and Lakehurst Soil Series (Markley, 1966, p. 84-85). Coring tended to blend the horizons, whereas the trenching method permitted each horizon to be sampled and was used for subsequent samples.

The soils sampled in woods along Ridge Avenue in Egg Harbor Township (2-12a, b, and c) also showed relatively well-developed soil horizons. In a nearby woods, however, the soil (2-1a, b, and c) had clearly been disturbed; virtually no organic matter was present in the surface soils, and the pH of the soil was higher than that of undisturbed soil, particularly in the orange sandy clay at a depth of 0.35 to 0.45 ft, where a pH of 10.13 was measured (table 10). The pH of the Ridge Avenue samples ranged from 7.53 at the surface to 5.13 in the gray sand of the A horizon. The soil horizons from which the Wharton State Forest samples were taken are all acidic, with pH's ranging from 5.06 in the O horizon, to 4.94 in the O/A horizon, 5.03 in the underlying bleached A horizon, to 5.31 at the top of the B horizon (table 10).

Mercury in the Wharton State Forest soils, which were sampled by horizon (samples WF-2a-WF-2d, table 10), was concentrated in the litter layer and in the B horizon. A similar distribution was found in the Ridge Avenue samples (2-12, a, b, and c, table 10), whereas the concentrations of mercury in the disturbed soil from the wooded area in Egg Harbor Township (2-1a, b, and c) over the depth range sampled were significantly less than those in the undisturbed soils, and mercury in the disturbed soils was distributed more or less evenly throughout the soil profile that was sampled.

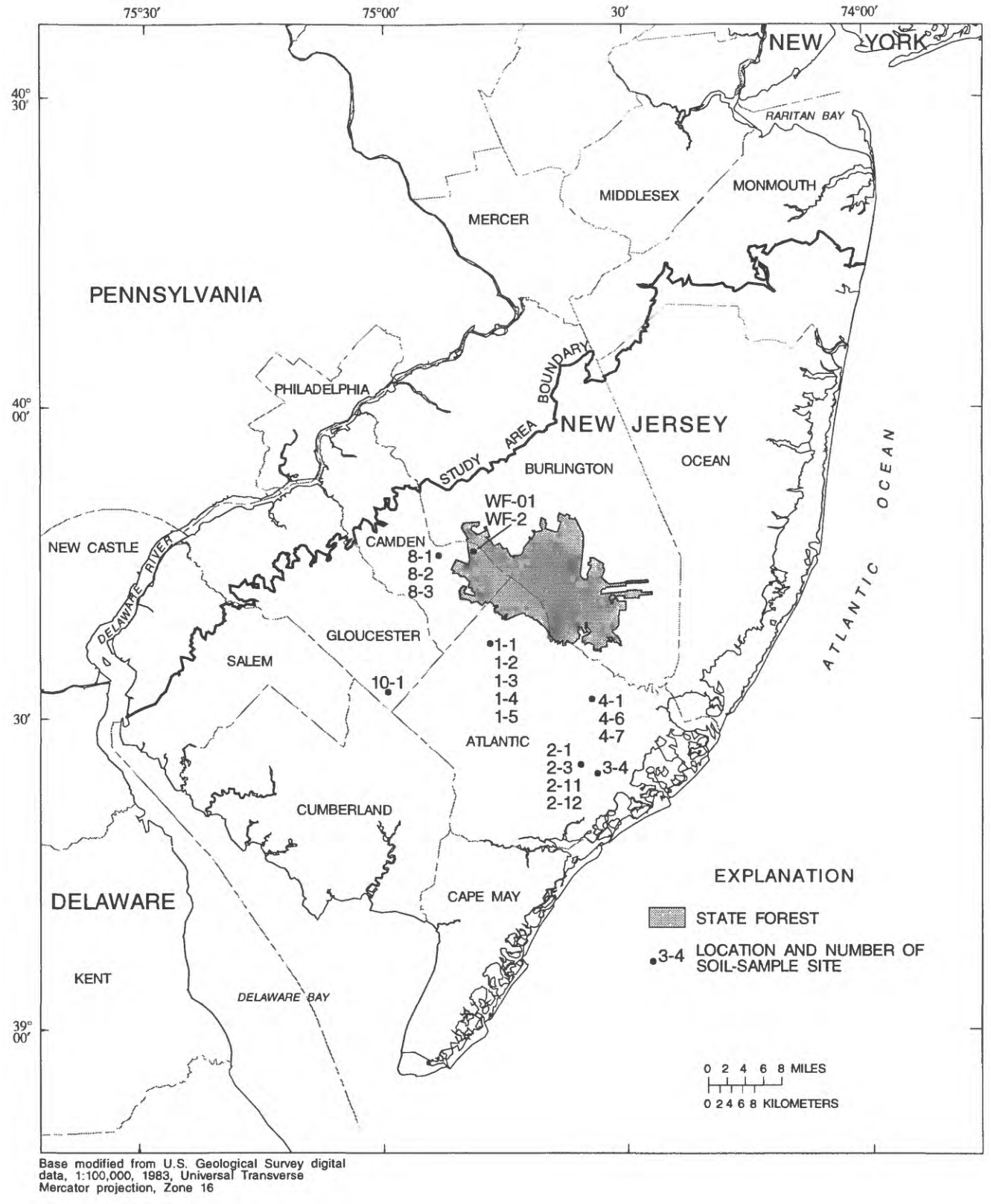


Figure 10. Locations of soil-sampling sites, New Jersey Coastal Plain.

Table 10. Concentrations of mercury in, and selected characteristics of, 19 sets of soil samples, New Jersey Coastal Plain

[Sample numbers begin with the site number; ft, feet; Hg, mercury; µg/kg, concentration in micrograms per kilogram; %, percent; LOI, loss on ignition; mg/g, milligrams per gram; OM, organic matter; NA, not analyzed; DUP, duplicate; <, less than]

Sample number	Town or township	Depth (ft)	Hg (µg/kg)	% LOI	OM (mg/g)	% moisture	pH	Description
1-1a	Hammonton	0-1.5	10.41	.69	6.93	2.52	4.46	Gray sand, organic debris, some clay, root hairs
1-1b	Hammonton	1.5-2.5	10.42	.37	3.74	1.31	5.12	Orange clayey sand, leaf debris
1-2a	Hammonton	0-0.4	16.19	2.81	28.09	8.06	5.26	Blackish sand, organic matter
1-2b	Hammonton	.4-1.5	13.24	.64	6.45	3.29	5.98	Yellowish-brown fine to medium sand, some clay, root hairs
1-3a	Hammonton	0-0.25	102.35	.38	3.80	20.38	6.11	Medium white sand, organic matter, green algae
1-4a	Hammonton	0-0.25	11.00	.99	9.87	14.43	5.21	Medium white sand, organic debris, algae-coated sand grains
1-5a	Hammonton	0-1.5	10.41	.55	5.55	2.64	4.46	Gray sand, some clay, organic matter, root hairs
1-5b	Hammonton	1.5-2.5	10.42	.37	3.74	1.96	5.12	Orange clayey sand, organic matter
2-1a	Egg Harbor	0-0.25	23.00	NA	NA	NA	7.75	Blackish sand, some pebbles, organic matter, root hairs
2-1b	Egg Harbor	.25-.35	13.26	NA	NA	NA	7.99	Reddish-brown, pebbly sand and clay, root hairs
2-1c	Egg Harbor	.35-.45	19.10	NA	NA	NA	10.13	Gray-brown pebbly sand
2-3a	Egg Harbor	0-0.9	19.42	NA	NA	NA	7.27	Blackish coarse pebbly sand, organic matter
2-3b	Egg Harbor	.9-1.5	39.09	NA	NA	NA	7.07	Yellowish-brown pebbly sand, root hairs
2-11a	Egg Harbor	0-0.1	14.32	1.96	20.06	7.81	5.09	Orange-brown coarse pebbly sand, some clay, root hairs
2-11b	Egg Harbor	.1-.35	14.02	1.85	18.99	9.11	4.97	Reddish-brown pebbly clayey sand, alumina clumps
2-11c	Egg Harbor	.35-.7	27.78	3.23	32.70	9.50	4.86	Blackish clayey sand, pebbles, organic matter, root hairs
2-11d	Egg Harbor	.7-1.0	38.06	3.32	33.68	8.78	4.86	Blackish sand, some pebbles, root hairs, organic matter
2-12a	Egg Harbor	0-0.3	114.00	NA	NA	NA	7.53	Blackish sand, organic matter, twigs
2-12b	Egg Harbor	.3-.7	11.03	NA	NA	NA	5.13	Gray sand, some organic matter
2-12c	Egg Harbor	.7-2.0	77.86	NA	NA	NA	5.53	Reddish-brown fine sand, some clay, organic matter, root hairs
3-4a	Egg Harbor	0-0.1	17.58	1.36	13.59	0.24	7.29	Tan coarse pebbly sand, root hairs
3-4b	Egg Harbor	.1-.2	6.60	0.86	8.56	1.50	7.52	Yellowish-brown coarse pebbly sand, some clay, root hairs
3-4c	Egg Harbor	.2-.45	36.83	1.81	18.10	6.19	5.23	Blackish pebbly sand, organic matter
3-4d	Egg Harbor	.45-.6	10.64	0.52	5.21	0.28	6.02	Tan coarse sand
3-4e	Egg Harbor	.6-1.0	22.00	1.38	13.77	5.72	5.37	Brown clayey sand
4-1a	Galloway	0-1.0	32.00	1.36	13.58	3.50	4.43	Blackish sand, root hairs
4-1b	Galloway	1.0-1.5	30.46	1.17	11.71	4.44	5.49	Brown fine sand, some clay
4-6a	Galloway	0-1.0	14.27	NA	NA	NA	5.83	Blackish fine sand, organic matter
4-6b	Galloway	1.0-1.5	22.92	NA	NA	NA	6.38	Yellowish-brown fine sand, some clay, root hairs

Table 10.--Concentrations of mercury in, and selected characteristics of, 19 sets of soil samples, New Jersey Coastal Plain--Continued

Sample number	Town or township	Depth (ft)	Hg (µg/kg)	% LOI	OM (mg/g)	% moisture	pH	Description
4-7a	Galloway	0-1.0	12.36	0.69	6.93	2.52	4.76	Blackish sand, organic matter, roots
4-7b	Galloway	1.0-1.5	20.80	1.14	11.44	6.69	5.35	Tan clayey sand, organic matter, root hairs
8-1a	Waterford	0-0.05	<30.0	2.29	22.93	0.79	5.69	Tan fine sand, few pebbles
8-1b	Waterford	.05-1.0	<30.0	2.79	27.92	8.85	5.39	Reddish-brown clayey sand
8-1c	Waterford	1.0-1.5	<30.0	4.22	42.23	11.36	4.89	Reddish-brown clay
8-2a	Waterford	0-0.3	<30.0	2.58	25.76	2.48	8.09	Brown fine sand, few small pebbles, organic matter
8-2aDUP	Waterford	0-0.3	<30.0	2.11	21.11	1.53	8.09	
8-2b	Waterford	.3-1.0	<30.0	1.63	16.35	6.31	7.30	Dark brown sand, some clay, organic matter
8-2c	Waterford	1.0-1.5	<30.0	2.08	20.8	6.63	6.78	Yellowish-brown clayey sand
8-3a	Waterford	0-0.4	<60	3.88	38.78	10.19	7.49	Sand, dark peaty organic matter, roots
8-3b	Waterford	.4-.6	<60	-2.23	-22.33	11.57	6.05	Bleached white sand, some roots
8-3c	Waterford	.6-.9	<60	4.03	40.32	7.65	5.30	Medium-brownish sand, organic matter
8-3d	Waterford	.9-1.0	<60	18.35	183.54	16.72	5.02	Brown silty sand, some clay
8-3e	Waterford	1.0-1.2	<60	2.25	22.50	3.43	5.52	Bleached fine white sand
8-3f	Waterford	1.2-3.0	<60	3.61	36.10	8.38	5.39	Reddish coarse sand, pebbles
10-1a	Franklin	0-0.25	NA	3.84	38.40	11.33	5.83	Black organic-rich soil, roots, plant debris
10-1b	Franklin	.25-.45	257.92	2.91	29.11	6.70	5.44	Reddish-brown sand, some clay, organic matter
10-1c	Franklin	.45-.85	137.42	2.49	24.90	10.61	5.56	Dark red silty fine clayey sand, little organic matter
10-1d	Franklin	.85-1.18	126.73	2.29	22.91	10.60	5.46	Coarse orange sand
WF-C1a	Waterford	0-0.5	97.20	NA	NA	NA	NA	NA
WF-C1b	Waterford	.5-.9	145.81	NA	NA	NA	NA	NA
WF-C1c	Waterford	.9-1.1	133.24	NA	NA	NA	NA	NA
WF-C1d	Waterford	1.1-1.5	101.12	NA	NA	NA	NA	NA
WF-C1e	Waterford	1.5-1.9	98.05	NA	NA	NA	NA	NA
WF-2a	Waterford	0-0.08	127.07	NA	NA	NA	5.06	Black, organic matter
WF-2b	Waterford	.08-.25	50.20	NA	NA	NA	4.94	Dark gray sand, organic matter
WF-2c	Waterford	.25-.75	63.78	NA	NA	NA	5.03	Bleached, gray sand
WF-2d	Waterford	.75-1.0	118.06	NA	NA	NA	5.31	Blackish sand, some clay

Developed Areas

The soils in developed areas showed signs of disturbance in that naturally developed soil horizons were buried or partially to completely obliterated over the depths at which soil samples were collected.

The concentrations of mercury in soils from developed areas (table 10) ranged from less than detection to 270 µg/kg mercury; the highest concentration was found in a soil located near the site of a former manufacturing (thermometers) facility. Some of the soils in the developed areas, including the soils currently used for farming (4-1a and b), are acidic, with organic-matter contents ranging from 3.74 to 183.54 mg/g. The pH's of a few sets of soil samples were either neutral or slightly alkaline (2-3a and b; 8-2a, b, and c); those of the surficial samples from several other sampled areas also had a neutral to slightly alkaline pH. By using a Spearman's correlation analysis, positive correlations were found between ranked mercury concentrations and both ranked organic-matter content and ranked percent moisture; the latter two characteristics were significantly correlated at the 0.005 level. No significant correlation between ranked mercury concentration and ranked pH was apparent, however.

Concentrations of mercury in the soils sampled are within the range reported in the literature for most soils, except those developed on cinnabar (mercury ore) deposits, or some histosols and paddy soils that contain elevated concentrations of mercury (Lindsay, 1979; Kabata-Pendias and Pendias, 1992). The mercury content of most soils ranges from 0.01 to 0.3 parts per million (10 to 300 µg/kg) (Lindsay, 1979, p. 7). The soil samples from the site of the former thermometer factory (part of site 10) contained the highest concentrations of mercury found in any soils sampled, either from undisturbed forested areas or from developed areas. But mercury concentrations in even these soils fall within the range of naturally occurring concentrations.

Cored Soil and Aquifer Sediments

Two cores of soils and aquifer sediments were collected, one by NJDEP at site 6 in Hammonton, Atlantic County, and the other by the USGS at site 10 in Franklin Township, Gloucester County. Results of analyses are shown in table 11. Analysis of the site 10 core, taken from 20 ft of mostly unsaturated zone at the site of the former thermometer factory, indicates that the mercury has not been strongly leached from the upper 3 ft of soil and apparently has not accumulated in the deeper parts of the unsaturated zone. The concentrations of mercury along the core profiles are shown in figure 11a. These concentrations are again within the range of mercury concentrations that occur naturally in sediments. Analysis of the aquifer sediments from the site 6 core demonstrated that elevated mercury concentrations were present in several clay-rich zones (fig. 11b). The highest measured concentration of mercury was about 100 µg/kg in a sample from a clay lens at a depth of 40 ft. Comparison with concentrations reported in the literature indicates that this concentration is within the natural range for clays. No trend in mercury concentration with depth was found in the site 6 core.

Table 11. Concentrations of mercury in soil and aquifer sediment cores from Hammonton Town, Atlantic County (site 6), and Franklin Township, Gloucester County (site 10), New Jersey Coastal Plain

[ft, feet; µg/kg, micrograms per kilogram; <, less than]

Sample number	Depth (ft)	Concentration (µg/kg)	Description
Hammonton Town, site 6			
MW5-1	8-10	17.38	Dark yellowish-orange fine sand; some clayey silt; trace dark red, medium gravel
MW5-2	18-20	8.71	Dark yellowish-orange, coarse, medium to fine sand; little clayey silt
MW5-3	28-30	16.25	Dark yellowish-orange fine sand, little silty clay
MW5-4	38-40	108.19	Dark gray clay, very loose
MW5-5	48-50	23.96	Light orange brown coarse to fine sand, trace silt
MW5-6	58-60	13.20	Dark yellowish-orange coarse to fine sand, trace fine gravel, trace clay
MW5-7	68-70	17.53	Light gray silty clay, loose; light yellowish orange coarse, medium to fine sand, trace silt
MW5-8	73-75	18.80	Pale yellow brown silty clay, light yellowish orange medium to fine sand, trace silt
MW5-9	78-80	27.07	Grayish orange, medium to fine sand; little clay
MW5-10	83-85	51.00	Grayish orange medium to fine sand, trace silt dark gray clay, 1-inch thick at 84 ft
Franklin Township, site 10			
1	1.65	31.08	Dark reddish-brown sand grading to finer sand and clay
2	3.54	32.17	Very coarse reddish-brown sand (quartz with iron-oxide coatings)
3	5.73	37.89	Coarse reddish to yellowish-red quartz sand; traces ilmenite
4	7.76	19.02	Medium sand with yellowish-red iron-oxide coatings; rare alumina nodules (<1 cm diameter)
5	9.63	34.38	Coarse to medium quartz sand with yellowish-brown iron-oxide coatings
6	11.8	38.81	Pinkish-red silt and clay
6A	11.8	25.01	Same as above
7	13.7	20.46	Light yellowish quartz sand; fine limonitic coatings
8	15.7	18.04	Medium sand; light yellowish oxide coatings
9	17.7	35.92	Same as above
10	19.6	12.02	Medium yellowish quartz sand; saturated

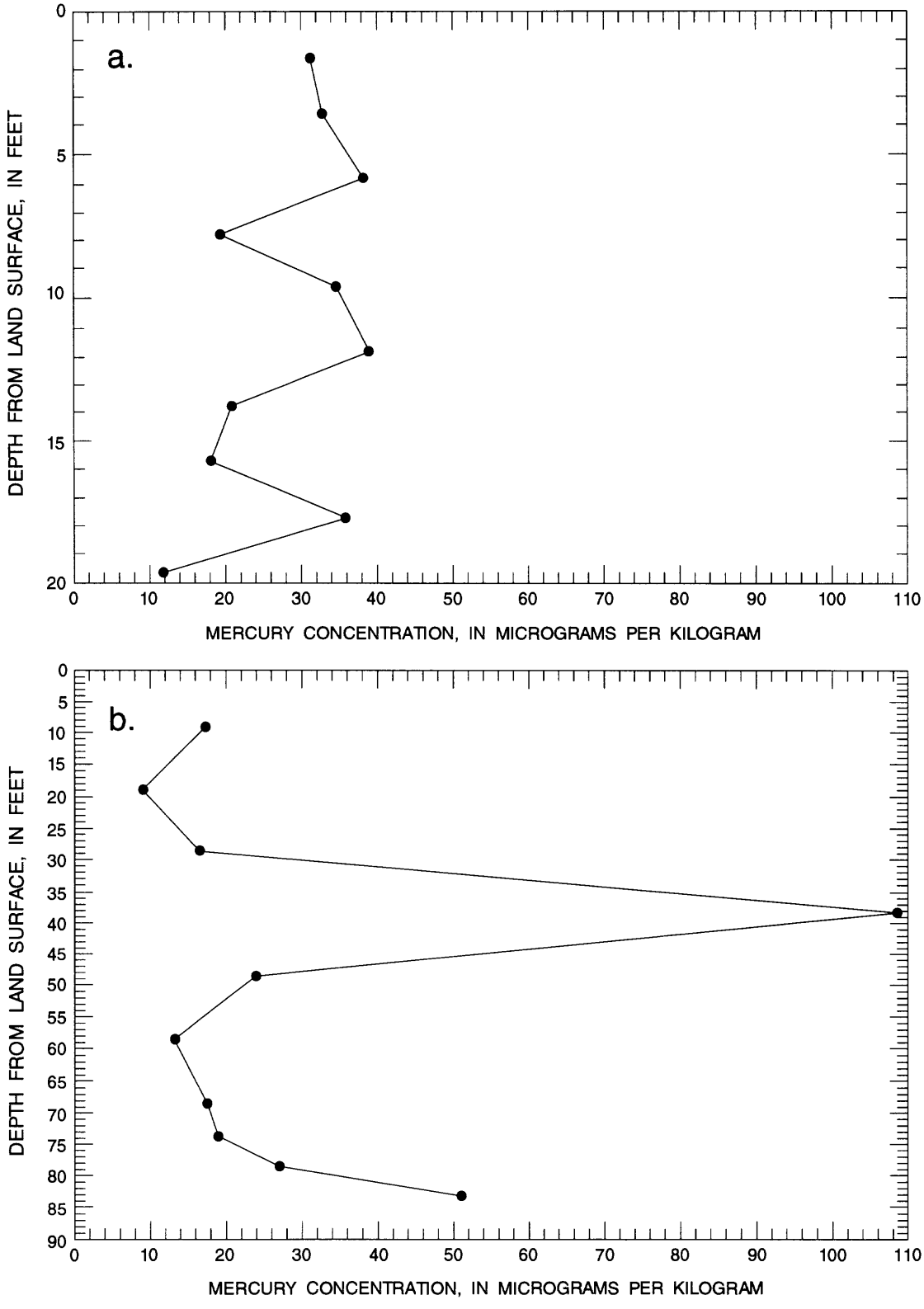


Figure 11. Concentrations of mercury in soil and aquifer sediments in a core from (a) site 10, Franklin Township, Gloucester County, and (b) site 6, Hammonton Town, Atlantic County, New Jersey Coastal Plain.

OCCURRENCE AND DISTRIBUTION OF MERCURY IN GROUND WATER AT SELECTED SITES

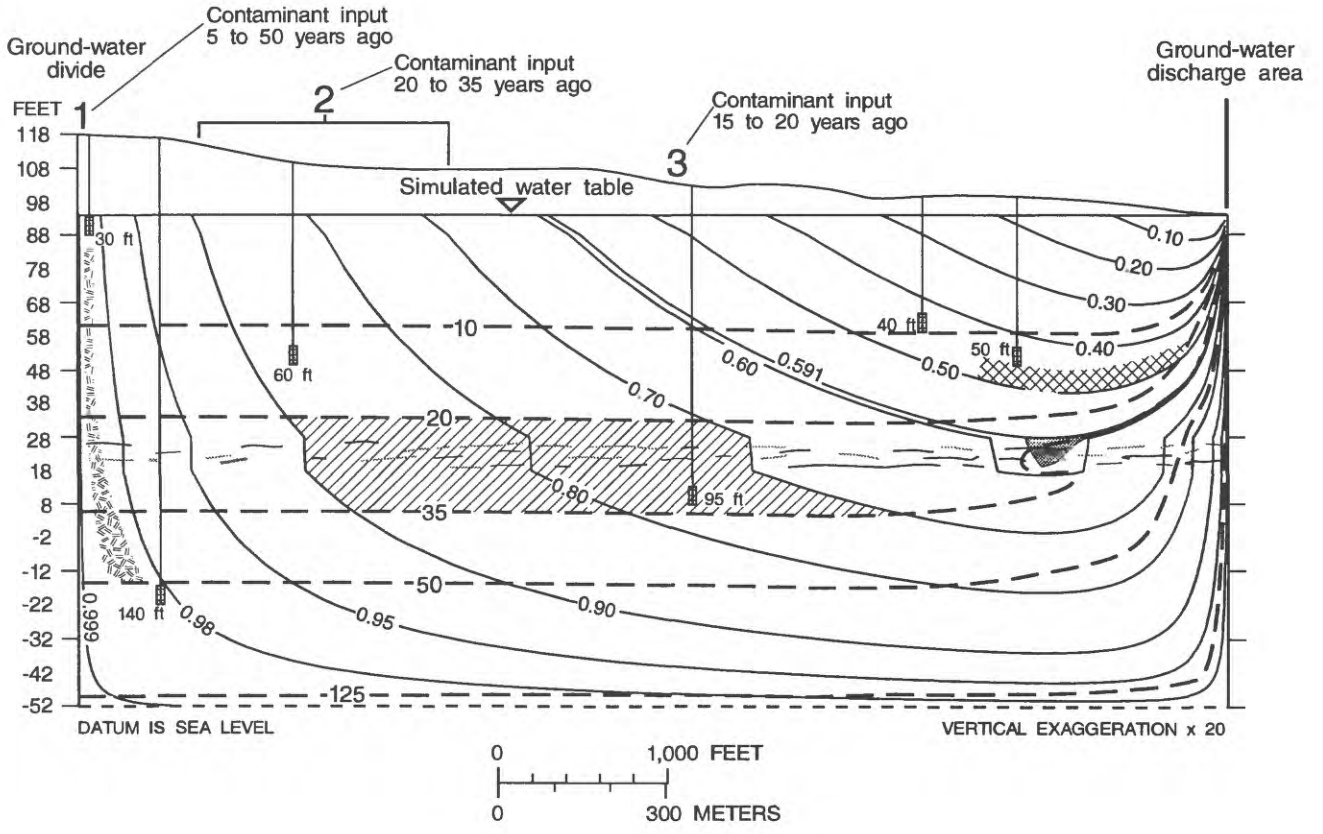
At the time the USGS study began, 13 of the 34 sites of elevated mercury concentrations in ground water had been identified, and characterization of the contamination at these sites by the NJDEP and county agencies had been completed or was near completion. Other sites were identified during the course of the study, but in some cases, investigation of the contamination was not complete by the end of the current study. Therefore, the following sections discuss the 13 originally identified sites, which are representative of the spectrum of land uses encountered at the 34 sites. NJDEP Ground-Water Impact Area Reports (unpublished reports on file at the N.J. Department of Environmental Protection) have been prepared for sites 1 through 9, 11, and 12. Site 13 had been investigated and reported on by the USEPA (unpublished memorandum on file at N.J. Department of Environmental Protection). Site 10 was investigated by the Gloucester County Health Department and by NJDEP, but no formal report was written. The USGS amplified the data for site 10 by conducting a land-use survey, resampling wells sampled during the earlier investigations, and sampling and analyzing soils at the site of the former thermometer factory.

As a preamble to the discussion of mercury in ground water at the 13 sites, examples of advective dispersal of contaminants in the aquifer from several hypothetical sources are given. The observed spatial distribution of mercury-contaminated ground water at the 13 sites needs to be considered in light of these factors.

Contaminant Distribution as a Function of Age of Ground Water and Location of Source

Ground-water age and flow paths are important factors in determining sources of mercury in ground water in the study area and in understanding the observed pattern of contaminant distribution at individual sites. Figure 12 depicts a section where hypothetical contaminant sources are imposed on the simulated ground-water flow system shown in figure 6. The unsaturated zone is assumed to be 25 ft thick at the divide. For this example, contaminated water is assumed to move advectively through the aquifer as a slug with no dispersion or retardation of the contaminant. No buildup of contaminant in soils is assumed; the contaminant is assumed to leach shortly after deposition. Starting at the divide the sources are (1) a point source that discharged contaminant sporadically from 5 to 50 years ago; (2) a nonpoint source that applied contaminant to the land surface from 20 to 35 years ago; and (3) a point source that discharged contaminant continuously during a 5-year period from 15 to 20 years ago.

Given the placement of the wells, the ages of water and dates when the contaminant was introduced at the surface, and the depicted flow system, none of the depicted wells currently taps the water contaminated by the point source at the ground-water divide (1). The contamination will reach the 140-ft-deep well near the divide, however. The well screened at 60 ft, installed in the area affected by the nonpoint source (2), does not now tap water affected by the contaminant, but a well



EXPLANATION

CONTAMINATED WATER--From point source (1) discharging contaminant sporadically 5-50 years ago

CONTAMINATED WATER--From nonpoint source (2) applying contaminant 20-35 years ago

CONTAMINATED WATER--From point source (3) discharging contaminant continuously 15-20 years ago

AREA OF SILT LAYER WITHIN THE KIRKWOOD-COHANSEY AQUIFER SYSTEM

AREA OF TRAVEL-TIME DISCONTINUTIY--Area where vertical ground-water flow component changes from downwards to upwards.

0.80 — STREAM LINE--Shows the simulated path of ground-water flow. Number is stream function.

10 — LINE OF EQUAL TRAVEL TIME--Number is simulated age of ground water in years. Interval is variable

BASE OF KIRKWOOD-COHANSEY AQUIFER SYSTEM

60 ft — SCREENED INTERVAL--Location of well screen and total well depth in feet.

Figure 12. Diagrammatic vertical section through the Kirkwood-Cohansey aquifer system in the New Jersey Coastal Plain showing hypothetical mercury sources at land surface, stream lines and and lines of equal travel time, and hypothetical distribution of elevated mercury concentrations in ground water tapped by various hypothetical wells.

screened at 95 ft farther downgradient is deep enough to tap the older, contaminated water. Farther downgradient in the system, the shallow 40-ft-deep well taps uncontaminated water, but the 50-ft-deep well taps water contaminated by the second, downgradient, point source (3). This hypothetical example illustrates that the location of contaminant sources affects the dispersal of the contaminant within the ground-water system, and the placement of a well screen affects the ability to measure the contaminant by sampling the water in the well.

Pumped wells introduce a perturbation into the flow system where flow lines are diverted to the well and ground-water velocities are increased (decreasing the age of ground water at depth). Were a large-volume public supply well to be added to figure 12, the flow lines would be substantially perturbed by pumping, and the distribution of contaminated water would change. Contaminants from sources farther from the divide travel farther in a horizontal direction than contaminants from sources closer to the divide. For example, the water contaminated by the nonpoint source (2) is still partly beneath the affected area; the water contaminated by the downgradient point source (3) has moved about 2,000 ft farther downgradient.

Distribution of Mercury

Of the 34 sites of elevated mercury concentrations in ground water identified previously and during this study, 31 encompass more than one well that was sampled. The distribution of mercury detections in samples from wells at most of these 31 sites generally is scattered, spatially. Typically, the detections reported consist of many cases of concentrations between 0.2 and 2.0 µg/L and several that are greater than 2.0 µg/L. At two sites (1 and 5), the mercury detections, particularly those that are greater than 2.0 µg/L, appear to be clustered. As in the hypothetical example shown in figure 12, the scattered distribution of mercury detections at most sites could be the result of wells at different depths tapping uncontaminated or contaminated water, depending on location. This scattered type of distribution can result either from a single source if wells of different depths tap into water of different ages and intercept different flow paths or from multiple sources of contaminants. Whether the source is single, generating a single "plume" of contaminated water, or multiple, generating several "plumes," cannot be determined from inspection of the areal distribution of mercury detections.

Occurrence of Mercury in Ground Water at Selected Sites

Site 1 - Hammonton Town, Atlantic County

Site 1 is located in a residential section of Hammonton Township, Atlantic County, near Hammonton Lake. From September 1991 through October 1992 the Atlantic County Health Department collected ground-water samples from 132 private wells in the area. The samples were analyzed for mercury and VOC's. Mercury concentrations in samples from 32 wells exceeded the 2 µg/L MCL at the most recent sampling, and ranged as high as 18.2 µg/L. Detectable levels of mercury below the MCL were found in an additional 82 wells. Mercury was not detected in samples from only 18 of the wells. Samples that contained mercury in elevated concentrations were collected from wells clustered in the central part of the site (fig. 13), although other samples in which mercury concentrations were elevated were collected from single wells or wells in small groups to the east, west, and south.

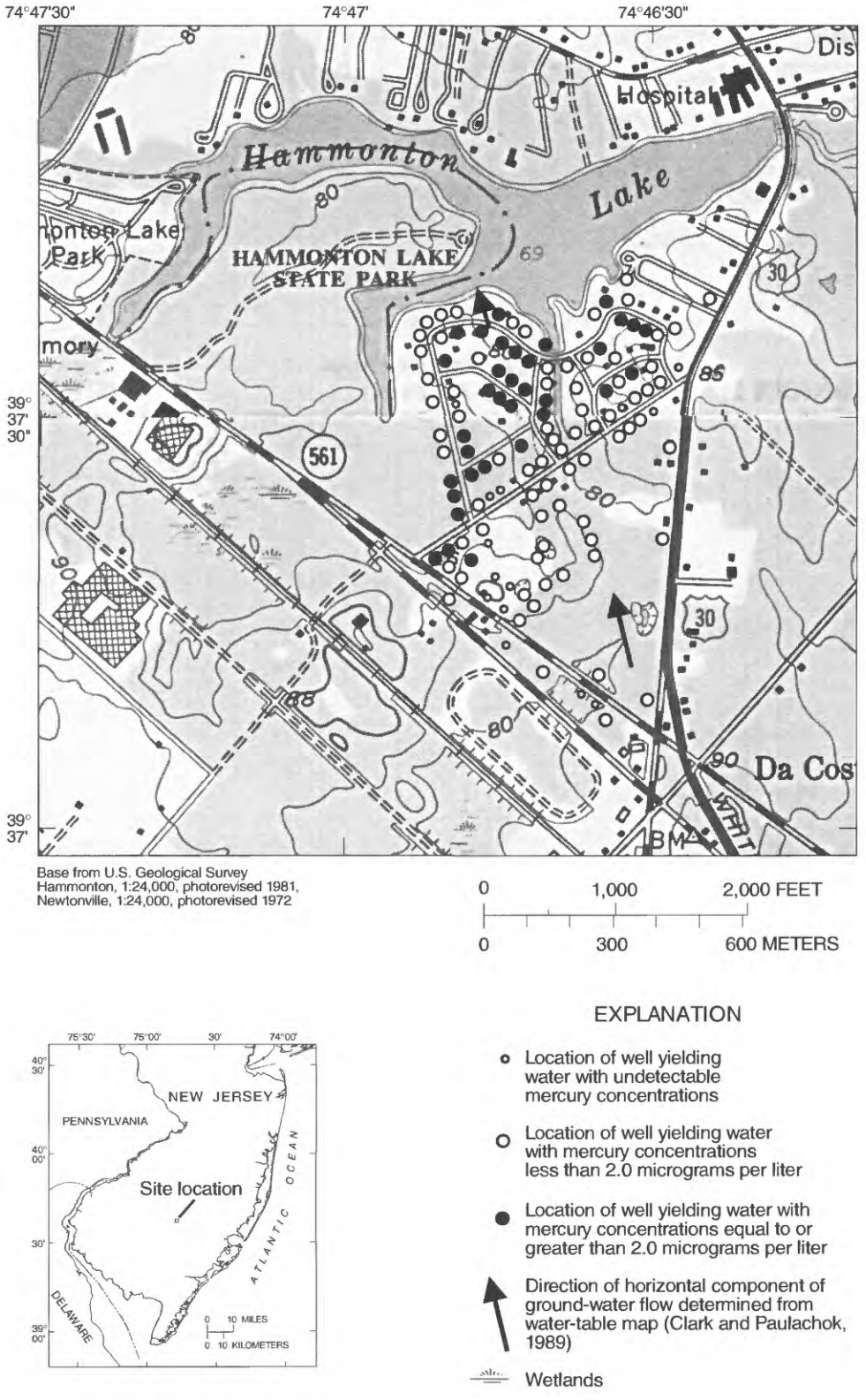


Figure 13. Concentrations of mercury in ground water from private wells at site 1, Hammonton Town, Atlantic County, New Jersey, and direction of the horizontal component of ground-water flow. (Modified from unpublished Ground-Water Impact Area Report, April 1992, on file at New Jersey Department of Environmental Protection, Trenton, N.J.)

Concentrations in samples from six wells exceeded USEPA MCL's for one or more VOC's including trichloroethene, 1, 2-dichloroethane, 1,1-dichloroethane, and benzene. Three of these six wells also yielded ground-water samples in which the MCL for mercury was exceeded. Detectable levels of VOC's below MCL's were found in an additional 12 wells.

Clark and Paulachok (1989) show that regional ground-water flow in the area is toward the north-northwest. Ground water likely discharges to Hammonton Lake, where flow directions are expected to be vertically upwards. This may help to explain the distribution of mercury concentrations observed at site 1. Figure 14 shows a vertical section with wells for which the depth is known, and a possible distribution of mercury concentrations.

Few possible point sources of mercury-contaminated ground water in the immediate area (2-mi radius) were identified through review of NJDEP files, county records, or a survey of the area. Possible point sources, such as a hospital and a cemetery, were noted on the opposite side of Hammonton Lake, a presumed hydraulic barrier. A golf-course area about 0.5 mi east of site 1 was developed in 1974. Aerial photographs from 1962 to the present indicate that the area was forested, with some agriculture, and that residential development near Hammonton Lake was present in the 1960's and continued to expand in subsequent decades. No aerial photographs prior to 1962 were available for the immediate area of site 1. Aerial photographs from the 1930's indicate the presence of a former munitions factory about 2 mi east of site 1. The water-table map by Clark and Paulachok (1989) indicates that ground water beneath this facility is unlikely to flow toward site 1.

Site 2 - Egg Harbor Township, Atlantic County

In a largely residential area (fig. 15), 237 private wells that yield potable water were sampled during 1988-92 by the ACHD and the NJDEP, for either VOC's, mercury, or both. Of the 216 private wells sampled for mercury at site 2, 28 yielded water with mercury concentrations exceeding the USEPA MCL of 2 µg/L. Concentrations in water from 15 wells at site 2 were greater than 5 µg/L and, of those, concentrations in water from 4 were greater than 10 µg/L. An additional 26 wells at the northwestern border of site 2 were sampled by the ACHD during 1990-92; of these, the concentration of mercury in the water sample from one well substantially exceeded the MCL (34.5 µg/L), but mercury concentrations were less than the MCL or undetectable in water from the other wells. These wells are included as part of site 2 for the purposes of this report, although they are not part of the original investigation conducted by NJDEP. Available data for site 2 indicate that mercury is detected in water from wells screened from about 50 to about 100 ft.

The VOC's detected in the private wells were tetrachloroethylene (PCE), trichloroethylene (TCE), 1,2-dichloroethylene and 1,1-dichloroethylene (DCE), and methylene chloride. PCE was the predominant organic contaminant; 11 percent of the private wells sampled yielded water containing PCE in concentrations exceeding the USEPA MCL of 1 µg/L. The highest concentration of PCE measured was 90.7 µg/L (unpublished Ground-Water Impact Area Report, June 1991, on file at N.J. Department of Environmental Protection, Trenton, N.J.).

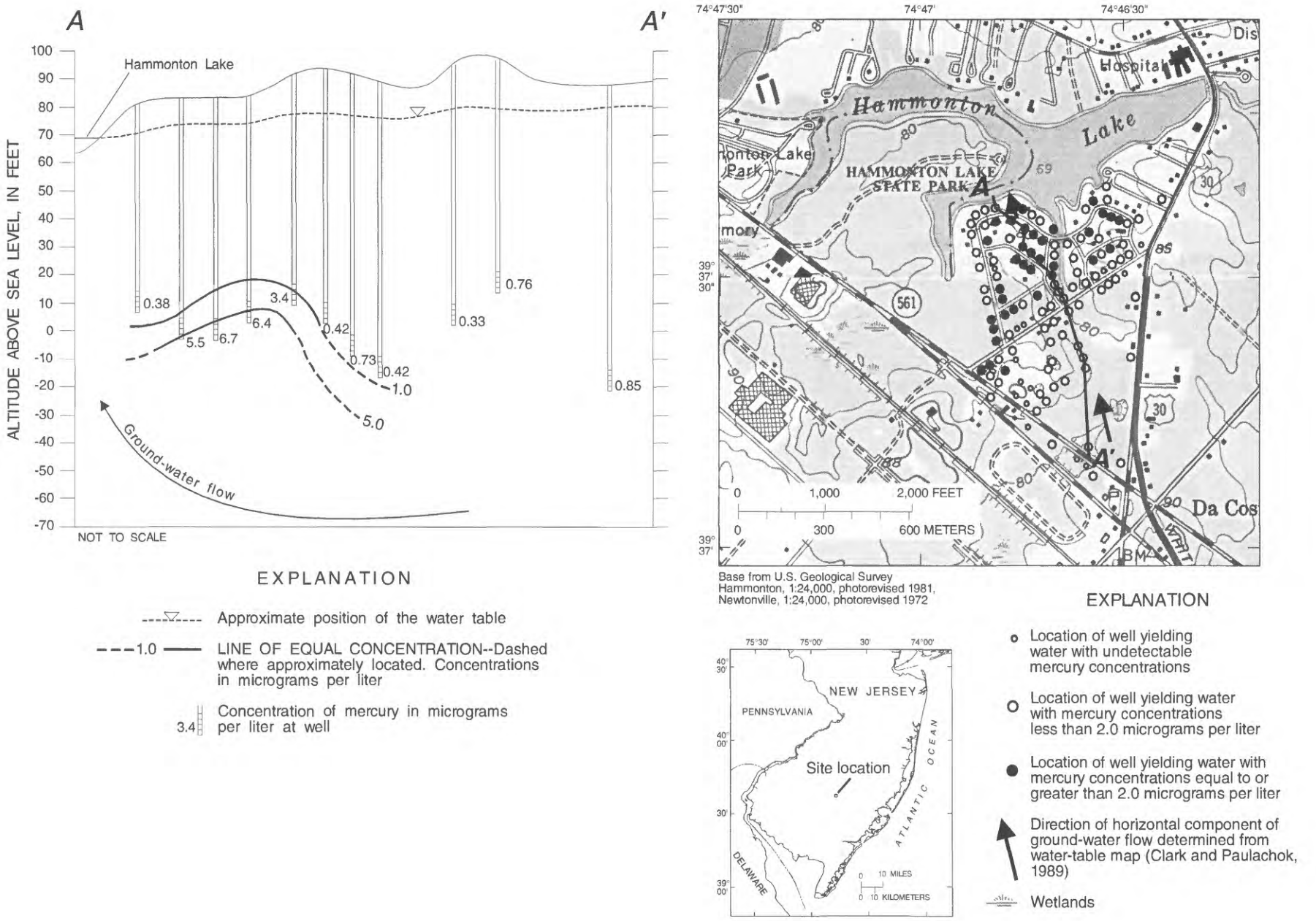


Figure 14. Vertical section through site 1, Hammonton Town, Atlantic County, New Jersey, showing wells, concentrations of mercury in water tapped by wells, and concentration contours indicating a possible distribution of mercury in the aquifer. (Line of section shown in accompanying map of site 1.)

A solid-waste transfer station is located near the center of site 2 (fig. 15); 12 monitoring wells at the station also were sampled during an NJDEP investigation of this facility. Buried drums containing hazardous substances were identified at the solid-waste transfer station. Results of analyses of water samples from the shallow monitoring wells (30 ft deep or less) at the station indicate that elevated concentrations of some VOC's (primarily toluene and 1,2-dichloroethene) were detected, whereas mercury was either undetectable or, in a few samples, tentatively identified at concentrations less than the reporting limit (Gregory Chin, N.J. Department of Environmental Protection, written commun., 1991). Subsequent sampling of wells at the waste transfer station under the NJPDES permit program in 1991 revealed that concentrations of mercury in water from four monitoring wells exceeded the MCL, ranging from 4.9 to 12.0 µg/L (see appendix 3, NJPDES permit number 80799).

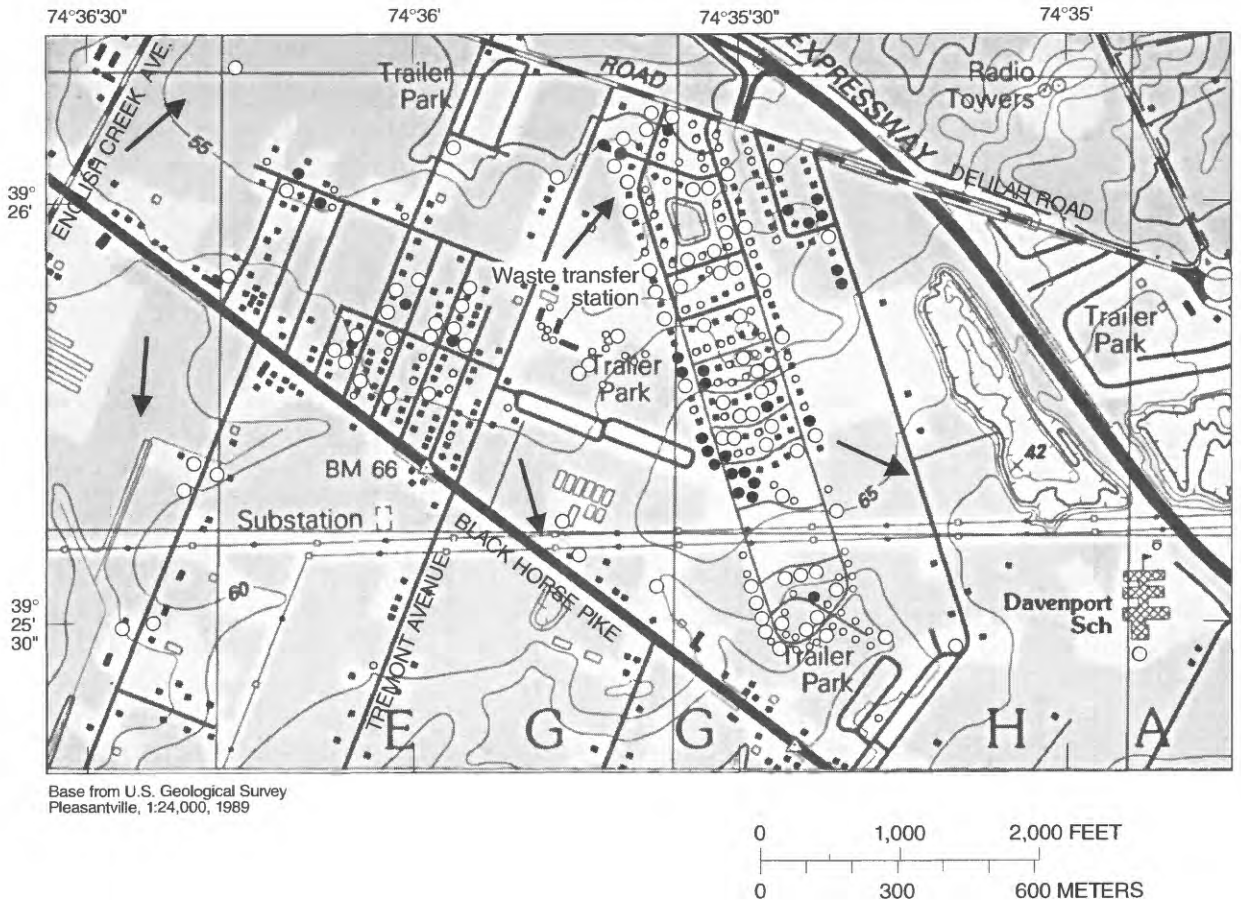
In its investigation of site 2, the NJDEP found that the extent of the mercury contamination is considerably greater than that of the organic contamination; VOC's are confined largely to ground water tapped southeast of the waste transfer station. A contamination site at a plastics company (N.J. Department of Environmental Protection, 1994) is located about 1 mi south-southwest of site 2. Ground water at the southern border of site 2 appears to flow south (Clark and Paulachok, 1989), toward the plastics-company site. A landfill is located about 1 mi northwest of site 2, but mercury concentrations in water from monitoring wells at the landfill have been found to be less than the MCL (see appendix 3, NJPDES permit number 54381). Ground water from the northern part of site 2 appears to flow north, toward the landfill.

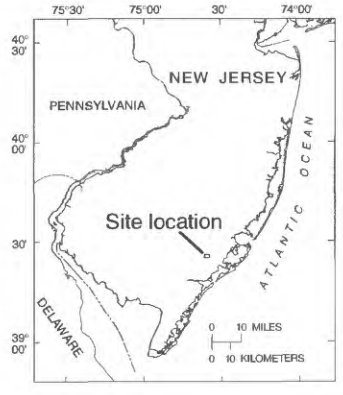
Although the area's hydrology is not known in detail, figure 15 shows the horizontal component of ground-water flow directions determined from the water-level map by Clark and Paulachok (1989). During the NJDEP investigation, ground water was determined from water-level data in monitoring wells to be flowing to the north at the waste transfer station. The extent to which pumping from the housing developments may have affected flow directions is not known, but because site 2 and the waste transfer station are on a local topographic high that forms a divide between several headwaters streams, ground water probably flows radially outward from these sites (fig. 15). The additional 26 wells referred to earlier are not shown on the map in figure 15, but are located just off the upper border of the map near the intersection of English Creek and Delilah Road.

Historic aerial photographs indicate that site 2 was agricultural before the housing developments were built. The area now occupied by the waste transfer station was previously a livestock farm and feed-manufacturing operation until the early 1960's, when the site was used for trash storage.

Site 3 - Egg Harbor Township, Atlantic County

Site 3 is located in a residential area of Egg Harbor Township (fig. 16). A former sanitary landfill adjacent to and east-southeast of the site has been converted to a baseball field. Mercury was identified in a ground-water sample from site 3 in December 1988. Subsequent sampling of more than 300 private wells by the ACHD has revealed that concentrations of mercury in the ground water range from undetectable (less than 0.2 µg/L) in 50 wells to 32 µg/L in 1 well; the latter well was resampled and yielded water with a mercury concentration of 15.79 µg/L. Eleven other





EXPLANATION

- Location of well yielding water with undetectable mercury concentrations
- Location of well yielding water with mercury concentrations less than 2.0 micrograms per liter
- Location of well yielding water with mercury concentrations equal to or greater than 2.0 micrograms per liter
- Direction of horizontal component of ground-water flow determined from water-table map (Clark and Paulachok, 1989)

Figure 15. Concentrations of mercury in ground water from private wells at site 2, Egg Harbor Township, Atlantic County, New Jersey, and direction of the horizontal component of ground-water flow determined from water-level data. (Modified from unpublished Ground-Water Impact Area Report, June 1991, on file at New Jersey Department of Environmental Protection, Trenton, N.J.)

wells yielded water with mercury concentrations between 10 and 25 µg/L, and another 47 wells yielded water with mercury concentrations between the MCL and 10 µg/L. Thirty-two wells in all were resampled and the samples analyzed by the ACHD; the results of the two sets of analyses compare favorably in all but three cases, where concentrations varied by more than 4 µg/L. The two sets of analysis results are included in table 8. The distribution of mercury concentrations is shown in figure 16, where, because of the large number of wells sampled at site 3 and the density of housing, each symbol on the map represents the well yielding water with the highest concentration of mercury detected in the half of a city block in which the well is located.

As part of an investigation of site 3 by the NJDEP, three sets of monitoring wells were installed, with one shallow and one deep well in each set. The shallow wells were 75 ft deep; the deep wells ranged from 113 to 139 ft in depth. The wells were sampled in 1989, and mercury was detected in water from two of the deep wells, at concentrations of 1.4 and 2.1 µg/L. Samples from these wells also were analyzed for VOC's. Toluene was detected in water from all the wells, but in subsequent sampling toluene was detected in only one shallow well at a concentration similar to that found in the previous sample; toluene in samples from the other wells was reported either as undetectable, or in estimated concentrations below the usual method detection limit.

Although well-construction data could not be found for many of the wells at site 3, available data indicate that wells at site 3 are screened at depths that range from about 60 to about 130 ft below land surface. Mercury was detected in water tapped by private wells over this entire depth range, but was not detected in the shallow (75 ft) monitoring wells installed at the site. A mercury concentration of 1 µg/L was measured in 1989 in a sample from one of three monitoring wells at the former landfill.

During the NJDEP investigation of site 3, ground water was determined to flow southeast (fig. 16). Thus, ground water flows from most of the affected private wells towards the former landfill. Another landfill, the site of a Superfund investigation, is located about 1 mi east of site 3. The ground-water flow direction at this landfill also appears to be toward the east, away from site 3 (unpublished data on file at N.J. Department of Environmental Protection, Trenton, N.J.). Private wells to the southwest, south, and southeast of this landfill were sampled as part of an investigation in 1986; water from five wells was found to contain various VOC's, and mercury in concentrations that exceeded the MCL. These wells are about 0.6 mi east of site 3, but are less than 0.5 mi north of site 28.

Aerial photographs indicate the area at site 3 was partly forested, partly agricultural, and partly residential by 1951; that residential development increased in the decade between 1951 and 1962; and that the neighboring stretch of the Garden State Parkway was completed in that same decade. By 1974, a trailer park had been added, and there was no further evidence of agricultural activities.

Site 4 - Galloway Township, Atlantic County

Site 4 is located on a local topographic divide in western Galloway Township, Atlantic County, between Route 30 and Route 561 (fig. 17). The area is largely residential, characterized by single-family housing with a few commercial properties

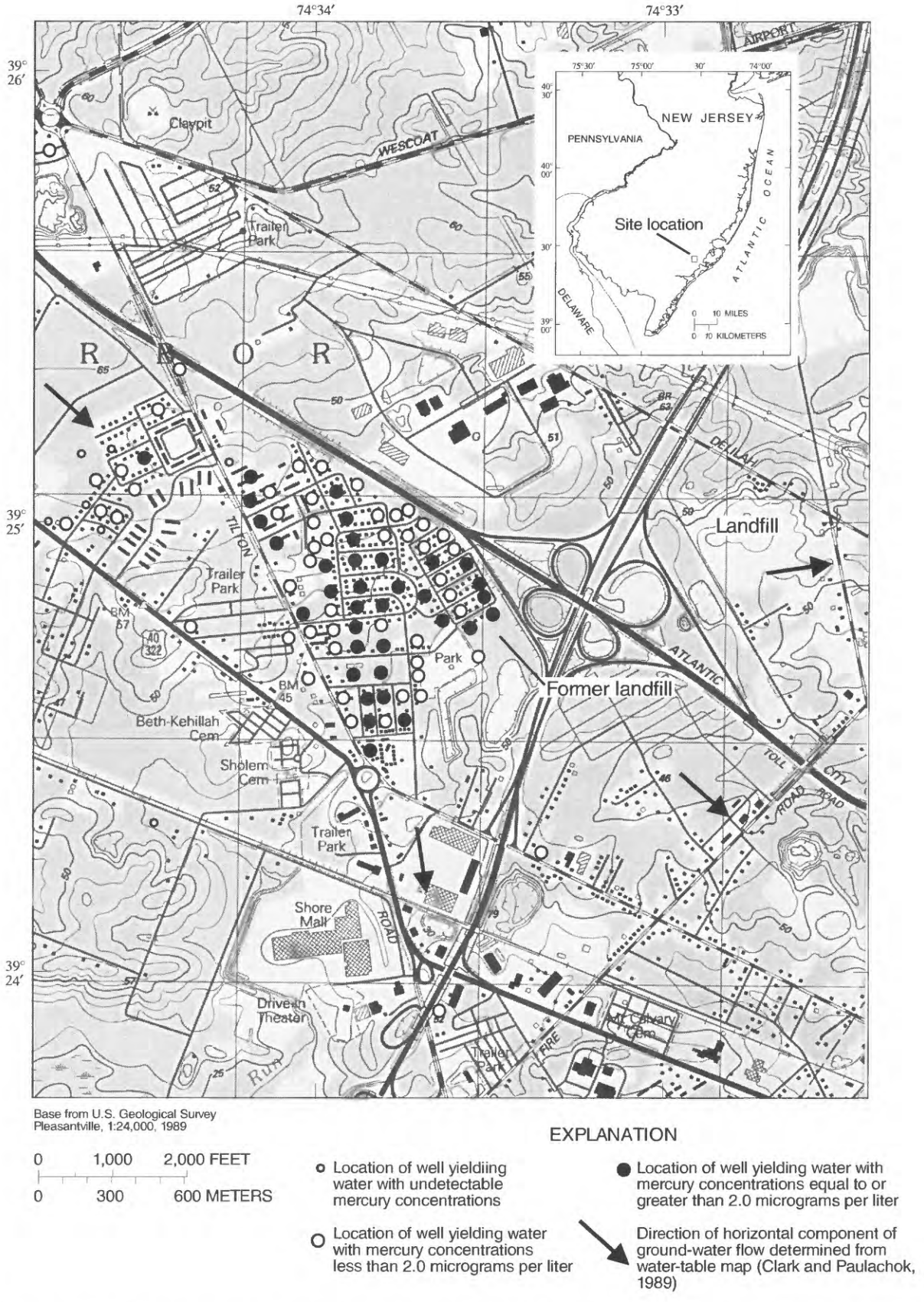


Figure 16. Concentrations of mercury in ground water from private wells at site 3, Egg Harbor Township, Atlantic County, New Jersey, and direction of the horizontal component of ground-water flow. (Modified from unpublished Ground Water Impact Area Report, May 1990, on file at New Jersey Department of Environmental Protection, Trenton, N.J.)

served by individual wells and septic systems. From August 1990 to February 1992, ground-water samples were collected from 76 private wells in the area by the ACHD. All samples were analyzed for mercury; most were also analyzed for VOC's. Mercury concentrations in samples from 12 wells exceeded the 2.0 μg/L MCL and ranged as high as 13.87 μg/L. Detectable levels of mercury below the MCL were found in water from an additional 30 wells. Mercury was not detected in water samples from 32 wells. The geographic distribution of mercury at the site, shown in figure 17, indicates that elevated mercury concentrations are clustered in several areas.

Samples from four wells exceeded MCL's for one or more VOC's including PCE and methylene chloride. Two of these four wells also yielded ground-water samples in which mercury concentrations exceeded the MCL. Detectable levels of VOC's below MCL's were found in water from an additional 12 wells.

Water-level data compiled by the USGS (Johnson and Watt, 1996) show that regional ground-water flow at the site is toward the southwest. Locally, shallow ground water likely discharges southwestward to the wetlands surrounding the headwaters of Babcock Creek, but because the site is situated at a topographic divide that is probably a local ground-water divide as well, water from the area northeast of the site likely flows northeast toward the Mullica River.

No known point sources of mercury-contaminated ground water within 2 mi of the area were identified through review of NJDEP files, county records, or a survey of the area. A Superfund site, approximately 2 mi southeast of site 4, was not considered a possible point source of mercury at site 4 because the ground-water flow direction is toward the east-south east at the Superfund site (U.S. Environmental Protection Agency draft Record of Decision, September 4, 1990, on file at N.J. Department of Environmental Protection, Trenton, N.J). Monitoring wells at a china-manufacturing site, approximately 0.5 mi south-southeast of site 4, yield water in which mercury typically is not detected (see appendix 3, NJPDES permit number 5177). Aerial photographs from 1951 to 1991 indicate that the site 4 area was agricultural with row crops and orchards; residential development occurred from 1951 to 1962, and development continued during 1962-74.

Site 5 - Galloway Township, Atlantic County

Site 5 is located in a residential area of Galloway Township, Atlantic County (fig. 18). The Federal Aviation Administration Technical Center (formerly National Air Facilities Experimental Center, or NAFEC)-Atlantic City International Airport is located southeast of the site. A private well sampled in 1988 yielded water with a mercury concentration of 3.9 μg/L. Subsequent sampling of this well and 131 other private wells by ACHD during 1989, 1990, and 1991 revealed the presence of detectable VOC's and/or mercury in water samples from nearly one-third of these wells. Water from 29 wells was found to contain contaminants in concentrations that exceeded the respective MCL's. The VOC's detected were primarily PCE and TCE. Mercury concentrations that exceeded the MCL were found in the initial water samples from 18 of 130 wells; concentrations ranged from 2.42 to 8.87 μg/L. Confirmatory sampling at 23 wells generally yielded similar results in most of these samples, although mercury concentrations in three of these samples were below the MCL and in two cases were undetectable (table 8). Unlike many of the other sites, the wells yielding water with mercury concentrations above the MCL are clustered in one area at site 5 (fig. 18).

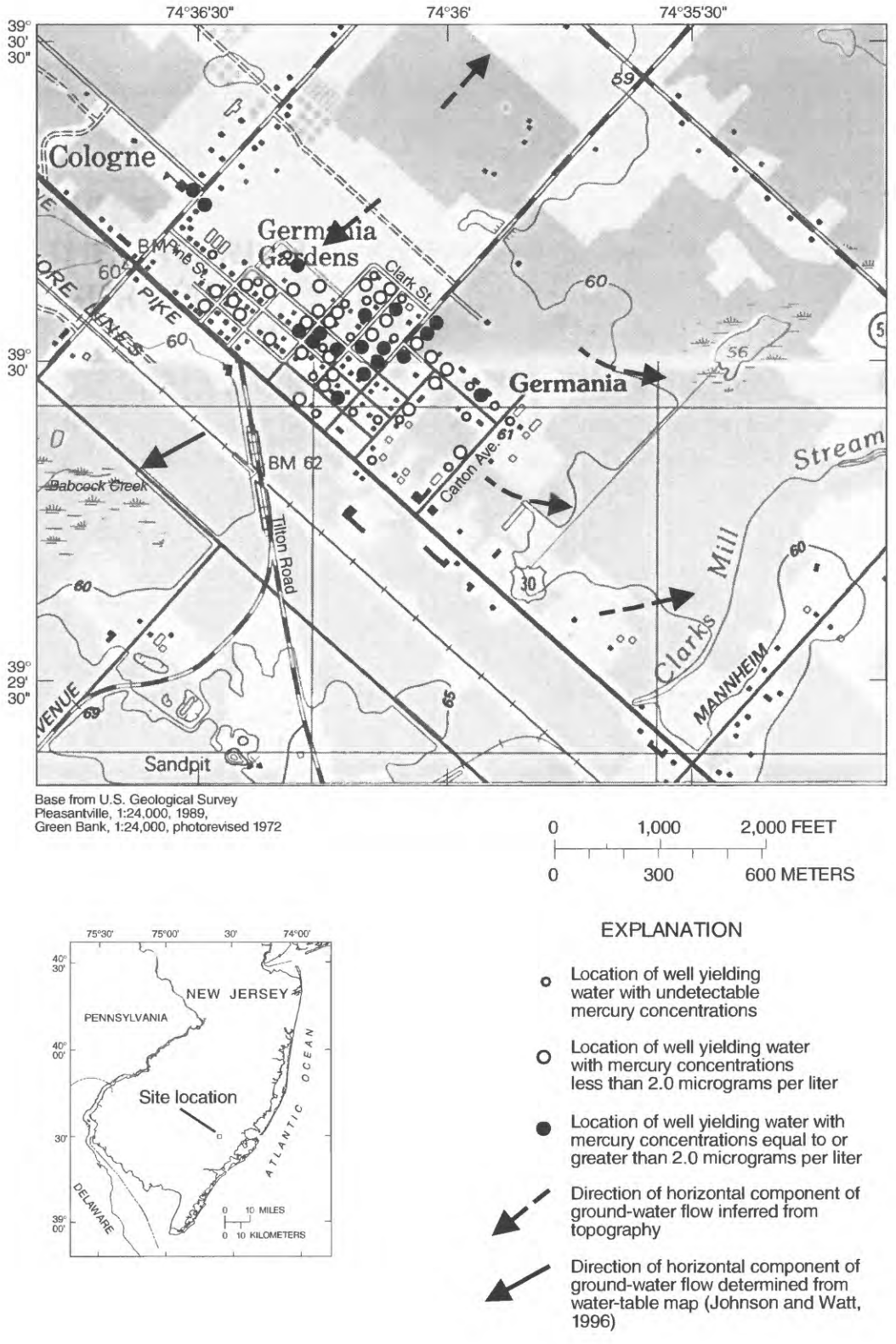


Figure 17. Concentrations of mercury in ground water from private wells at site 4, Galloway Township, Atlantic County, New Jersey, and direction of the horizontal component of ground-water flow inferred from topography and determined from water-table map. (Modified from unpublished Ground Water Impact Area Report, December 1992, on file at New Jersey Department of Environmental Protection, Trenton, N.J.)

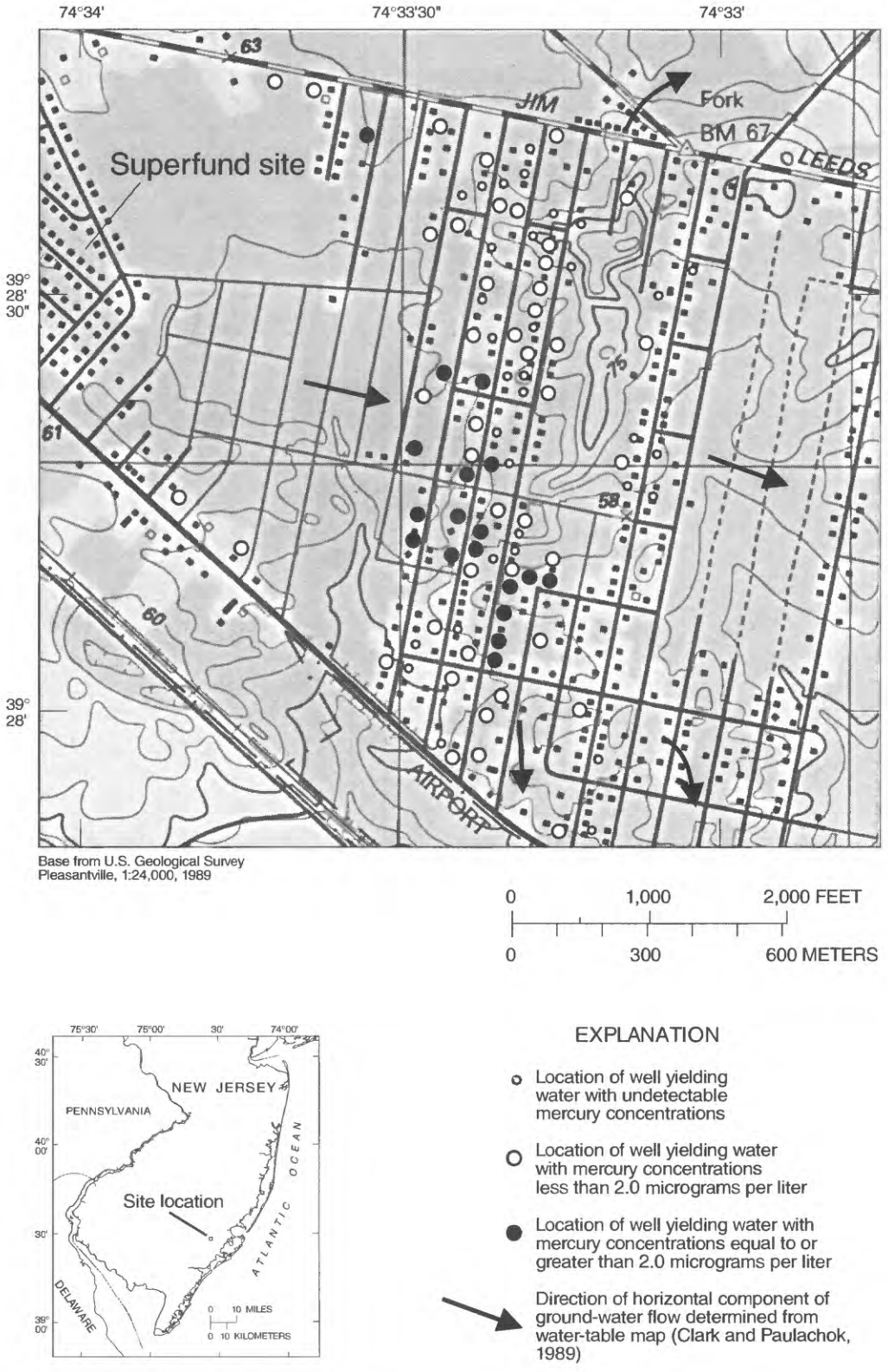


Figure 18. Concentrations of mercury in ground water from private wells at site 5, Galloway Township, Atlantic County, New Jersey, and direction of the horizontal component of ground-water flow. (Modified from unpublished Ground-Water Impact Area Report, October 1991, on file at New Jersey Department of Environmental Protection, Trenton, N.J.)

Two other sites with contaminated ground water are near or adjacent to site 5. VOC's had previously been detected in water from private wells in a residential area about 1.5 mi east of site 5; no mercury concentrations have been reported for ground water from that area. A Superfund site (discussed in the previous section) at which ground water had been found to be contaminated with VOC's is located about 1,000 ft west of the border of site 5. The primary organic contaminants at the Superfund site are benzene and various chlorinated solvents such as TCE. Benzene and other petroleum constituents (ethyl benzene, toluene, xylenes) were found in ground water from the eastern part of the Superfund site, and were believed to emanate from gas stations and an automobile junkyard (unpublished U.S. Environmental Protection Agency draft Record of Decision, September 4, 1990, on file at N.J. Department of Environmental Protection, Trenton, N.J.). The draft report indicates that the chlorinated solvents could have derived from a former dry-cleaning establishment as well as use of septic-system cleaners.

Water from 20 wells at site 5 was sampled during the Superfund investigation; 5 wells were found to yield water that contained mercury in concentrations above the MCL. Subsequent resampling resulted in two of the five wells yielding water containing mercury in concentrations of 3.9 and 4.0 µg/L. Lead was also detected in water from some of the 20 wells sampled during the Superfund investigation, but none of the concentrations exceeded the 50-µg/L MCL then in effect (unpublished U.S. Environmental Protection Agency draft Record of Decision, September 4, 1990, on file at N.J. Department of Environmental Protection, Trenton, N.J.).

Ground water in the vicinity of site 5 flows mostly toward the east and east-southeast, but locally flows toward the north and south and discharges to flanking streams (Clark and Paulachok, 1989) (fig. 18). Assessment of ground-water flow direction at the Superfund site also indicates that the horizontal component of flow is to the southeast (unpublished U.S. Environmental Protection Agency draft Record of Decision, September 4, 1990, on file at N.J. Department of Environmental Protection, Trenton, N.J.).

The history of land use at site 5 is similar to that at sites 2 and 3. Part of the land was forested, part under cultivation in the 1950's. Agriculture decreased during the 1960's as residential development increased.

Site 6 - Hammonton Town, Atlantic County

Site 6 is a residential area located southeast of the downtown area of Hammonton, Atlantic County (fig. 19). Site 6 consists of single-family homes clustered in a rural area where land use is largely agricultural and low-density residential.

Water samples from wells at 72 homes were collected and analyzed for mercury in 1991 and 1992 by ACHD, NJDEP, and a private laboratory; of the 72 wells, 13 yielded water that contained mercury in concentrations that exceeded the MCL on the initial sampling. The highest concentration of mercury encountered was 72.0 µg/L, although prior sampling of the well for which this concentration was reported (18 times from November 1991 through September 1992) had yielded concentrations that ranged from 19.0 to 60.7 µg/L, with a median of 35.0. The last reported sampling of this well,

1 day after the sample containing 72.0 µg/L was collected, yielded a sample containing 2.2 µg/L of mercury (see table 8). The most recent samples from site 6 indicate water from 10 wells contains mercury in concentrations that exceed the MCL.

Various VOC's--primarily PCE, TCE, 1,1-dichloroethylene, and cis-1,2-dichloroethylene--were detected in water from some of the wells sampled; MCL's for these compounds were exceeded in samples from five wells. Overall, the instances of VOC contamination were few and geographically scattered, in contrast to the instances of mercury contamination.

Five monitoring wells were installed by NJDEP at the site; water from one well contained mercury in a concentration that exceeded the MCL, but VOC's were not detected in water from these wells. Ground water at site 6 was determined to flow south, on the basis of water levels measured in the monitoring wells (fig. 19). Water-table mounding was observed at a well that is located near two domestic wells that yielded water with the highest mercury concentrations measured at site 6. The mounding was attributed to septic-system usage (unpublished Ground-Water Impact Area Report, June 1993, on file at N.J. Department of Environmental Protection, Trenton, N.J.).

Site 1 is located approximately 1 mi northeast of site 6; an industrial park also is located to the northeast. The immediate area surrounding site 6 has remained relatively rural, however. In the 1950's, agriculture and undeveloped land were primary land uses. A few houses were built in the 1960's, and development increased slightly during the 1970's. No possible point sources for contamination are evident in the past history of land use at site 6, and no likely point sources are apparent today.

Site 7 - Egg Harbor Township, Atlantic County

Site 7 is located in Atlantic County in a largely residential area of Egg Harbor Township (fig. 20). A sanitary landfill is located to the east of site 7, and a gravel pit at which monitoring wells have been installed also is located east of the site. A private well sampled in February 1989 was found to yield water containing VOC's. The ACHD subsequently sampled 125 wells in the area during 1990 and 1991; water samples were analyzed for VOC's and/or mercury. Most of the wells sampled yielded water in which VOC's and mercury were detected. The VOC's detected included PCE, 1,1-dichloroethylene, methylene chloride, and chlorobenzene. In some water samples, concentrations of one or more VOC's were found to exceed the MCL's for those compounds. The highest mercury concentration measured was 3.5 µg/L. Of the 77 wells sampled for analysis of mercury, four wells were found to yield water with mercury concentrations above the MCL, and subsequent sampling of these wells confirmed that mercury was present in elevated concentrations in the ground water tapped by these wells. Wells at this site that yielded water with detectable concentrations of mercury are distributed over a larger area than are the wells that yielded water with detectable concentrations of VOC's (Gregory Chin, N.J. Department of Environmental Protection, written commun., 1992).

Ground-water flow directions determined from a recent water-table map of the area (Watt and Johnson, 1992) indicate that ground water at the site generally flows south. Water-level data from monitoring wells installed at the gravel pit to the

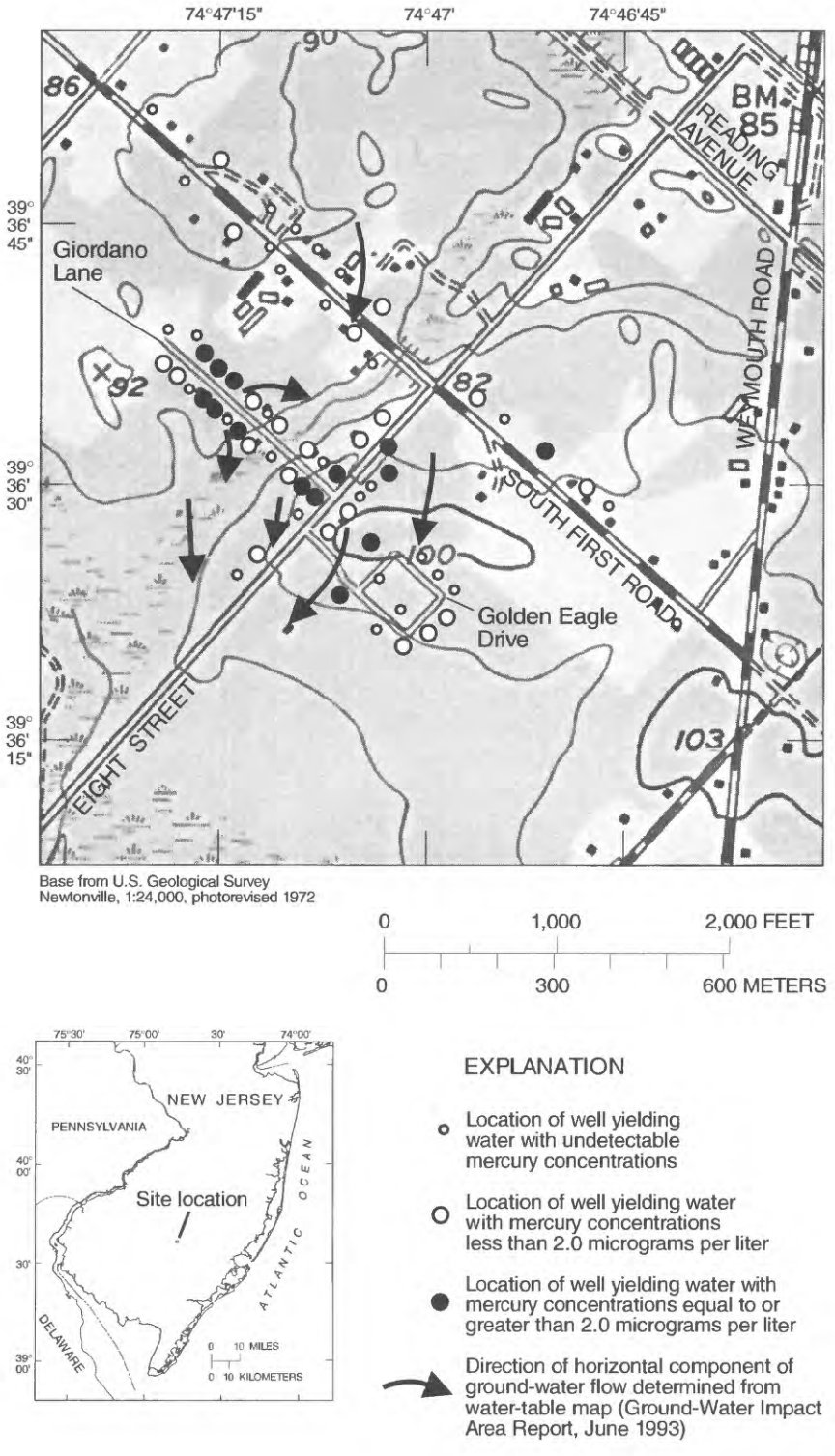


Figure 19. Concentrations of mercury in ground water from private wells at site 6, Hammonton Town, Atlantic County, New Jersey, and direction of the horizontal component of ground-water flow. (Modified from unpublished Ground-Water Impact Area Report, June 1993, on file at New Jersey Department of Environmental Protection, Trenton, N.J.)

east of the site indicate that the horizontal component of shallow ground-water flow at the gravel pit is toward the south (fig. 20) or southwest. Water-quality data from gravel-pit monitoring wells, collected as part of the NJPDES program, indicate high levels of mercury (40-1,300 µg/L) in water collected during one sampling round in 1992 (appendix 3, NJPDES permit number 61581). The cumulative effect of pumping wells at site 7 on ground-water flow directions from the gravel pit is not known and cannot be evaluated from the available data. The landfill is about 0.5 mi farther east of site 7 than is the gravel pit; water-level data from monitoring wells at the landfill indicate ground-water flows south-southeast, which generally confirms directions determined from the water-table map of Watt and Johnson (1992).

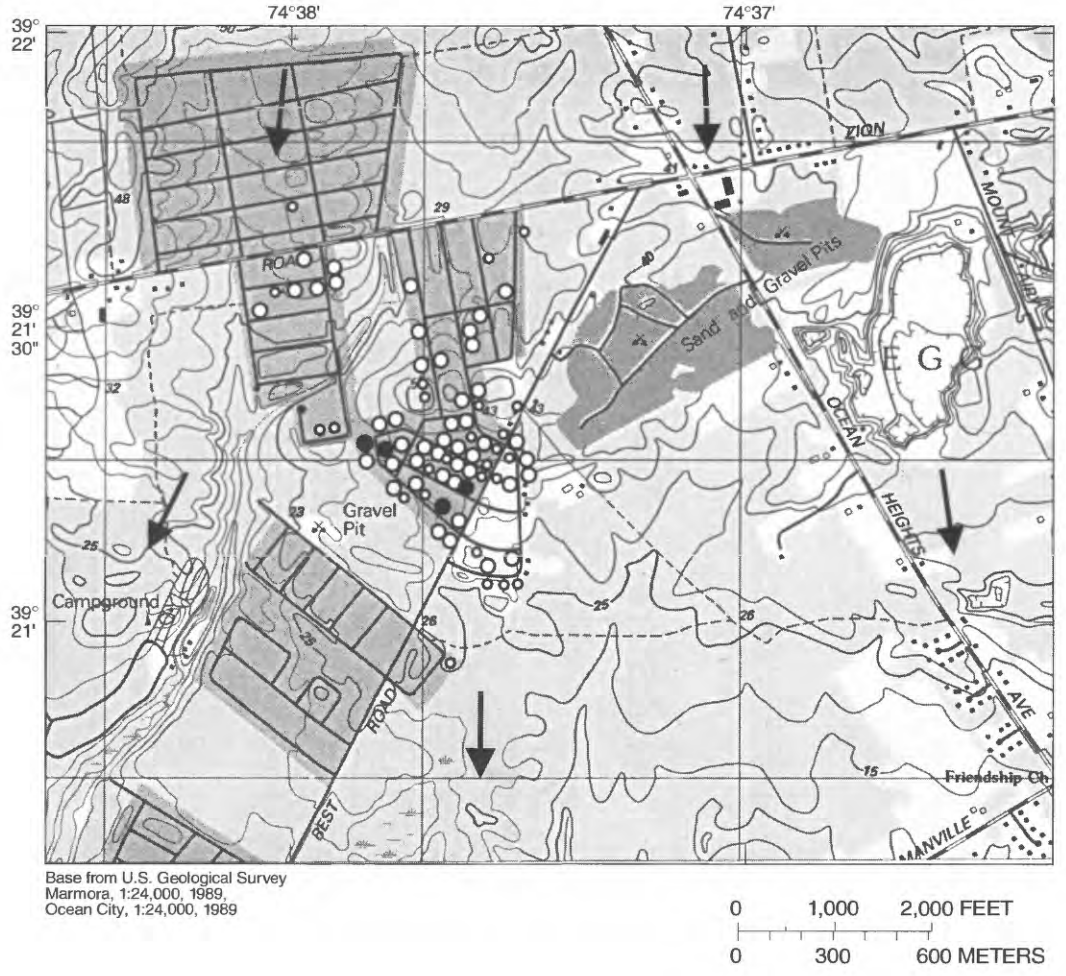
During the 1950's, land at and near site 7 was either forested or agricultural. Agriculture persisted through the 1960's and some forested land remained, but residential development increased. By the mid-1970's, the area had become residential, a campground was located nearby, and a junkyard or dump was present.

Site 8 - Waterford Township, Camden County

Site 8 is located in the area of Atco, in Waterford Township, Camden County (fig. 21). The site includes some farmland as well as single-family homes, small, privately owned businesses, and a few industrial operations. The site is bounded by the Mullica River to the north.

From July 1990 to mid-May 1992, water samples from 324 wells were collected and analyzed for VOC's or mercury or both. Camden County Health Department (CCHD), Waterford Township Municipal Utilities Authority, and NJDEP coordinated sampling and tabulated results. Of 233 wells sampled for mercury, 17 yielded water that contained mercury in concentrations above the MCL and that, when the wells were resampled, contained similar mercury concentrations. Five other wells that initially yielded water with mercury concentrations exceeding the MCL, in subsequent sampling, yielded water with mercury concentrations below the MCL. Another 239 wells were sampled for mercury analysis after the original investigation. Of 472 wells sampled for analysis of mercury by June 1993, 104 yielded water in which mercury was detected. Twenty-one of the 104 wells yielded water with mercury concentrations in excess of the MCL; 3 of these yielded water with concentrations in excess of 15 µg/L. Benzene and chlorinated solvents were detected in some of the wells at site 8; some concentrations were found to be above MCL's. No obvious relation could be discerned between presence or absence of mercury and presence or absence of VOC's, as VOC's were detected in water samples in which mercury was detected and in samples in which mercury was not detected.

Known sites of ground-water contamination in Waterford Township include two underground-storage-tank sites and a gas-station site which has a recovery well that has been effective in eliminating the offsite spread of contaminants (G.M. Smarsh, N.J. Department of Environmental Protection, written commun., 1992). Wells yielding water in which mercury has been detected are distributed across the entire site, although most of the wells yielding water in which mercury concentrations exceeded the MCL are located in the western half of the site (fig. 21). Ground water, depending on location, moves to the southeast, toward Hays Mill Creek and Sleeper Branch, or to the northeast, toward the Mullica River (Rhodehamel, 1973, p. 19, fig. 9).



EXPLANATION

- Location of well yielding water with undetectable mercury concentrations
- Location of well yielding water with mercury concentrations less than 2.0 micrograms per liter
- Location of well yielding water with mercury concentrations equal to or greater than 2.0 micrograms per liter
- Direction of horizontal component of ground-water flow determined from water-table map (Watt and Johnson, 1992)

Figure 20. Concentrations of mercury in ground water from private wells at site 7, Egg Harbor Township, Atlantic County, New Jersey, and direction of the horizontal component of ground-water flow. (Modified from unpublished Ground-Water Impact Area Report, December 1991, on file at New Jersey Department of Environmental Protection, Trenton, N.J.)

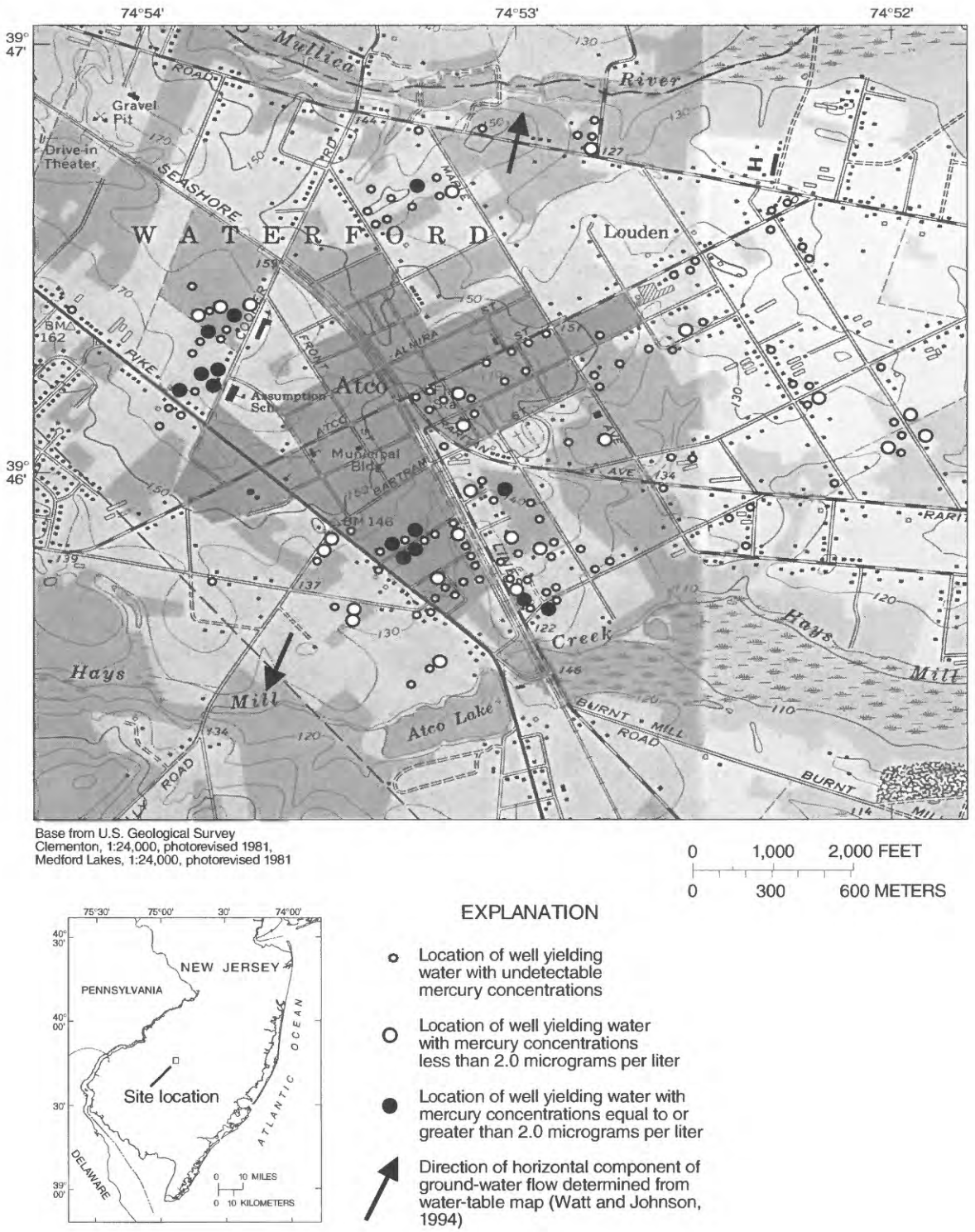


Figure 21. Concentrations of mercury in ground water from private wells at site 8, area of Atco, Waterford Township, Camden County, New Jersey, and direction of the horizontal component of ground-water flow. (Wells sampled during 1991-92 in the area surrounding Atco are not depicted.) (Modified from unpublished Ground-Water Impact Area Report, September 1992, on file at New Jersey Department of Environmental Protection, Trenton, N.J.)

Previous land use at site 8 included commercial and residential areas of Atco, with agriculture to the east, north, and northwest during the 1940's. Residential development increased during the 1950's and has continued to the present (1993), but farmland still covers part of the area.

Site 9 - Vineland City, Cumberland County

Site 9 is located in the southwestern section of Vineland City, Cumberland County, along Garrison Road between Route 47 and South Orchard Road (fig. 22). The area is largely residential, characterized by single-family housing with a few commercial properties served by individual wells and septic systems. Ground-water contamination that affects private wells in the area was discovered in August 1990. From August 1990 to mid-March 1992, ground-water samples were collected from 52 private wells in the area by the Vineland City Health Department and the NJDEP. Samples were analyzed for mercury, VOC's, or both. Initially, samples from seven wells exceeded the 2.0-µg/L MCL for mercury; upon resampling, three wells yielded water with mercury concentrations ranging from 2.9 to 7.0 µg/L. The geographic distribution of analytical results for mercury is shown in figure 22.

Concentrations in samples from 19 wells exceeded MCL's for one or more VOC's including PCE, TCE, 1,2-dichloroethene, bromodichloromethane, 1,1,1-trichloroethane, and methylene chloride. Five of these 19 wells also initially yielded ground-water samples in which the MCL for mercury was exceeded. Soils along roadsides near affected wells, in upgradient areas, and in yards of residences were sampled. Mercury was not detected in any of the soil samples; the analytical detection levels for these samples ranged from 62 to 89 parts per billion (µg/kg) (unpublished data, 1992, on file at N.J. Department of Environmental Protection, Trenton, N.J.). Local, shallow ground-water flow is primarily toward the north and northwest, discharging to Parvin Branch. Regional, deeper flow is westward, toward the Maurice River.

In the 1950's, fewer houses were present at the site than are present today, and about 40 percent of the land area was devoted to agriculture. Residential and commercial development increased from the 1960's through the 1980's. Former commercial establishments east of the site may have contributed VOC's to the ground water (unpublished memorandum from R.A. Gallagher, March 31, 1992, on file at N.J. Department of Environmental Protection, Trenton, N.J.). A sewage-disposal plant northwest of site 9 was constructed in the 1950's; Parvin Branch, a presumed discharge area for shallow ground water, is located between the plant and site 9. No possible point sources of mercury in the area were identified through review of NJDEP files, county records, or a survey of the area by NJDEP personnel.

Site 10 - Franklin Township, Gloucester County

Site 10 is located in Franklin Township, Gloucester County, adjacent to Newfield Borough (fig. 23). The site is largely residential; part of the site is occupied by a school.

In 1989, routine testing of water from a new well at the school revealed mercury concentrations that exceeded the MCL. Subsequently, elevated mercury

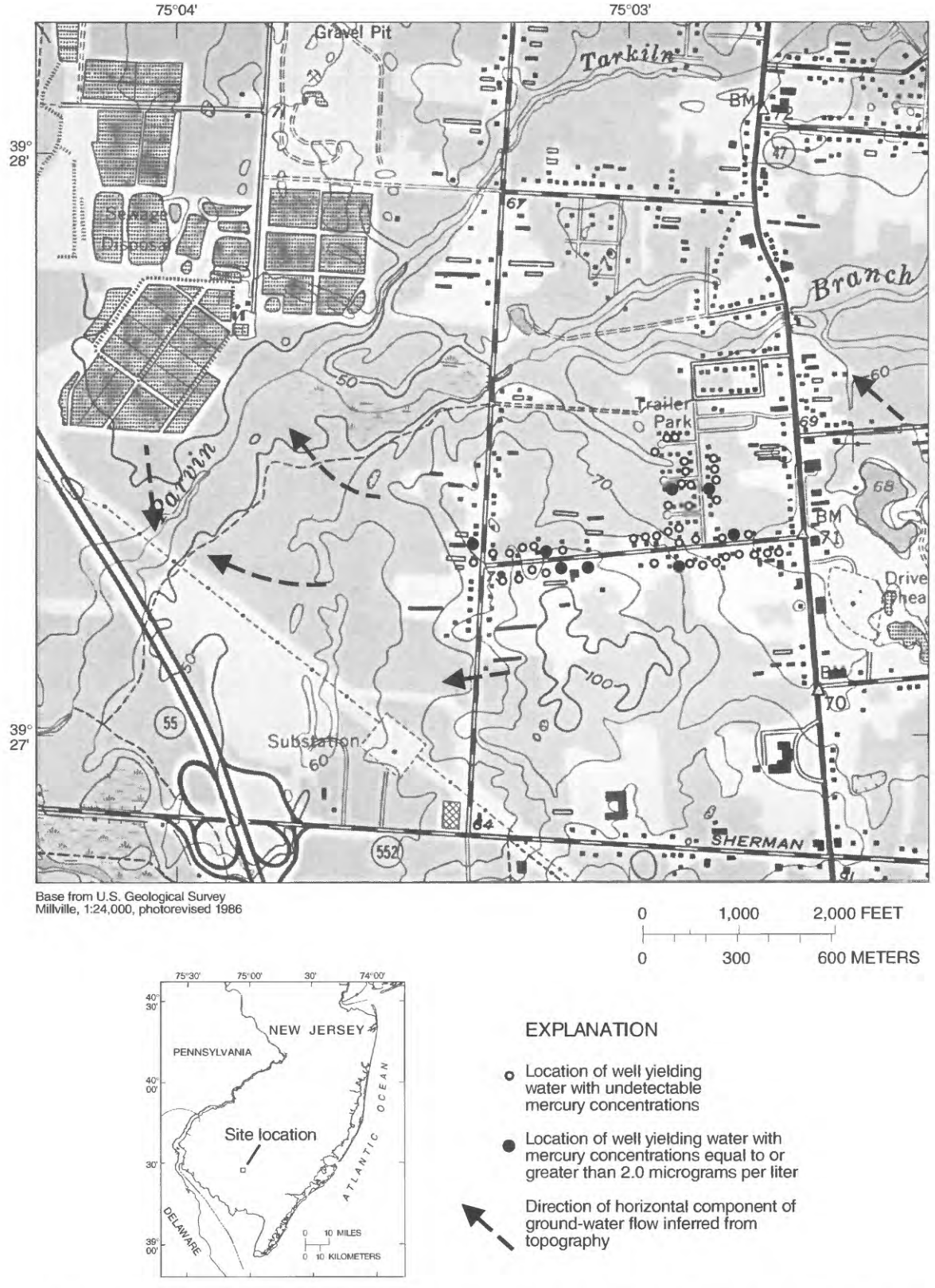


Figure 22. Concentrations of mercury in ground water from private wells at site 9, Vineland City, Cumberland County, New Jersey, and direction of the horizontal component of ground-water flow, inferred from topography. (Modified from unpublished Interim Ground-Water Impact Area Report, May 1992, on file at New Jersey Department of Environmental Protection, Trenton, N.J.)

concentrations were detected in water from the old, shallower well previously used by the school, and sampling of three other wells on the property indicated that mercury was present in water from one of those wells. In 1990, water samples were collected from 26 mostly domestic wells in the area surrounding the school; although mercury was not detected in most of the water samples, six samples contained detectable mercury and, of these, mercury in three exceeded the MCL. Concentrations in water from the school's well were up to three times as high as those measured in water from the domestic wells, however.

In 1992, the USGS resampled the school wells, including a shallow observation well on the property; resampled three nearby domestic wells and a commercial well; and sampled two previously unsampled domestic wells and an observation well at the site of a former thermometer factory. The analytical results for water from the school wells were similar to results of previous analyses; the highest mercury concentration (18.6 μg/L) was found in water from the new well at the school. One domestic well again yielded water with mercury concentrations that exceeded the MCL. Two domestic wells yielded water with detectable concentrations of mercury, but the concentrations were well below the MCL. At the former thermometer-factory site, neither the water sample from the domestic well nor the sample from the observation well contained detectable concentrations of mercury. Of the school wells, where the highest concentrations of mercury at site 10 were measured, the shallowest well (29 ft) yielded water in which mercury was not detected.

Three possible point sources of mercury exist or existed within site 10--a landfill, a building that previously housed the thermometer factory, and a cemetery. The water samples from the domestic well (approximately 60 ft deep) and the observation well (26 ft deep) at the site of the former thermometer factory did not contain detectable concentrations of mercury (fig. 23). Mercury has not been detected in water from the monitoring wells at the landfill, which received its NJPDES permit in 1985 (appendix 3, NJPDES permit number 54453). The cemetery is located adjacent to the school, but it was first used in the 1950's and is unlikely to have been a source of contaminants in the subsequent 4 decades.

Shallow, local ground-water flow directions, inferred from topography, are likely to be radially from the site, which occupies, and extends eastward from, a local topographic high (fig. 23). Figure 24 shows a schematic section along a hypothetical flow path from the school eastward. The shaded area illustrates a possible lens or plume of mercury contamination within the aquifer at site 10. The only other nearby site of mercury-contaminated ground water (site 25) is several miles distant, and because it is downgradient from the ground-water divide and headwaters of several streams intervene, site 25 appears to be located in a different local ground-water flow regime than site 10.

Land use at site 10 included forested areas, agriculture, and a few residences prior to 1950. The school was built on former agricultural land in the early 1950's, and the number of residences has increased since that time.

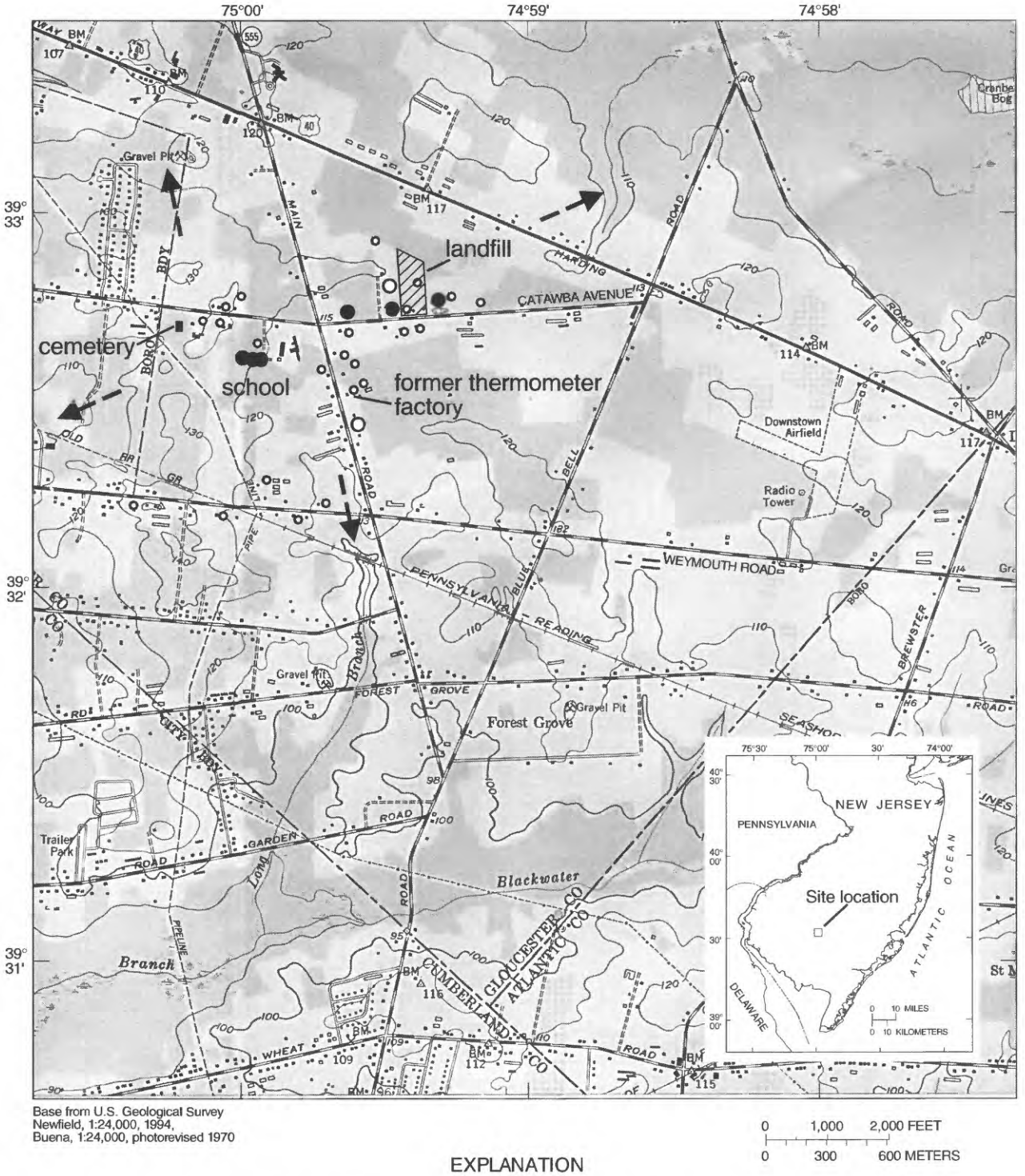


Figure 23. Concentrations of mercury in ground water from school, domestic, and commercial wells at site 10, Franklin Township, Gloucester County, New Jersey, and direction of the horizontal component of ground-water flow inferred from topography.

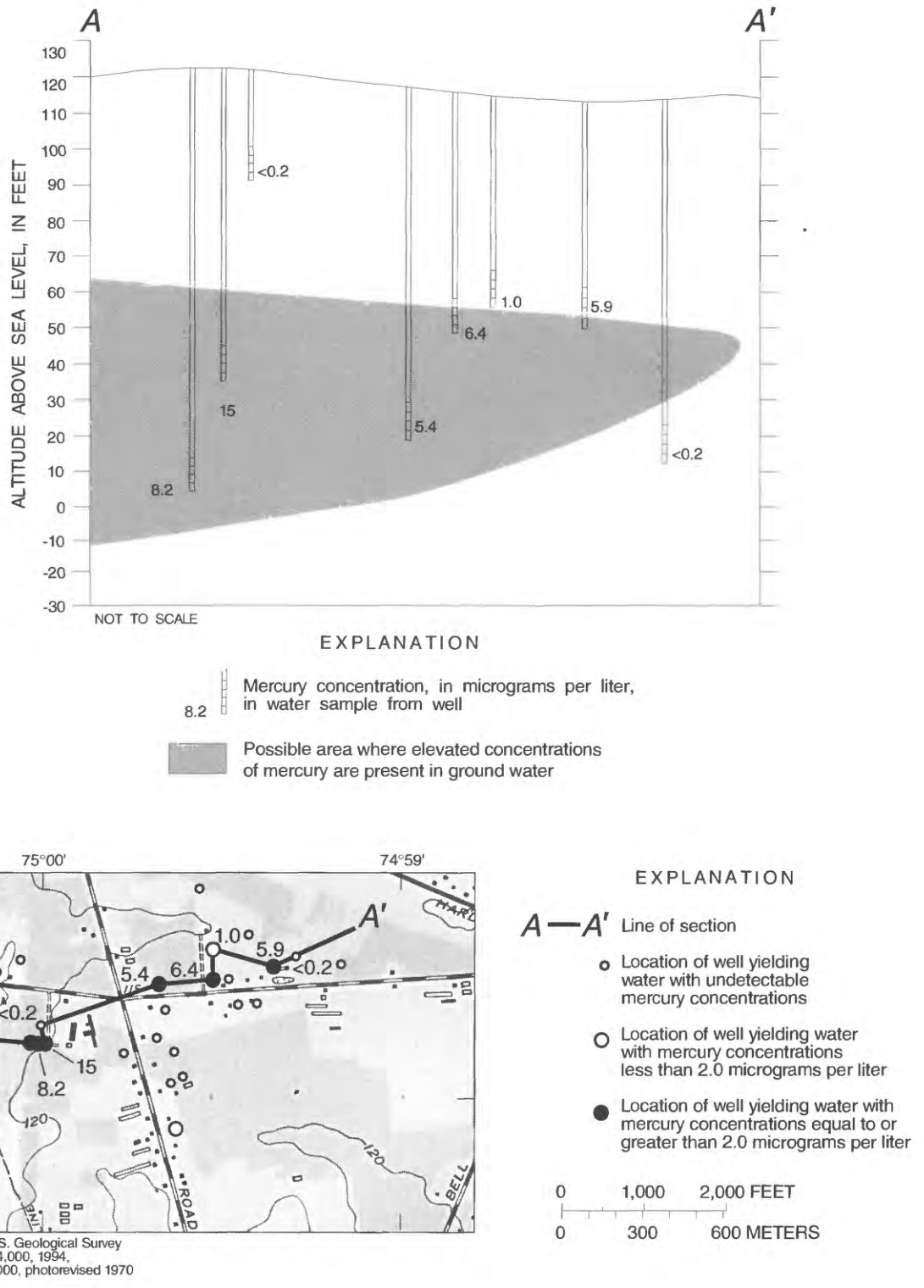


Figure 24. Line of section A-A' (inset) showing mercury concentrations in ground water from selected wells, and schematic section A-A' showing possible configuration of elevated mercury concentrations in ground water at site 10, Franklin Township, Gloucester County, New Jersey. (See figure 23 for location of site 10. Mercury concentration data from the initial sampling of the wells depicted.)

Site 11 - Lacy Township, Ocean County

Site 11 is located in Lacey Township, on a local topographic divide between Cedar Creek and the North Branch of the Forked River (fig. 25). Because various VOC's had been found in ground water from a nearby residential area, 90 private wells at site 11 were sampled during 1986-90 for analysis for VOC's by the Ocean County Health Department (OCHD) and the NJDEP. Eight wells initially were sampled for mercury, of which three yielded water with mercury concentrations exceeding the MCL. Two of these wells were resampled and the samples analyzed by a different laboratory. The analytical results for both sets of samples were similar. Additional sampling by NJDEP included three wells not previously sampled for mercury and yielded two more water samples with mercury concentrations that exceeded the MCL. VOC's were detected in several wells, with benzene concentrations exceeding the MCL (1 μg/L) in water from 11 wells, xylene concentrations exceeding the MCL (44 μg/L) in 3 wells, and 1,2-dichloroethane concentrations exceeding the MCL (2 μg/L) in 4 wells. VOC's were detected in three wells sampled for mercury, but only one well yielded water containing concentrations of a VOC and mercury that each exceeded their respective MCL. Twelve wells were sampled for analysis of lead; water from five exceeded the MCL for lead which, at that time, was 50 μg/L (unpublished Ground-Water Impact Area Report, April 1991, on file at N.J. Department of Environmental Protection, Trenton, N.J.).

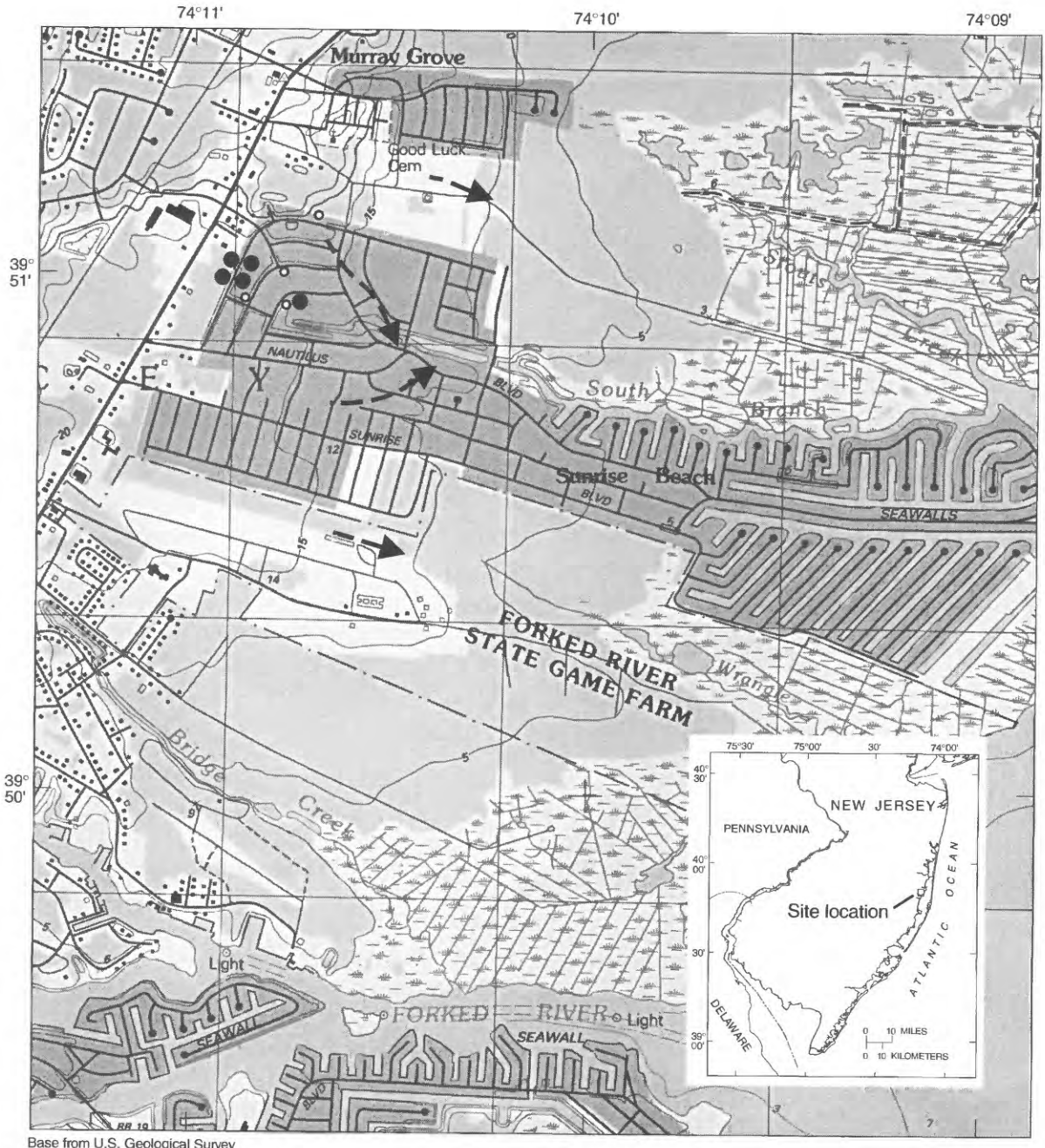
The horizontal component of ground-water flow was determined by NJDEP to be in an east-southeast direction (fig. 25). Previous land use at site 11 was varied. Some of the land was undeveloped in the 1950's, agriculture was present, and construction of marinas began during that time. High-density residential development increased during the 1960's and 1970's. The area has been sewered for about 14 years.

No point sources of the contaminants found at site 11 have been identified. A cemetery is located north of the site, but ground-water flow there also appears to be to the east-southeast and not toward site 11.

Site 12 - Dover Township, Ocean County

Site 12 is located in Dover Township, Ocean County, about 1 mi inland from Barnegat Bay (fig. 26). The area is residential, densely packed with single-family dwellings on small (3,200-12,500 ft^2) lots.

Of 147 ground-water samples collected and analyzed before May 1988 by the OCHD in accordance with county real-estate transfer regulations, 69 were found to contain a variety of VOC's. In some cases, the VOC concentrations exceeded MCL's. A dry-cleaning establishment was considered a potential source of some VOC contamination (Charles, 1989). Subsequent sampling by the OCHD and NJDEP in the area revealed additional instances of VOC contamination. In addition, two ground-water samples were found to contain mercury in concentrations above the MCL. Resampling by NJDEP and analysis by the New Jersey Department of Health (NJDOH) confirmed the finding for samples from one well; for the other, the mercury concentration had decreased to slightly below the MCL. NJDEP also sampled 15 other wells in the area for analysis for mercury during 1988 and 1989. Ten of these wells yielded water with detectable concentrations of mercury that were less than the MCL,



Base from U.S. Geological Survey
Forked River, 1:24,000, 1989

0 1,000 2,000 FEET
0 300 600 METERS

EXPLANATION

- Location of well yielding water with undetectable mercury concentrations
- Location of well yielding water with mercury concentrations equal to or greater than 2.0 micrograms per liter
- Direction of horizontal component of ground-water flow inferred from topography

Figure 25. Concentrations of mercury in ground water from private wells at site 11, Lacey Township, Ocean County, New Jersey, and direction of the horizontal component of ground-water flow inferred from topography. (Mercury-concentration data from unpublished Ground-Water Impact Area Report, April 1991, on file at New Jersey Department of Environmental Protection, Trenton, N.J.)

and five wells yielded water in which mercury was not detected. Real-estate transfers triggered sampling of four other wells in the area in 1992, which were found to yield water with mercury concentrations ranging from 3.5 µg/L to 45 µg/L. The well yielding water with 45 µg/L mercury was resampled in 1993; the confirmatory sample contained 17 µg/L mercury. Some wells were sampled for other metals, which generally were not detected; however, lead was found in two samples at concentrations of 6 and 50 µg/L. The known distribution of detectable mercury in ground water at site 12 is rather scattered, although all the wells at a cluster of houses near the bay (fig. 26) yielded water with detectable amounts of mercury.

Several of the wells yielding water in which mercury was not detected, or was detected at low levels, are approximately 60 ft deep; the depths of the wells yielding mercury-contaminated water are not known. Shallow ground-water flow is presumed to be to the southeast, toward the bay and the creeks that flow into the bay.

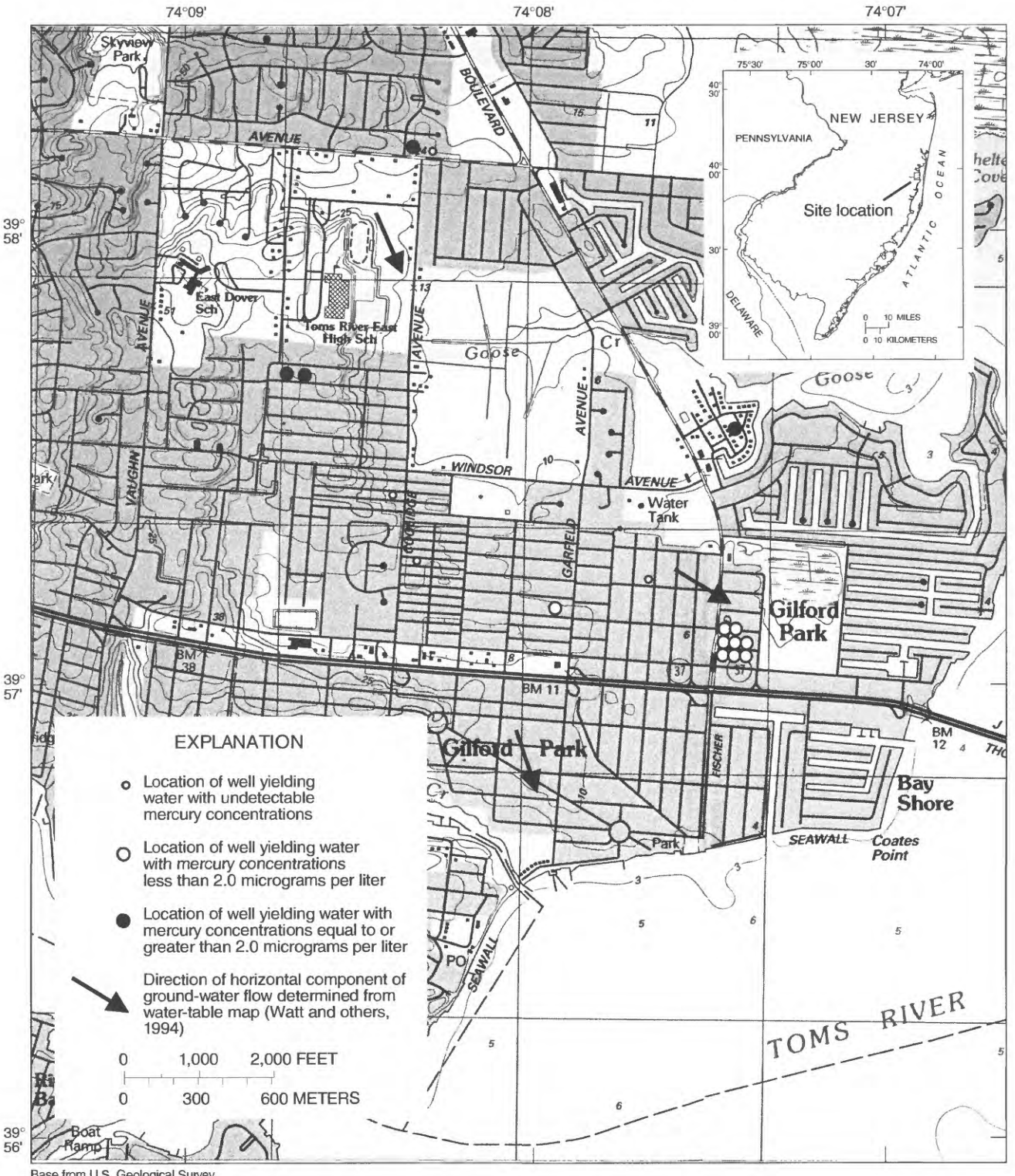
Much of the site 12 area was undeveloped in the 1950's, although houses and marinas were present. Most of the residential development occurred during the 1960's and 1970's. No known point sources of metal contamination are nearby; a Superfund site is more than 5 mi distant. The nearest cemetery is about 1.5 mi west of site 12.

Site 13 - Pittsgrove Township, Salem County

Site 13 is located in a rural and residential section of Pittsgrove Township, Salem County, and extends into Deerfield Township, Cumberland County. The site borders Parvin State Park in Salem County. Mercury-contaminated water from residential wells at this site was first reported in December 1983. Water samples from 52 wells were collected from 1983 through mid-March 1988 by the Health Departments of Salem and Cumberland Counties, and by USEPA and its contractors. Analytical results indicate that water from seven domestic wells contained mercury in concentrations exceeding the MCL; concentrations ranged up to 240 µg/L. Recently (1988), the highest concentration measured in ground water at site 13 has been 42 µg/L. Detectable levels of mercury below the MCL were present in samples from 27 wells. Samples from 18 other wells did not contain detectable concentrations of mercury.

Shallow (50 ft) ground-water flow directions, inferred from local topography, are likely to be toward Parvin State Park; ground water discharges to the many streams, wetlands, and lakes within and near the park (fig. 27).

Much of the site was undeveloped land during the 1960's; a building complex and gravel pit, a few houses, and some orchards were present. Residential development increased slightly during the 1970's and 1980's. The gravel pit still existed. A golf course was built north of the site prior to 1972. Currently (1993), a landfill occupies the area of the former gravel pit. The landfill is about 1 mi north of site 13, on the opposite side of Muddy Run and a tributary to Muddy Run. Mercury has been detected at concentrations above the MCL (5.60 µg/L; see appendix 3, NJPDES permit number 54402) at one of six monitoring wells at the landfill--a concentration substantially less than those measured in water from several wells at site 13.



Base from U.S. Geological Survey
Toms River, 1:24,000, 1989,
Seaside Park, 1:24,000, 1989

Figure 26. Concentrations of mercury in ground water from private wells at site 12, Dover Township, Ocean County, New Jersey, and direction of the horizontal component of ground-water flow.

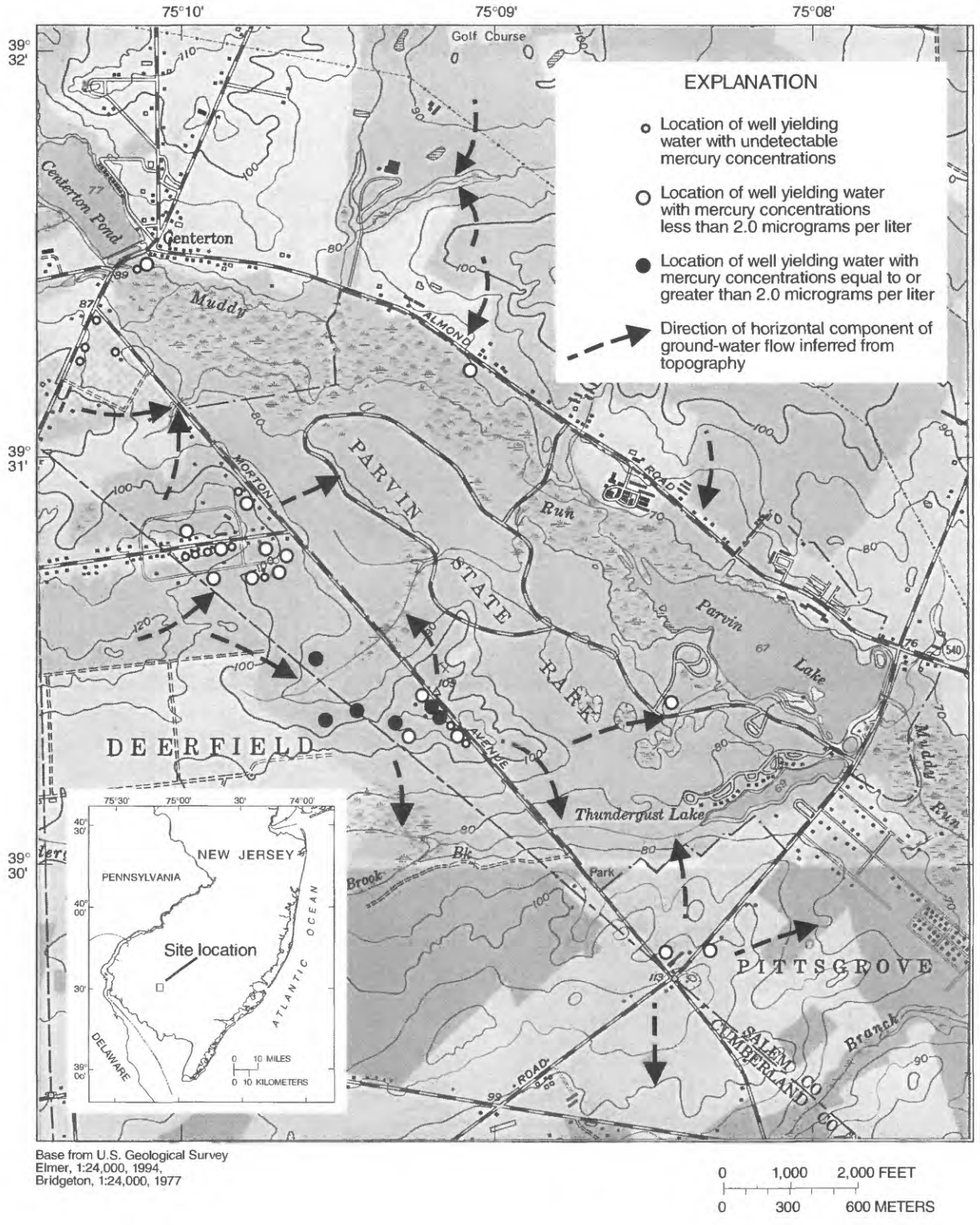


Figure 27. Concentrations of mercury in ground water from private wells at site 13, Pittsgrove Township, Salem County, and Deerfield Township, Cumberland County, New Jersey, and direction of the horizontal component of shallow ground-water flow inferred from topography.

A landfill that has been the focus of a Superfund investigation is located about 2 mi southwest of site 13. In addition to VOC's, mercury was a major contaminant at this site, where pesticide residues and containers are believed to have been disposed of beginning in the late 1930's and continuing for about 20 years (Ebasco, 1991). Concentrations of mercury as high as 400 μg/L in ground water were reported. Ground water flows to the southeast, and a contaminant plume extends in this direction (Ebasco, 1991) away from site 13.

Similarities Among Sites of Elevated Mercury Concentrations in Ground Water

Similarities in water chemistry and land-use features among the 34 sites were evaluated to identify common characteristics that are associated with elevated concentrations of mercury in ground water.

Water-Quality Characteristics

A water-quality feature common to most of the 34 sites is the presence of VOC's in some of the ground-water samples. VOC analysis results were available for 25 of the 34 sites and revealed that a variety of man-made organic compounds were detected at these sites. The most commonly found organic compounds were chlorinated solvents, but benzene compounds also were detected at several sites. As discussed in more detail in previous sections of this report, the distribution of the VOC-contaminated water appears to be very different from the distribution of mercury contaminated water. Moreover, at some sites the VOC or suite of VOC's detected in water from an individual well differed from that in water from adjacent wells. At some sites, the benzene, toluene, and xylenes detected are indicative of gasoline spills. The chlorinated solvents, for the most part, have not been traced to known point sources. The presence of chloroform, which was nearly ubiquitous in water samples from the Atlantic County sites (where it was most commonly measured) is believed to be related to inputs of chlorine to the ground water, where interactions with organic matter produce the compound. Chlorine can reach ground water through disinfection of wells and through septic systems.

Because the degree of organic contamination is relatively low (although individual compounds were found to exceed USEPA MCL's), the likelihood that extensive plumes of highly contaminated ground water are present at these sites appears to be small. Introduction of relatively small amounts of organic compounds to septic systems appears to be a possible cause of at least some of the VOC contamination. At present, no connection between the source of the VOC's and the source (or sources) of the mercury in ground water at these sites has been discerned. Interactions between the VOC's and mercury that might facilitate mercury transport through the aquifer cannot be ruled out at this time, however.

Land-Use Features

Because the mercury-contaminated ground water generally has been obtained from depths of 50 to 120 ft below land surface, it appears that the contamination, if introduced at the land surface, came from past activities. Results of hydrologic simulation conducted during a previous study to determine the age of ground water in the New Jersey Coastal Plain as a function of depth indicated that

water 50 to 120 ft deep would be about 10 to slightly more than 35 years old, if a vertical ground-water velocity of about 3.3 ft/yr is assumed (Zoltan Szabo, U.S. Geological Survey, oral commun., 1993). Because an assessment of previous land use at, and upgradient from, the known sites of elevated mercury concentrations in ground water was needed to evaluate possible past sources of mercury, previous land use at the 34 sites was determined (table 12).

Land-use features common to the sites of elevated mercury concentrations in ground water are related to both past and present activities. With the exception of sites 26 and 27, which are individual houses in rural areas, the sites are housing developments, most of which were built after 1950. Many of the sites are located in uplands, on or near local topographic divides. Historic aerial photographs show that 26 sites are located on or adjacent to formerly agricultural land (see table 12). Most of the 34 sites are located within 3 mi of at least one possible point source, such as landfills, cemeteries, past or present military operations, or industrial activities. In addition, all sites were, and are, subject to atmospheric deposition of mercury.

POSSIBLE SOURCES AND MOBILIZATION MECHANISMS OF MERCURY IN GROUND WATER

One of the major objectives of this mercury study was to develop hypotheses about the possible sources of the mercury found in ground water in the study area. Some of the hypotheses could be tested with available data, whereas others required additional data that were collected subsequently. The hypotheses that were developed are as follows:

1. The mercury was an artifact of sampling and/or analysis methods or procedures;
2. The mercury was contributed by the pumps installed in the affected wells;
3. The mercury was contributed by household sources, either as a component of septic-system effluent, as a result of well disinfection, or as a result of leaching from exterior paint;
4. The mercury was contributed by emanations from point sources such as landfills, military installations, industrial or commercial sites, or cemeteries;
5. The mercury was contributed by atmospheric deposition;
6. The mercury was contributed by leaching of land-applied substances such as inorganic- and organomercurial pesticides used in agriculture and on golf courses, or mercurial seed dressings.

Most of the 34 sites, particularly those in Atlantic County, are within about 1 mi of a railroad line. During the period when mercury contamination apparently was entering the ground-water system, some train engines could have been burning coal, which can contains mercury. Because this mercury would enter the atmosphere, this possible source is discussed as part of hypothesis 5. No data are available that indicate whether or not other aspects of railroad operation might be possible sources. Therefore, this hypothesis was not pursued further.

Table 12. Previous and recent (1991) land use at 34 sites where water from one or more wells contained mercury in concentrations equal to or greater than 1 microgram per liter, New Jersey Coastal Plain

[%, percent; mi, miles]

Site number	Land use	Time period
1	Forested, agriculture, development near lake increased	1962-74
	More residences, shopping center	1974-91
2	Agriculture, few residences, forest	1951-62
	Development increased, trailer park begun	1962-74
	Development and trailer park completed, no agriculture	1974-91
3	Forested, agriculture, development begun, Garden State Parkway completed	1951-62
	Development continues, Atlantic City Expressway completed	1962-74
	Little change, baseball fields(?)	1974-91
4	Agriculture (orchards), residential development	1951-62
	Development continued	1962-74
	Little change	1974-91
5	Agriculture, forest	1951-62
	Development begun and increased	1962-74
	Agriculture decreased	1974-91
6	Agriculture (40%), undeveloped land	1951-61
	Agriculture, undeveloped land, few residences	1961-74
	Residential development increased slightly, agriculture, undeveloped land	1974-91
7	Forested, agriculture	1951-61
	Development began, agriculture, forested	1961-74
	Development completed, lake, junkyard, campground	1974-90
8	Residences, agriculture to east, north, and northwest, undeveloped land to northeast	1940-51
	Development increased, Mullica River dammed, agriculture to east	1951-61
	Development increased, agriculture near Medford Lakes	1961-74
	Extensive residential development	1974-91
9	Residences, agriculture (about 40% of area), gravel pit and sewage disposal plant to northwest	1951-62
	Increased development	1962-74
	Increased development (residential and industrial), trailer park	1974-91
10	Forest, agriculture, open land, few residences	1953
	School built, more residences	1953-70
11	Undeveloped, agriculture, marina development present in 1961, residential development in 1961	1951-61
	Development increased	1961-74
	Marina and residential development completed	1974-91
12	Undeveloped land, marshland, some residential and marina development	1951-61
	Development increased,high density of residences	1961-74
	Development completed (marinas and residences)	1974-91

Table 12. Previous and recent (1991) land use at 34 sites where water from one or more wells contained mercury in concentrations equal to or greater than 1 microgram per liter, New Jersey Coastal Plain--Continued

Site number	Land use	Time period
13	Undeveloped land, agriculture, few residences, building complex, gravel pit	1951-62
	Few additional residences, pit (or dump) still exists	1962-74
	Little change	1974-91
14	Agriculture, some residences, undeveloped land	1951-61
	Residential development increased, agriculture (about 20% of the area), undeveloped land	1961-74
	Little change	1974-91
15	Agriculture (60% of the area), residences along pike	1951-61
	Residential development increased slightly	1961-74
	Agriculture, residences	1974-91
16	Agriculture, residences	1954-61
	Development increased	1961-74
	Development completed	1974-91
17	Forested, agriculture, few residences	1951-62
	Development begun	1962-74
	Development completed	1974-91
18	Forested, open grassy area, agriculture	1930-51
	Agriculture (orchards), forest	1951-61
	Agriculture, forest, one new house	1961-74
	Development begun, new agricultural area	1974-91
19	Forested, agriculture	1951-61
	Development begun, agriculture, forested	1961-74
	Development completed, lake, junkyard, campground	1974-91
20	Agriculture (40%), residences, drive-in theatre, development to southeast	1940-51
	Less agriculture (20%), sparse development, trailer park developing begun	1951-62
	Trailer park larger, mall built, scattered residential development, no agriculture	1962-72
	Little change	1972-91
21	Undeveloped land, residences	1951-62
	Development increased	1962-74
	Development completed, some undeveloped land	1974-91
22	Agriculture, residences, undeveloped land	1940-51
	Agriculture, residences, dump present to northeast in 1962, road grid laid out	1951-62
	Agriculture, dump present, second dump east of Ridgeway	1962-74
	Housing development, extensive dump areas, trailer park, some agriculture still present in 1991	1974-91
23	Undeveloped land, streets laid out for development, residential development begun, numerous gravel pits in 1961	1951-61
	Development increased	1961-74
	Development increased, sewage disposal plant present in 1991, lake	1974-91

Table 12. Previous and recent (1991) land use at 34 sites where water from one or more wells contained mercury in concentrations equal to or greater than 1 microgram per liter, New Jersey Coastal Plain--Continued

Site number	Land use	Time period
24	Few residences, undeveloped land, landfill present in 1974	1951-74
	Landfill enlarged, residential development increased slightly	1974-91
25	Forest, open areas, orchards, few residences, wetland	1953-72
	New residences, roads, trailer parks, industrial buildings	1972-86
26	Agriculture, small landfill 2-3 mi to north in 1961	1951-61
	Cleared land and agriculture, landfill enlarged	1961-74
	Agriculture, landfill enlarged	1974-91
27	Agriculture	1951-61
	Agriculture	1961-74
	Agriculture	1974-91
28	Pleasantville developed, landfill present, undeveloped to north	1940-51
	Little change	1951-62
	Atlantic City Expressway built, landfill sites north of Expressway, undeveloped land to north	1962-72
	Little change	1972-91
29	Undeveloped land, marshland, residential development begun, gravel pits	1951-61
	Development continued	1961-74
	Development completed	1974-91
30	Agriculture, few residences, Kettle Run impounded, undeveloped land	1940-51
	Agriculture and undeveloped land still present, road grid laid out, airport present in 1965	1951-65
	Agriculture, residential development, impoundment dry, undeveloped land	1965-74
	Development increases, agriculture still present	1974-91
31	Forested; scattered residences; agriculture, excavated area (dump); golf course; a few long, low buildings	1956-72
	Agriculture (50% of area), scattered residences	1972-91
32	Forested, few residences, fields, possible dump present	1951-62
	Trees planted infield, unpaved race track present, few residences	1962-74
	Residential development begun and completed; racetrack no longer present; new pond; and long, low buildings	1974-91
33	Undeveloped, forested, wetlands to north, scattered residences, agriculture, extensive development to the east	1953-72
34	Undeveloped, forested, wetloads along river, few residences, Garden State Parkway completed, development to northwest, manufacturing facility to west by 1970.	1953-70
	More residences, increased development to northwest, industrial waste ponds and sewage treatment plant at manufacturing facility	1970-89

Possible mobilization mechanisms were evaluated on the basis of previous investigations of the chemical nature of, and reactions involving, mercury in aqueous systems. A conceptual model of some possible mechanisms of mercury mobilization in the study area was developed.

Possible Sources of Mercury

Hypothesis 1: Sampling and Analysis

The first question that needed to be answered as various agencies investigated the occurrences of mercury in ground water was that of the validity of the data--that is, is the presence of mercury an artifact of contamination during sampling or analysis? As discussed previously in this report, numerous efforts were made to assure the validity of the data. Windom and Smith (1992) resampled wells using stringent quality assurance on sampling protocols and analyzed samples using isotope-dilution and ICP/MS, which is a more sensitive method than CVAA and is specific to mercury. Their results show that, for eight wells in Atlantic County yielding water with mercury concentrations greater than the USEPA MCL, the data collected and analyzed previously show real environmental contamination. Twelve water samples reported to contain mercury in concentrations less than the MCL or in which mercury was not detected also were analyzed by Windom and Smith (1992); their results again support the values obtained in earlier analyses by ACHD. Further, quality-assurance procedures undertaken during the USGS study have shown that normal handling of samples during collecting and filtering generally does not result in measurable levels of contamination. Most of the samples collected by NJDEP and the counties were not filtered, however, and thus a potential source of contamination--field equipment used in filtering samples--was not present during the collection of water samples by State and county personnel; these samples constitute the vast majority of samples considered in this study. Although it is possible that some of the mercury concentrations that are close to method detection limits could represent some level of random contamination during sampling or during preparation in the lab, the reproducibility of most results, including "nondetects," for samples collected by different samplers and analyzed by different laboratories indicates that mercury is present in the ground water.

Hypothesis 2: Pumps

Another important question, posed early in the course of the USGS study, was whether the mercury contamination could be linked to some aspect of well construction--in particular, the pump used. Information on the type of pump installed was found for 185 of the 2,239 wells at the 34 sites for which mercury-concentration data were available. Only four pump brands were represented with sufficient frequency to be tested statistically. A chi-squared test was performed to determine whether any one brand was associated with a larger number of mercury concentrations at or above the MCL. No significant difference in proportion of mercury concentrations at or above the MCL across the four pump brands was found. The number of jet pumps associated with mercury concentrations at or above the MCL is essentially the same as the number of submersible pumps (14 and 15, respectively), although the jet pumps are associated with higher mercury concentrations than the submersible pumps (mean concentrations are 7.21 and 4.55 μg/L, respectively). By using a Mann-Whitney test, this relation was found to be significant at the 0.05 level. Many more

pumps (76 jet pumps and 80 submersible pumps) are associated with mercury concentrations that are less than the MCL or with "nondetects," however. Because domestic-well jet-pump siphons commonly are plastic, and the impeller assembly of submersible pumps is metal, it is unclear whether the relation disclosed by the Mann-Whitney test has any real meaning. The available data do not support the hypothesis that the mercury in ground-water samples is attributable to a particular brand or type of pump.

A likely source of mercury from a pump would probably be a mercury switch in the electrical system. Some centrifugal pumps use a level-sensing mercury switch in the pump-motor controls; these typically are sump pumps used in slurry, process, drainage, and sewage services (Karassik, 1986). In water-supply pumps, because both the motor and other components of the electrical system are hermetically sealed to prevent contact with water or are located above the water level, electrical switches are unlikely to be a source of mercury to ground water. Further, hypothesis 2 is not adequate to explain the instances where mercury is detected in a first sample but not a second from a given well, or the reverse. Such instances can be explained, however, by movement of contaminated ground water, either in response to differing local pumping regimes or by natural flow.

Table 13. Statistical parameters for chi-squared test[1] for proportions of instances of mercury-contaminated water associated with four pump brands

[P_i, proportion of instances of maximum contaminant level exceedance[2]; n_i, number of pumps in sample; $\bar{p}$, $\bar{q}$, mean number of exceedances and nonexceedances, respectively; X^2, chi-squared statistic]

	Brand 1	Brand 2	Brand 3	Brand 4
P_i	0.128	0.143	0.286	0.208
n_i	86	42	7	24

$\bar{p} = 0.191$

$\bar{q} = 0.809$

[1] $X^2 = \sum_{i=1}^{4} n_i P_i - \bar{P}^2 / \bar{p}\bar{q} = 3.32$ with 3 degrees of freedom.

[2]Maximum contaminant level exceedance, for the purposes of this table, includes all instances in which concentrations of mercury are equal to or greater than the maximum contaminant level of 2 micrograms per liter in drinking water.

Hypothesis 3: Households: Septic Systems, Wells, and House Paint

Household septic systems are a possible local source of mercury. In the past, chlorine bleaches could contain from 17 to 36 µg/L of mercury (Siegel and Eshleman, 1975), and it is likely that many households used chlorine bleaches regularly. A rough calculation can give some idea of the magnitude of mercury contamination introduced by bleaches. If 20 mL of bleach containing mercury at a concentration of 36 µg/L was used in a washload containing 40 L of water (20 L for wash, 20 L for rinse), the 0.72 µg of mercury in the 20 mL of bleach would be diluted to 0.018 µg/L per washload. With three washloads per week, a mass of 112 µg of mercury per year would be delivered to a septic system. The concentration of mercury in each washload (0.018 µg/L) would, however, be diluted substantially by other household wastewater. Whether mercury in the septic system sorbs to organic matter, whether the organic matter is substantially removed by periodic pumping, or whether septic-system cleaners, such as the chlorinated solvents used in the past, release sorbed mercury to ground water is not known.

Investigators who studied a plume of contaminated water from a septic system in Muskoka, Ontario, Canada, report low pH's in the core of the plume that result from nitrification of ammonia (Robertson and others, 1991). The authors indicate that the low pH may enhance metal mobility. Although septic systems may not contribute substantial amounts of mercury to ground water, geochemical processes associated with constituents introduced by septic-system effluent may mobilize mercury that was contributed by other sources and that is sorbed to aquifer sediments.

Use of chlorine bleach to disinfect a well could perhaps briefly contribute detectable amounts of mercury to ground water. A mercury concentration of 0.8 µg/L is reported for water from a well that had been treated with chlorine bleach on the day of sampling (Barber and Steele, 1980). Chlorine typically is added at the time the well is drilled, or if the ground water becomes contaminated with bacteria from septic-system effluent or surface runoff. Many of the wells yielding mercury-contaminated water were drilled at least 20 years ago. Mercury contributed by chlorine used at the time of drilling is unlikely to be present in the ground water decades later; household water use presumably would remove any mercury within a few hours of pumping.

Exterior latex house paint typically contains organomercurial compounds to discourage the formation of molds and mildews. Organomercurial fungicides are present in oil-based as well as latex paints (D'Itri and D'Itri, 1977). Houses at the majority of the 34 sites were built in the 1950's through the 1980's, and paint containing mercury probably has been used on their exteriors. Concentrations of fungicides such as phenylmercuric acetate (PMA) in paints ranged from 100 to 15,000 parts per million (D'Itri, 1972, p. 19); typical additions of mercurial fungicides to paint ranged from 1 to 3 lb in 100 gallons of latex paint (D'Itri and D'Itri, 1977).

In studies of outgassing of mercury from interior latex paints (Agocs and others, 1990; Beusterien and others, 1991), researchers found that the mercury emitted from the paint was in elemental form. In an earlier study, Sibbett and others (1972) estimated that mercury in the paint investigated would continue to be outgassed for 7.5 years, at the rate of 499 nanomoles (99.8 µg) per day. Loss rates to the

atmosphere under humid conditions have been measured for paints containing mercury (Taylor, 1965). Losses ranged from 22 to 87 percent of the mercury present over a period of 3 months, with an average loss of nearly 50 percent (45.3 percent).

If 20 gallons of latex paint are needed for the exterior of a house and the paint contains an organomercurial fungicide such as PMA added at a rate of 3 lb per 100 gallons, those 20 gallons contain about 1.62×10^8 µg of mercury, calculated from the formula weight of PMA (336.75 g/mole, of which mercury is 59.57 percent). This is a substantial amount of mercury, but the amount available to be leached by rain would be diminished because much of the mercury in the paint would outgas. If about 50 percent of the 1.62×10^8 µg of mercury were lost to the atmosphere, then about 8.1×10^7 µg of mercury would remain. The organomercurial fungicides such as PMA in latex paint apparently convert to elemental mercury once the paint dries; this is consistent with the behavior of PMA in soils, which has been found to convert to elemental mercury (Kimura and Miller, 1964). The amount of mercury that would leach from applied latex paint depends on the solubility of the mercury remaining in the paint. Although PMA is fairly soluble in water (4.37×10^6 µg/L), elemental mercury is not (6.39×10^{-1} µg/L) in air-free water at 25 °C (Cotton and Wilkinson, 1980). Because elemental mercury reacts with nitric acid (Merck, 1983), the dilute nitric acid component of acid rain perhaps could render any elemental mercury more soluble, however.

Figure 28 shows annual consumption of mercury for mildew retardant in paint used by December 31 for the years 1959-89. If national data can be considered representative of what transpired in New Jersey, the peaks of manufacture of paint containing mercury, and, presumably, use, took place between 1968 and 1980, approximately 14 to 26 years ago. Although the ages of the mercury-contaminated water samples have not been determined, contaminated water from the deeper wells (120 to 200 ft) in the site data base is likely to be as old as 30 years, and, at 200 ft, could be older than 50 years. If the assumptions about paint use are correct, and mercury from paint can be assumed to reach ground water, then the oldest mercury-contaminated ground water may be less likely to contain mercury derived from paint than is younger water. Therefore, mercury leached from paint is unlikely to be the only source of mercury contamination of ground water because the largest amounts of mercury used in paint appear to date to a time period more recent than the likely ages of the deepest mercury-contaminated water. Further, there are no data to indicate whether any mercury is leached from paint by precipitation.

Mercury also was used in marine anti-fouling paints. The mercury in these paints typically was in oxide form and fairly insoluble (Merck, 1983), although some low-solubility organomercurial compounds also were used (D'Itri, 1972). Areas where paint would have been scraped from, and applied to, boat hulls are undoubtedly present in southern New Jersey. Mercuric oxide is soluble in dilute solutions of hydrochloric and nitric acid, which are components of "acid rain." Although it appears possible that some mercury could leach from anti-fouling paint debris, it is likely that activities involving marine paints would be concentrated along the shores of estuaries and the ocean, which typically are areas of ground-water discharge rather than ground-water recharge. Only if substantial pumping were drawing water from a seaward direction toward land would contaminants along the shore be likely to enter nearby inland wells.

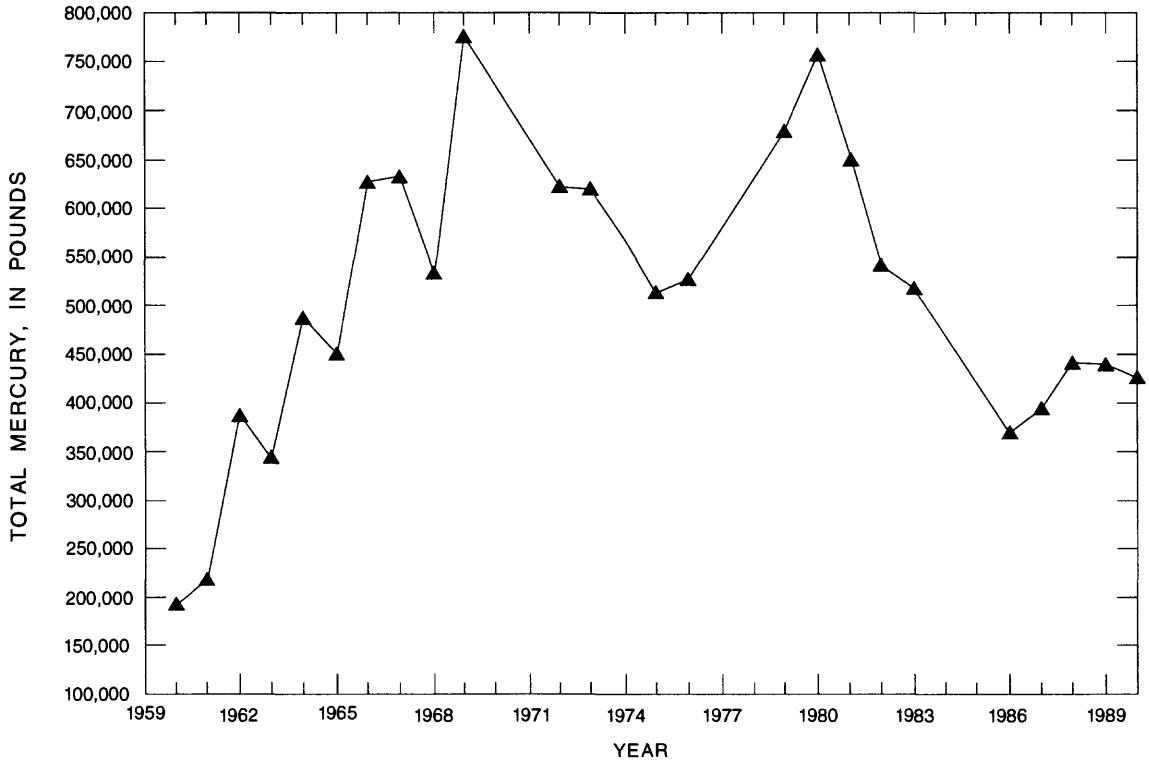


Figure 28. Pounds of mercury used in paint manufactured in the United States. (Data from Michael Aucott, New Jersey Department of Environmental Protection, calculated from raw data in Minerals Yearbooks, U.S. Department of the Interior, Bureau of Mines, 1959-1989, written commun., 1994).

Washing paint brushes after use could contribute mercury to septic systems. Although the amount of mercury would be diluted by rinse water and other household water, the mass of mercury contributed by paint in a large paintbrush is estimated to range from about 190 to about 475 times greater than the mass calculated to be contributed annually by chlorine bleach (using 3 lb/100 gallons as the amount of PMA and 10 to 25 mL as the amount of paint remaining in the brush).

Hypothesis 4: Nonhousehold Point Sources

The possible nonhousehold point sources of mercury in ground water examined in this study include landfills, industrial and commercial sites, military operations, cemeteries, and septic systems at hospitals and schools.

For those Superfund sites where mercury has been identified as a contaminant, the extents of contaminant plumes generally have been defined; the available data do not conclusively link these sites to any of the 34 sites of elevated mercury concentrations in ground water identified in this report. Any Superfund site within 3 mi of one or more of the 34 sites of elevated mercury concentrations in ground water was examined to determine whether the Superfund site was upgradient from any of the 34 sites. One site appears to be upgradient from site 5, another upgradient from site 24. The Superfund site adjacent to site 5 is in a residential neighborhood similar to that at site 5. Mercury was detected in water from several domestic wells at the Superfund site adjacent to site 5, but the mercury was not linked specifically to the potential point sources of VOC's discovered at that site, nor did USEPA link contamination at site 5 to the adjacent Superfund site (unpublished U.S. Environmental Protection Agency Record of Decision Summary, September 4, 1990, on file at New Jersey Department of Environmental Protection, Trenton, N.J.). The Superfund site near site 24 is discussed in the following section on landfills.

Landfills

A substantial number of landfills are present in southern New Jersey. Because the State issues permits for and requires the installation of monitoring wells at these sites, data are available for the permitted landfills that allow the NJDEP to assess flow directions of shallow ground water and to determine whether significant amounts of contaminated ground water are emanating from the landfills. Figure 29 shows the locations of the 34 sites of elevated mercury concentrations in ground water and locations of permitted landfills. Data on concentrations of mercury in water from monitoring wells at these landfills, collected as part of the NJPDES program, are contained in appendix 3; of course, no data are available for "casual" (unpermitted and illegal) dump sites, unless such sites are undergoing investigation by NJDEP or another agency.

All the 13 sites of elevated mercury concentrations in ground water that had been investigated before this study began are within 3 mi of one or more landfills. Landfills commonly are sited on high ground, but most of the sites of elevated mercury concentrations in ground water also are located in upland areas. Ground-water flow directions were assessed by examining locations of landfills relative to locations of basin divides, streams, and the sites of elevated mercury concentrations in ground water as well as water-table maps (Watt and Johnson, 1992; Watt and others, 1994;

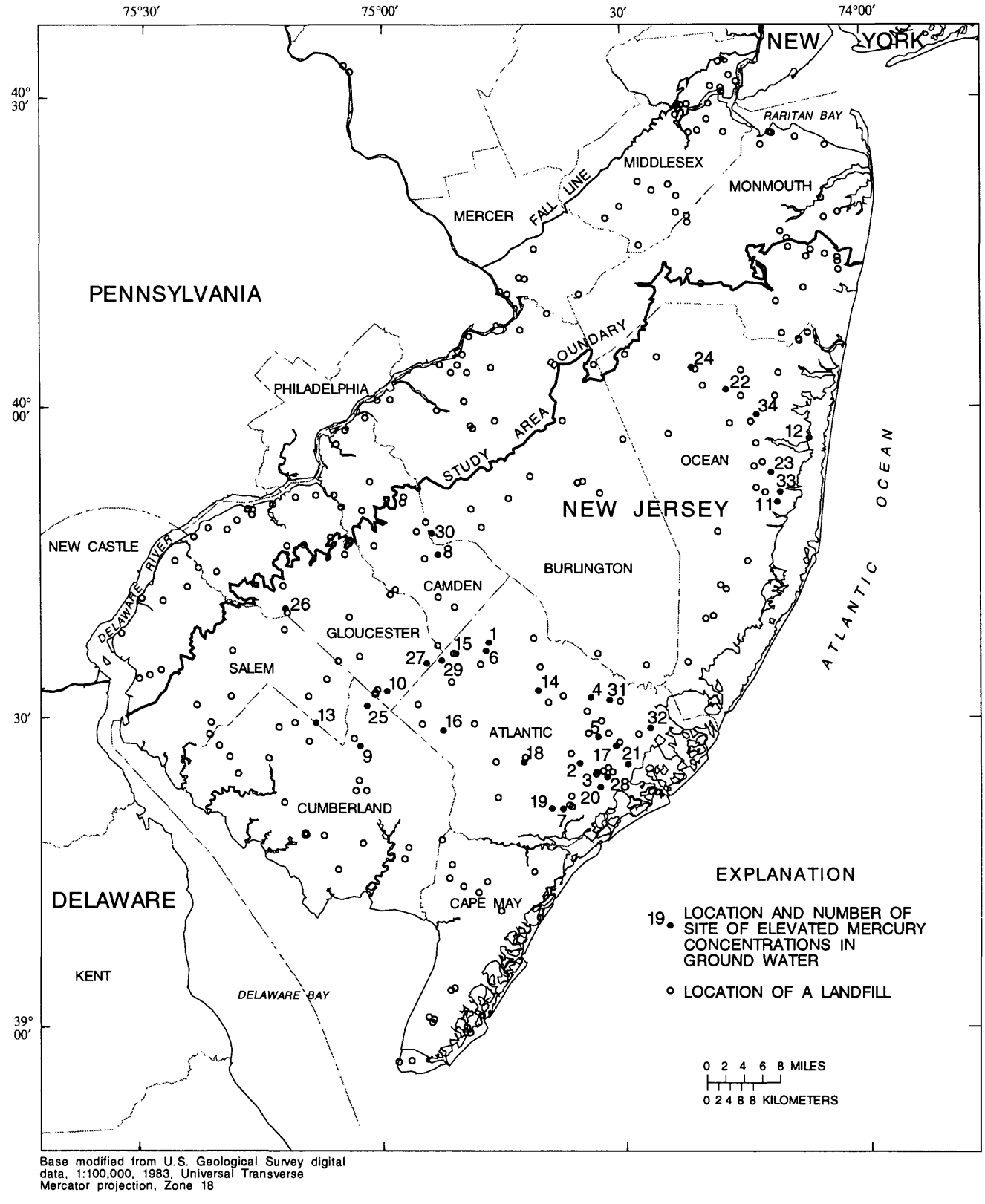


Figure 29. Locations of 34 sites of elevated mercury concentrations in ground water and locations of permitted landfills, New Jersey Coastal Plain.

Johnson and Watt, 1996; Clark and Paulachok, 1989) of parts of Atlantic and Ocean Counties also were examined. Although several of the sites of elevated mercury concentrations in ground water appeared to be downgradient from a landfill, subsequent assessment of more site-specific ground-water flow data (unpublished data on file at N.J. Department of Environmental Protection, Trenton, N.J.) indicated that ground water from the landfills generally did not flow toward the nearest site of elevated mercury concentrations in ground water. No data are available with which to assess the effect that pumped wells at the various housing developments might have on the ground-water flow field, however.

Figure 30 shows water-table contours and directions of the horizontal component of ground-water flow for parts of Atlantic, Burlington, Camden, and Gloucester Counties and the locations of 12 sites of elevated mercury concentrations in ground water and adjacent landfills. The density of landfills and sites of elevated mercury concentrations in ground water is high in the area shown. With the exception of site 10 (already discussed) and site 15, the landfills shown in figure 30 generally are 1 mi or more from the sites of elevated mercury concentrations in ground water. In Atlantic County, a landfill is adjacent to homes at site 15; domestic wells closest to the landfill yield water containing mercury concentrations less than 1 µg/L. Because the landfill is located between site 15 and Great Egg Harbor river, ground water probably flows toward the river. No data are available to indicate whether pumping from the domestic wells has altered the ground-water flow directions such that contaminants from the landfill could move toward site 15.

Also in Atlantic County, a landfill 0.75 mi northwest of site 21 is located in what appears to be an upgradient direction. No mercury was detected in water from monitoring wells at the landfill, however (appendix 3, NJPDES permit number 55891). Similarly, a landfill is located about 0.5 mi north of site 18, but water from monitoring wells at the landfill contains mercury in concentrations that are less than the MCL or undetectable (see appendix 3, NJPDES permit number 54241). A former dump, now a Superfund site associated with VOC and metal contamination of ground water, is located within 0.5 mi northwest of site 31. Ground water from the Superfund site flows northeast, however, toward a tributary to the Mullica River. A municipal landfill is located just east of site 31; a monitoring well at the landfill has yielded water containing 60.4 µg/L mercury (see appendix 3, NJPDES permit number 54411). On the basis of topography, however, the landfill appears to be downgradient from site 31. Ground-water flow directions inferred from the water-table map of Johnson and Watt (1996) also indicate that flow from the area of the landfill is probably to the northeast and east, rather than to the west toward site 31.

A landfill that is also a Superfund site is near sites 22 and 24 in Ocean County. On the basis of water-table contours, it appears that the landfill may be upgradient from site 22 (fig. 31). Because the landfill is near site 24 and was believed to be the source of VOC's to about 100 domestic wells (unpublished data on file at N.J. Department of Environmental Protection, Trenton, N.J.), it has the potential to have been a source of mercury to some domestic wells. The available data do not confirm this possibility, however. As is the case with other sites investigated as part of this study, many possible sources of mercury other than landfills exist, and the sources of VOC's and mercury in the ground water are not necessarily the same.

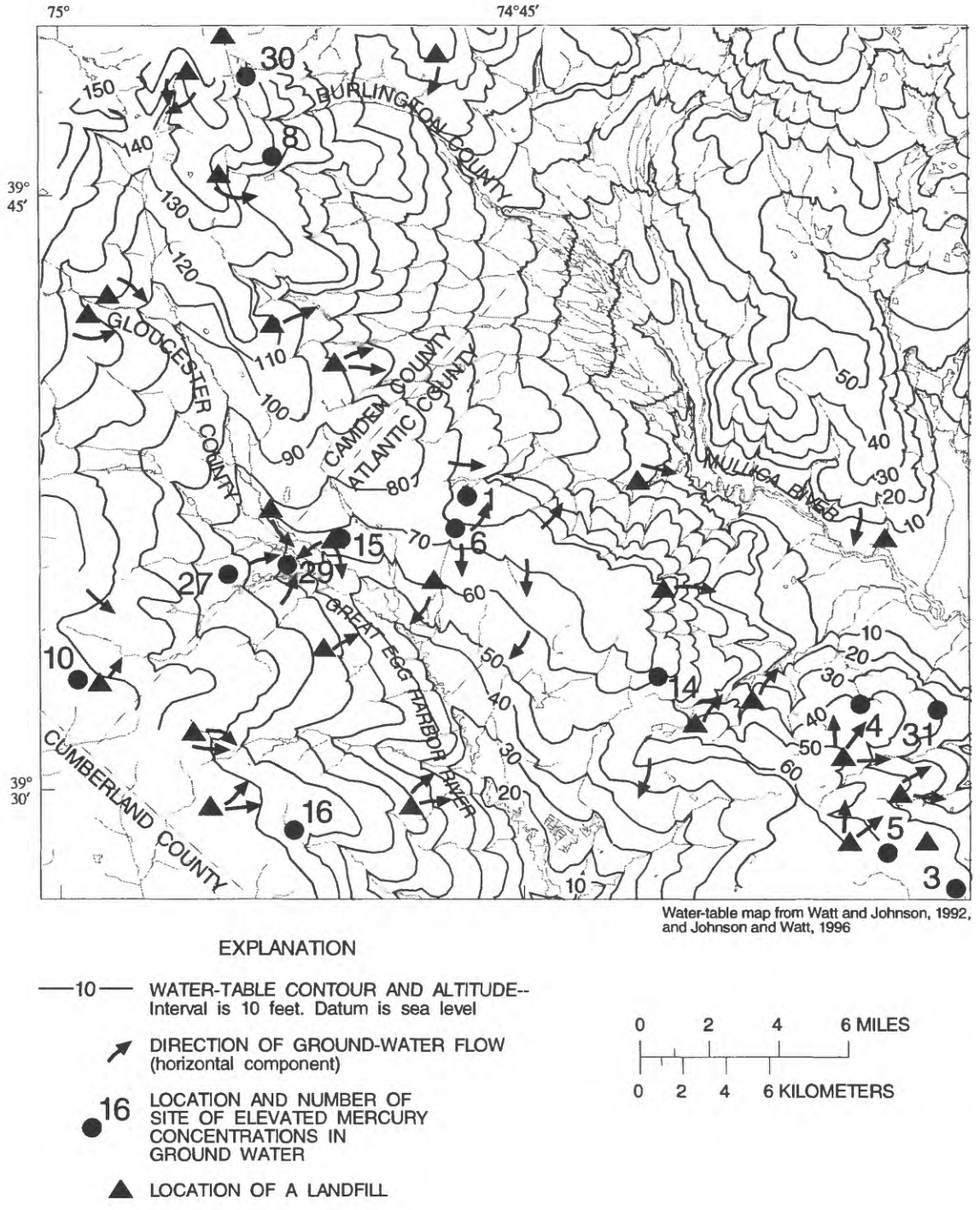


Figure 30. Water-table contours, direction of the horizontal component of ground-water flow, and locations of sites of elevated mercury concentrations in ground water and landfills, in parts of Atlantic, Burlington, Camden, and Gloucester Counties, New Jersey.

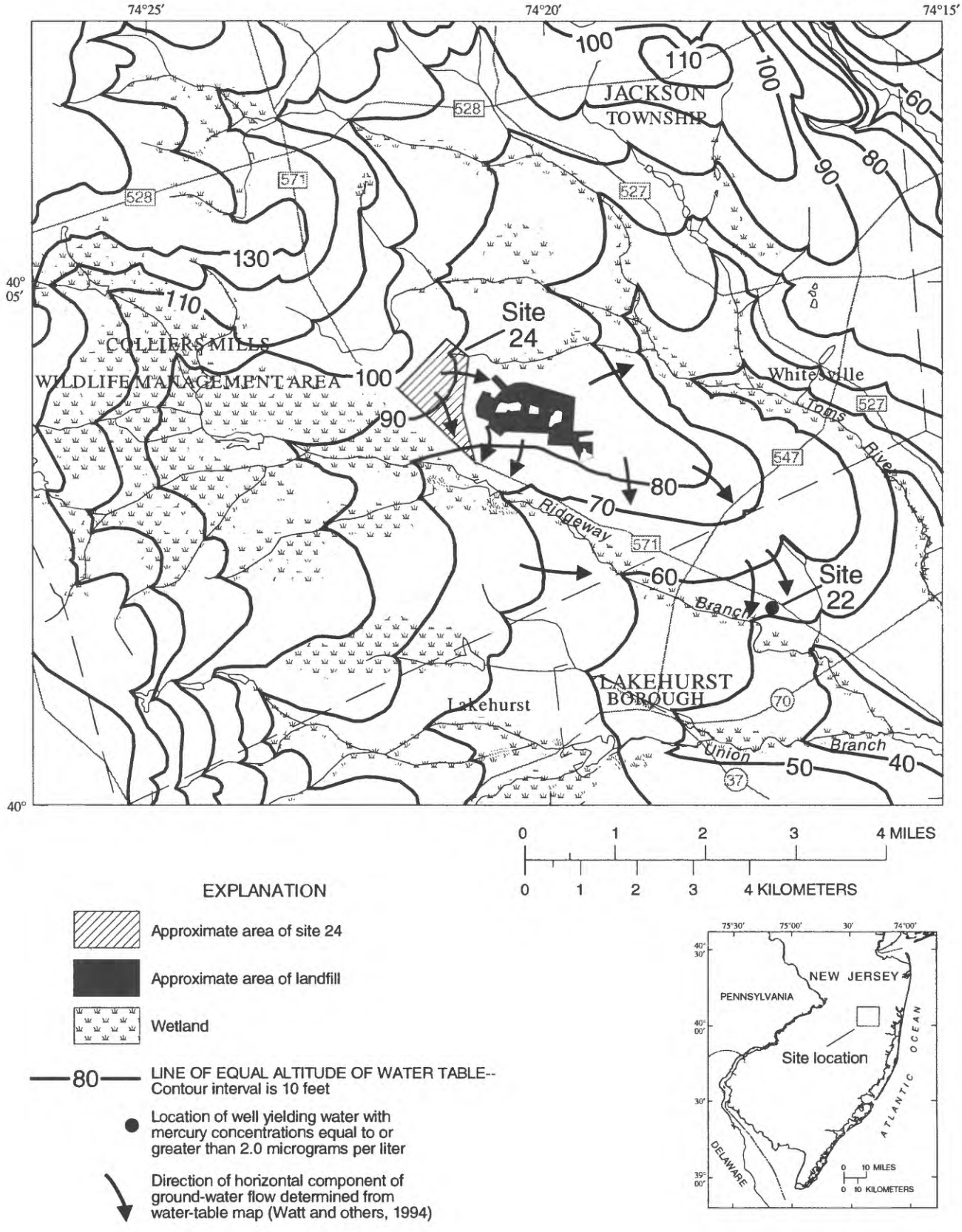


Figure 31. Water-table contours, direction of the horizontal component of ground-water flow, and locations of sites 22 and 24 and a nearby landfill, Jackson and Manchester Townships, Ocean County, New Jersey. (Modified from Watt and others, 1994)

Domestic wells near several other Ocean County landfills have been sampled. No water samples from these wells have been found to contain mercury in concentrations above the reporting limit.

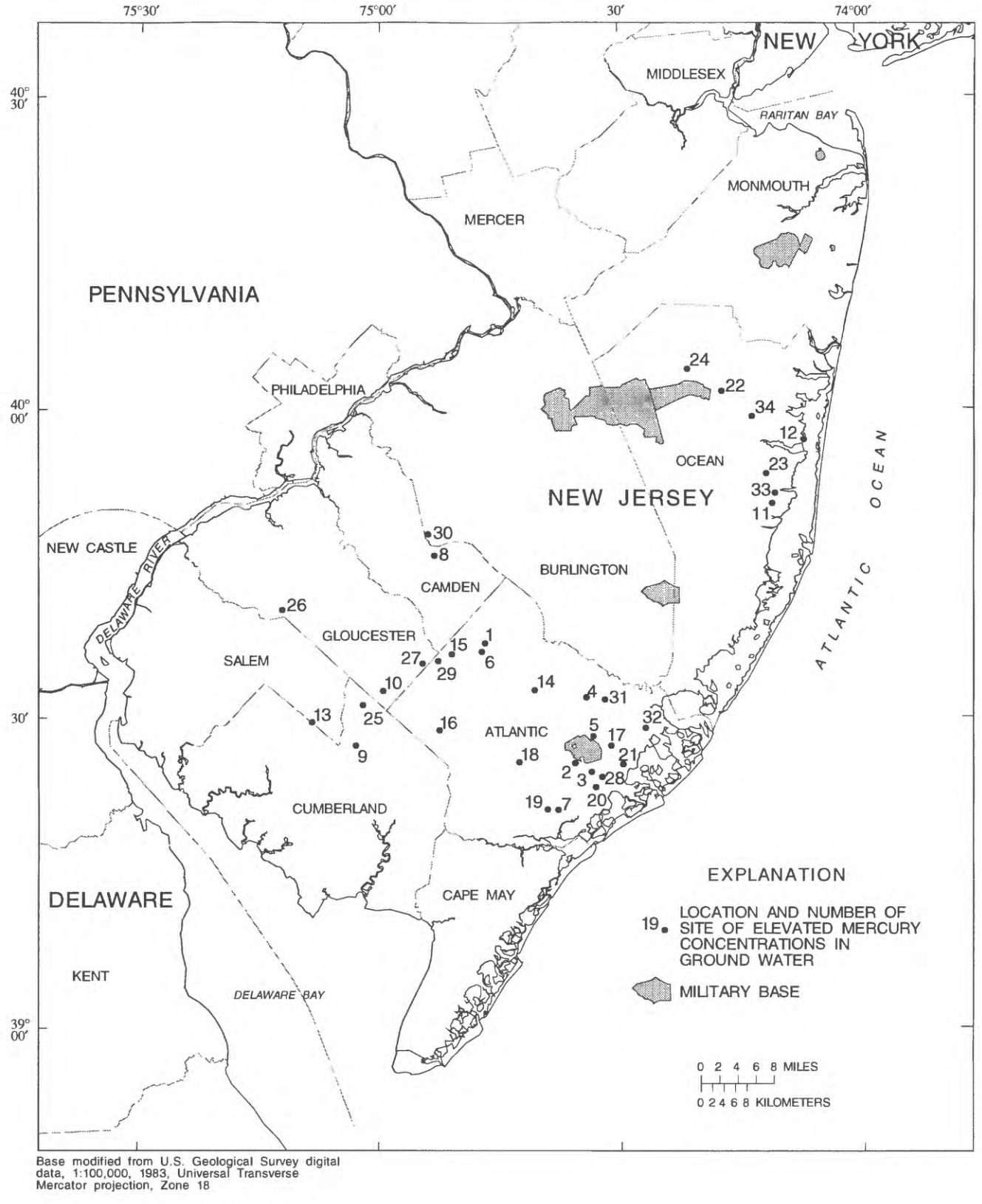
In general, results of analyses of water-quality samples from landfill monitoring wells (app. 3) indicate that mercury concentrations in the shallow ground water tapped by the wells at the majority (56.8 percent) of the landfills are either not detectable or low (generally about 0.2-2.0 µg/L). In some instances, however, one or more monitoring wells at a landfill have yielded water with mercury concentrations greatly exceeding the MCL. One or more monitoring wells at 18 percent of the landfills have yielded water in which mercury concentrations were greater than, or equal to, 10 µg/L; at 12.5 percent of the landfills, one or more wells yielded water with mercury concentrations of 20 µg/L or greater. Some of these facilities are located several miles from one or more of the 34 sites of mercury-contaminated water identified during this study. For most of those facilities located within 1 mi of one of the 34 sites, ground water generally does not appear to flow from the landfill toward the site.

Although the likelihood of contamination from casual dump sites is difficult to assess because the existence of such sites typically is not known, casual dumping of hazardous materials in the past could be a possible source of mercury in ground water at the 34 sites. Examination of historic aerial photographs of the areas of the 34 sites did not reveal many landscape features that could be identified clearly as past casual dump sites. Several scarred areas near sites of elevated mercury concentrations in ground water were noted; these appear to have been sand- and gravel-mining operations. Mercury-bearing wastes could have been disposed of at some of these gravel pits. For example, monitoring wells at gravel pits near site 7 have yielded water with mercury concentrations that vary from 40 to 1,300 µg/L (see appendix 3), but on the basis of available data, ground water from these pits does not appear to flow directly toward site 7 (unpublished Ground-Water Impact Area Report, December 1991, on file at N.J. Department of Environmental Protection, Trenton, N.J.).

Military Installations

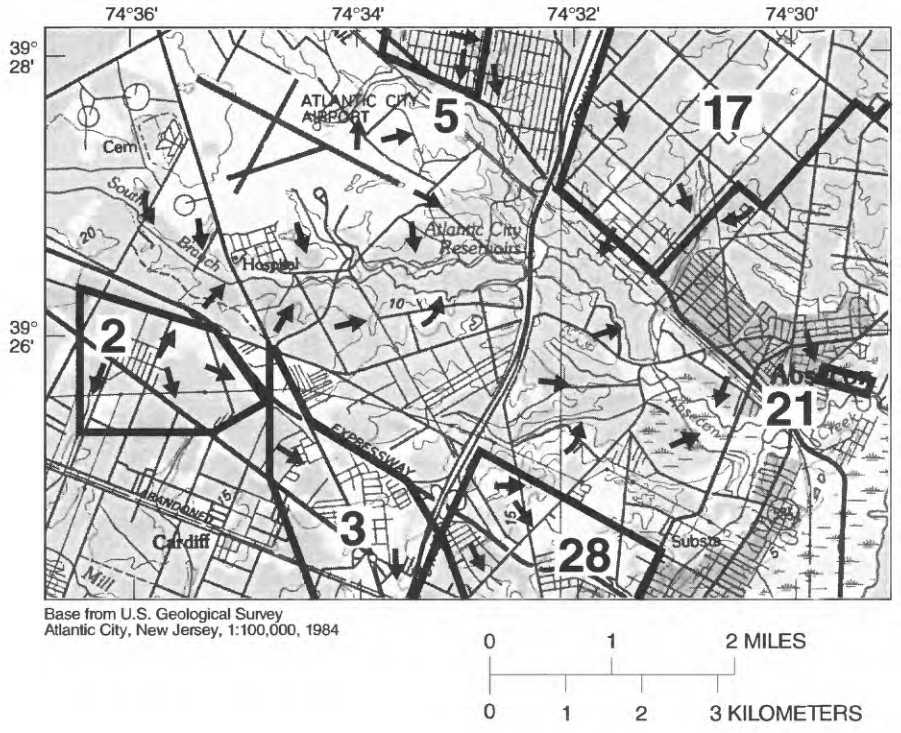
Locations of military and other U.S. government installations in southern New Jersey are shown in figure 32. At one installation, which includes the Federal Aviation Administration Technical Center (formerly NAFEC) and the Atlantic City International Airport, a sewage outfall to South Branch known to be a source of mercury and other contaminants was present--this outfall was sealed in 1992 (Edward Stevenson, N.J. Department of Environmental Protection, oral commun., 1994). Ground water at the airport has been found to be contaminated with jet fuel and VOC's; remediation is underway (unpublished data on file at N.J. Department of Environmental Protection, Trenton, N.J.). Although sites 2, 3, 5, 6, and 17 are all about 1 mi from the airport, an examination of topography and locations of streams and reservoirs indicates that shallow ground water from the airport probably discharges to flanking streams (South Branch and North Branch) and toward the Atlantic City Reservoir, which separate the airport from these sites (fig. 33).

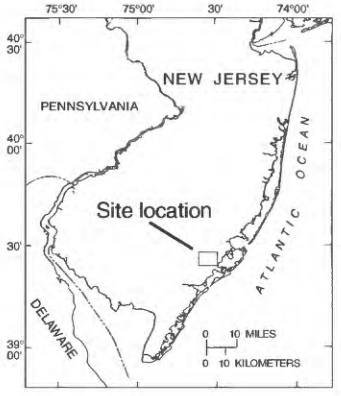
Lakehurst Naval Air Engineering Center (NAEC) is located about 2 mi from site 24, and several Superfund sites are located within its perimeter (fig. 34). The contaminants at most of these sites are VOC's. Water from some wells at the NAEC has



Base modified from U.S. Geological Survey digital data, 1:100,000, 1983, Universal Transverse Mercator projection, Zone 18

Figure 32. Locations of operational military and other U.S. Government installations, and sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain.

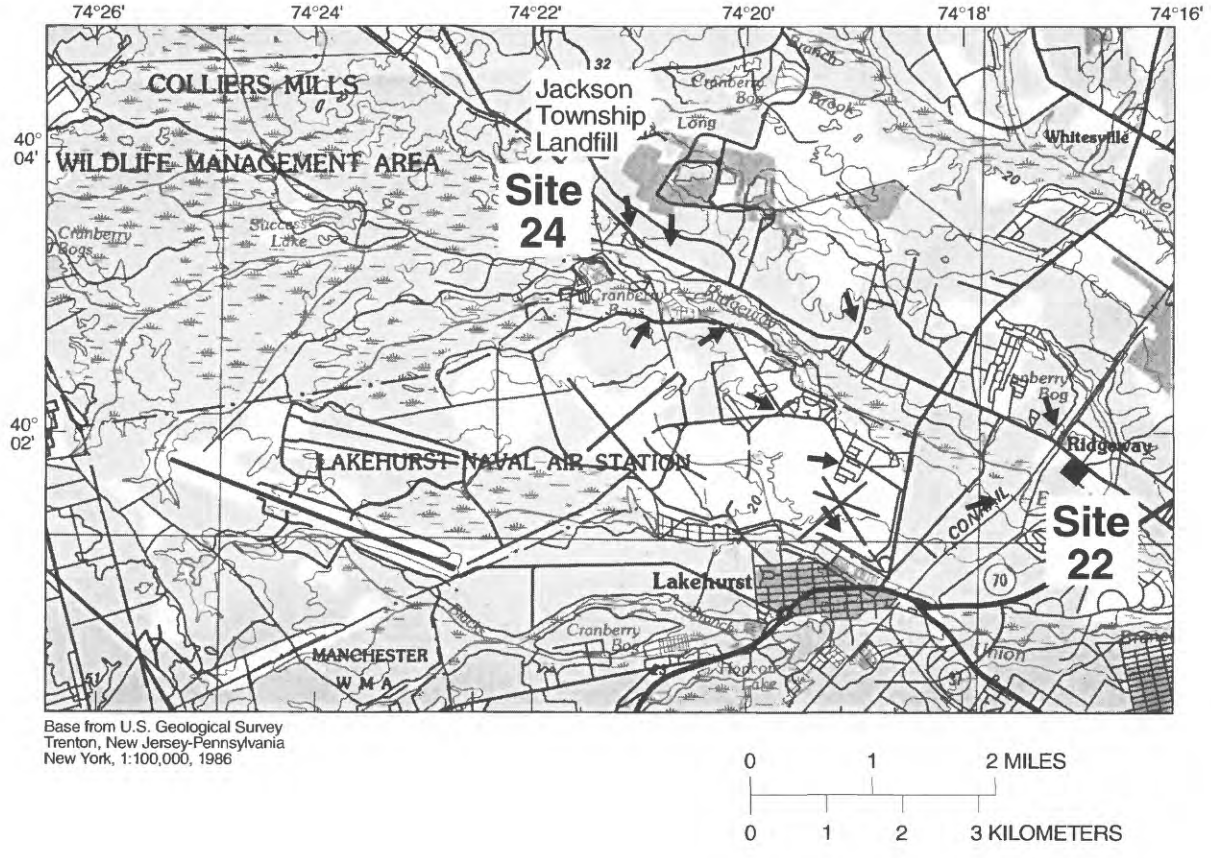




EXPLANATION

Direction of horizontal component of ground-water flow determined from water-table map (Clark and Paulachok, 1989)

Figure 33. Locations of the Federal Aviation Administration Technical Center (formerly National Air Facilities Experimental Center, or NAFEC)-Atlantic City International Airport, and surrounding sites of elevated mercury concentrations in ground water, Atlantic County, New Jersey.



EXPLANATION

Direction of horizontal component of ground-water flow determined from water-table map (Watt and others, 1994)

Figure 34. Locations of the Lakehurst Naval Air Engineering Center (Naval Air Station) and sites 22 and 24, Ocean County, New Jersey.

been sampled and analyzed for mercury; a water sample from the Distribution Center well contained 2 µg/L mercury in 1978, but, when the well was resampled in 1985, the water contained only 1 µg/L mercury. Insofar as the NAEC is bounded on both north and south by wetlands and streams that flow east-southeast, and site 24 is northwest of the NAEC beyond the Ridgeway Branch, it is unlikely that ground water from the NAEC would be in hydraulic connection with the water tapped by wells at site 24 (fig. 34). Site 22, where three out of four samples have contained mercury in detectable concentrations (one above the MCL), is located on the opposite bank of Ridgeway Branch from the NAEC. Shallow ground water at site 22 would be expected to discharge southward to Ridgeway Branch (also see fig. 31).

Aerial photographs were searched for evidence of former military installations, and several were identified in 1930's photographs. One former installation was located at the site of the Amotol Racetrack in Atlantic County (fig. 35). This installation was a World War I munitions factory where mercury, commonly a component in the fuses of bombs, may have been used. Sites 1 and 6 are about 2 mi from this former facility, but whether the former munitions factory is a source of ground-water contamination is unknown. A water-table map developed by Clark and Paulachok (1989) indicates that the racetrack on the munitions-plant site is located on a local water-table high with flow directions diverging to the south, east, and northeast. It seems unlikely that ground water from Amotol Racetrack would flow northwest and, therefore, toward sites 1 and 6.

Industrial and Commercial Sites

Given the generally rural nature of much of southern New Jersey, the number of industrial sites in the study area is relatively small compared with the heavily industrialized areas along the Delaware River, west of the study area. Most industrial sites in the study area are near or within towns and small cities, such as Vineland. Some industrial sites are associated with metal contamination of soils, surface water, and/or ground water resulting from past activities such as metal plating, pesticide production, and metal reclamation, and some are active Superfund sites for which a significant amount of data are available and for which point sources of contamination have been identified. Substantial data also are available for hazardous-waste sites investigated by NJDEP. Locations of hazardous-waste sites, some of which are industrial sites and some of which are landfills, are shown in figure 36.

A pesticide-manufacturing site in Cumberland County, now a Superfund site, has been determined to be a source of substantial arsenic contamination of soils, surface water, lake and stream sediments, and ground water (Ebasco, 1989). Mercury also was found at the site. Although located 1.2 mi southwest of site 25, this Superfund site is clearly downgradient from site 25, as it is located adjacent to a major tributary of the Maurice River, which is 0.9 mi west of the Superfund site. Water-borne contamination has been shown to have moved from the site toward the tributary and the Maurice River (Ebasco, 1989).

Another Superfund site where metals were and are used is associated with a manufacturing and processing facility in Ocean County, located about 1 mi west of site 34. Toms River, a substantial ground-water discharge area, intervenes between site 34 and the Superfund site. Ground-water flow in the area of site 34 is westward, toward

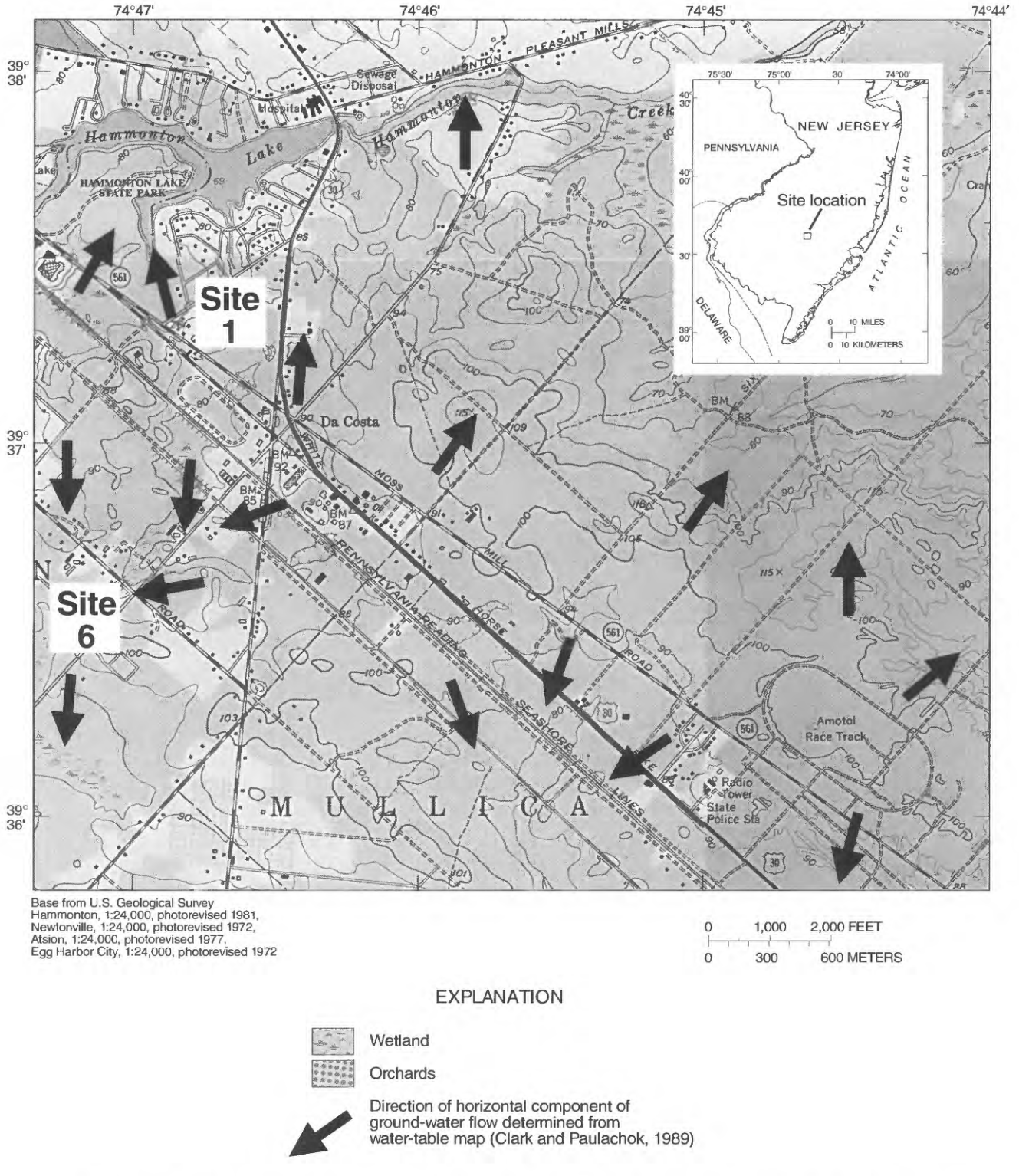


Figure 35. Locations of the Amotol Racetrack, site of a former World War I munitions factory, and sites 1 and 6, Atlantic County, New Jersey.

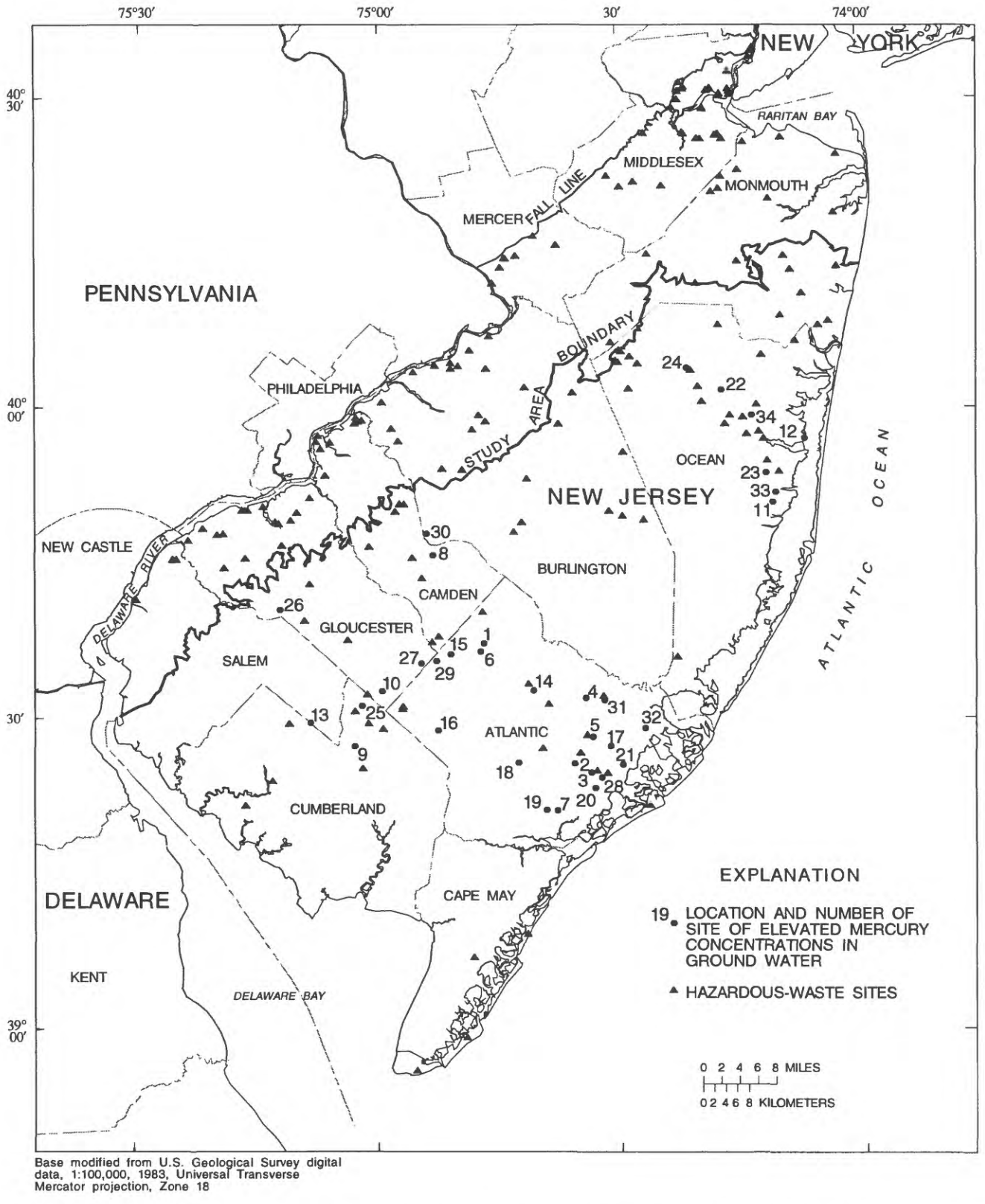


Figure 36. Locations of hazardous-waste sites and 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain.

the river. Wells in the area of site 34 were last sampled by USEPA in 1991; the only contaminants found were mercury and low concentrations of TCE. Wells between site 34 and the Superfund site also were sampled, and yielded contaminant-free water (Stephen Cipot, U.S. Environmental Protection Agency, Region II, New York, oral commun., 1995).

A metal-polishing and purification plant, located in an agricultural area on the outskirts of Hammonton, discharged mercury waste to the ground and to an infiltration lagoon. This plant, no longer in operation, is about 2.4 mi north of site 1; ground-water flow at the plant is toward tributaries to the Mullica River, one of which intervenes between the plant and site 1, as does Hammonton Lake.

In addition to metal-plating, polishing, and reclamation activities and pesticide manufacturing, mercury has been used in the manufacturing of some glass products. Fluorescent bulbs and high-intensity street lamps contain mercury (Faust and Aly, 1981). Glassware made for scientific use is calibrated by using liquid mercury. Several glass-manufacturing operations are listed in NJPDES files (appendix 3, permit numbers 4171, 50474, 53627, 57908, 81370), but their use of mercury, if any, is not known to the authors. Although mercury has been detected in water from some of the monitoring wells at these sites, no concentrations that exceed the MCL have been reported. One glass manufacturer in Millville, Cumberland County, is located 3 mi south-southeast of site 9 (figs. 1 and 22), but ground-water flow at the glass plant is unlikely to be toward site 9. Another glass manufacturer is located 0.5 mi from the nearest houses in site 16 (fig. 1) in Buena Vista Township, Atlantic County. Mercury has not been detected in water samples from monitoring wells at this facility (appendix 3, permit number 50474). Mercury was detected in water from two production wells that tap deeper water than the monitoring wells at this facility, however.

At or near the 13 original sites of elevated mercury concentrations in ground water investigated by either NJDEP or USEPA, no existing industrial sources of metal contamination were identified. But because the water containing elevated mercury concentrations is tapped by wells at all 34 sites at depths indicative of relatively old water (20 to 50 years old), contamination apparently has been introduced by past, rather than present, activities. The existence of past industrial operations, no longer in existence, is difficult to verify.

In particular, small industrial operations, such as the thermometer "factory" in a house at site 10 in Franklin Township, Gloucester County, existed in the past, but are difficult to discover unless anecdotal evidence can be collected. In the case of the former thermometer factory, although water from two wells on the property contained no detectable mercury, available data on local ground-water flow are insufficient to determine the role, if any, of the factory in the mercury contamination of ground water at site 10.

Other potential sources of mercury contamination are various enterprises that have used mercury or mercury compounds. These could include commercial laboratories, dentists' offices, and funeral homes (if mercury compounds are used in embalming activities). A laboratory in Hamilton Township, Atlantic County, in operation since 1968, has produced wastewaters containing VOC's and metals

(Charles, 1989), but results of analyses of water samples from monitoring wells indicate that mercury has not been detected in the ground water (appendix 3, NJPDES permit number 70301). The only available American study of mercury discharges from dentists' offices (Metro, 1991) indicates that, of the eight Seattle, Washington, dentists' offices studied, wastewaters contained from 12 to 196 mg/L of mercury, with a mean concentration of 150 mg/L. (Welland, who prepared the study for Metro, estimates that about 14 percent of the mercury load to the Seattle sewer system comes from dentists' offices.) No information, other than outdated telephone directories, on past locations of dentists' offices near the 34 sites in southern New Jersey was available at the time of this study. Additionally, no data are available to indicate that wastes from the septic systems at dentists' offices or at funeral parlors are a threat to potable water supplies in southern New Jersey.

Commercial enterprises that handle various wastes are also potential sources of contaminants. The waste transfer station at site 2 has been studied; at the time of the study, ground-water flow at the station was determined to be in a direction away from most of the domestic wells at site 2, but subsequent review of water-level data by NJDEP indicates that local ground-water flow may be more complex than originally envisioned (unpublished Ground-Water Impact Area Report, June 1991, on file at N.J. Department of Environmental Protection, Trenton, N.J.). Although concentrations of mercury in water from monitoring wells at the station were not found to be elevated initially, subsequent samples contained mercury in concentrations above the MCL. It is not known whether this mercury results from activities at the waste-transfer station, or whether its source is related to previous land uses.

Commercial enterprises, like industrial operations, if they can be considered to be possible contaminant sources to some of the 34 sites of elevated mercury concentrations in ground water, would have discharged mercury to ground water in the past because of the depths at which mercury contamination is found. The data from the study of Seattle dentists' offices indicates that discharges of mercury to the waste stream can be large from this source. On the basis of available data for New Jersey, no known industrial or commercial sources of mercury can be linked conclusively to any of the 34 sites of elevated mercury concentrations in ground water, however.

Cemeteries

Because arsenic was used in embalming during the 19th century, cemeteries dating to the mid-19th century have been suggested as possible sources of arsenic contamination of ground water (Gass, 1990). Mercuric chloride also has been used in embalming (Merck, 1983, p. 839). No study documenting ground-water contamination with mercury (either from embalming fluids or from mercury/silver amalgam dental fillings) from cemeteries is known to the authors, however. In order for contaminants to emanate from cemeteries, caskets would need to be breached by corrosive ground water. The shallow ground water in the Kirkwood-Cohansey aquifer system is highly corrosive (Barringer and others, 1993), but, on the basis of measurements of corrosion rates of steel (Barringer, 1994), steel 3 mm (0.12 in.) thick would be breached in approximately 20 years if the corrosion rate remained constant. Because a buildup of corrosion products, such as iron hydroxide, slows the corrosion rate over time, it is unlikely that steel caskets would be corroded through in so short a period of time as 20 years. Therefore, it is likely that any contamination from cemeteries would emanate only from those that date to the 19th or the early 20th century.

From available hydrologic data, it was determined during this study that few of the sites of elevated mercury concentrations in ground water were located downgradient from cemeteries (figs. 37 and 38). On the basis of available information on local hydrology and age of the cemetery, it appears that cemeteries do not represent a likely source of the mercury contamination of ground water at the 13 original sites. Of the sites shown in figure 37, where both sites and cemeteries are densely clustered, most cemeteries are located several miles from the nearest site or are located in another surface-water drainage basin. In addition to the cemetery at site 10 (discussed earlier), the two other cemeteries that are closest to sites of elevated mercury concentrations in ground water are located southeast of site 26 and north of site 18. The cemetery near site 26, although only about 1,500 ft distant, appears to be downgradient from the well at site 26. The cemetery near site 18 may be upgradient from that site. More site-specific information on ground-water quality at different depths and locations is needed to further assess the validity of the hypothesis that cemeteries can be point sources of mercury contamination in ground water.

Other Nonhousehold Point Sources

Other possible nonhousehold point sources not included in the previous categories are the septic systems of hospitals (including nursing homes) and school or college septic systems that receive waste from the school laboratories.

Hospitals have used various pharmaceuticals containing mercury in the past and also have used mercury thermometers. Disposal practices for mercurial pharmaceuticals and for broken thermometers during the past 50 years are not likely to have been documented. The authors assume that some mercury-bearing waste may have been disposed of into the septic systems at such facilities, if they have septic systems rather than being served by municipal sewer lines. Of the hospitals in Atlantic County, one is located across a lake from site 1; as discussed previously, the lake receives ground-water discharge and, thus, presumably represents a hydraulic barrier to ground-water flow toward site 1 from the north. Another facility is located adjacent to site 5; no data are available in NJDEP files to indicate any contaminant discharges to ground water from this facility, and flow directions shown in figure 18 suggest that ground water from the hospital probably does not flow toward site 5, but obliquely away from it. No hospitals are within about 2 mi of any of the sites in Ocean or Gloucester Counties, as indicated by county maps from the 1980's, nor are any listed in NJDEP files as discharging contaminants to ground water. Monitoring wells at a hospital in Salem County with a NJPDES permit for ground-water discharges yield water with concentrations of mercury ranging from 0.90 to 4.3 µg/L (appendix 3, NJPDES permit number 99571), but the hospital is located 4 mi from site 13 and more than 5 mi from site 26. Monitoring wells at another hospital in Camden County have yielded water with mercury concentrations ranging from nondetectable to 3.00 µg/L; this facility is more than 5 mi from sites 1, 6, 8, 15, and 29.

It appears unlikely that school laboratories would be places in which mercury compounds would be used routinely. Thermometers, on the other hand, probably would be used routinely, and breakage probably is not uncommon. Typical disposal practices in school laboratories over the past 50 years are unknown, but, if any elemental mercury reached the school's septic systems, it would need to be dissolved in order to contaminate the surrounding ground water. The solubility of elemental mercury in water is very low; its solubility in sewage effluent is not known. No school septic systems are listed in NJDEP files as discharging mercury to ground water.

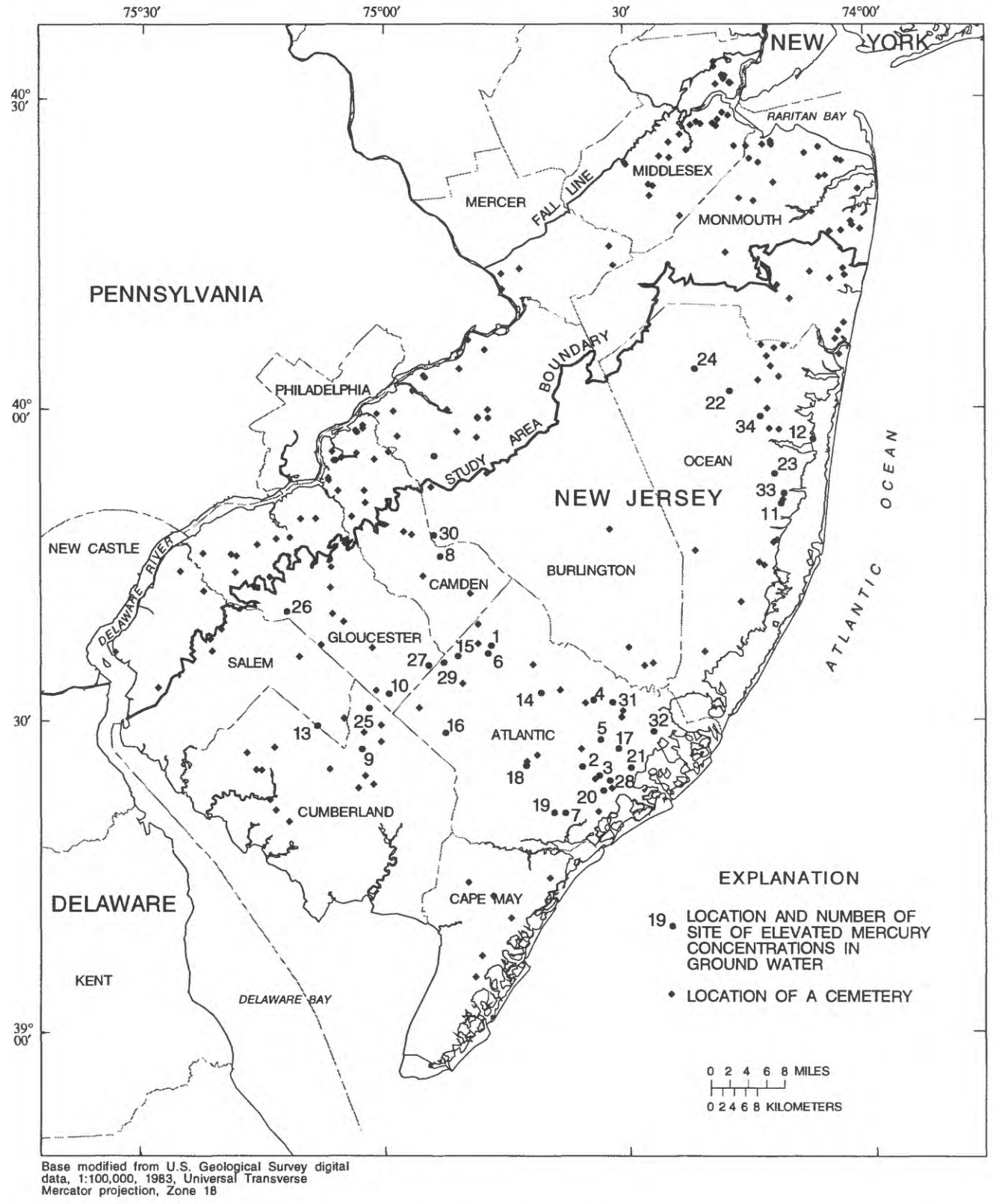
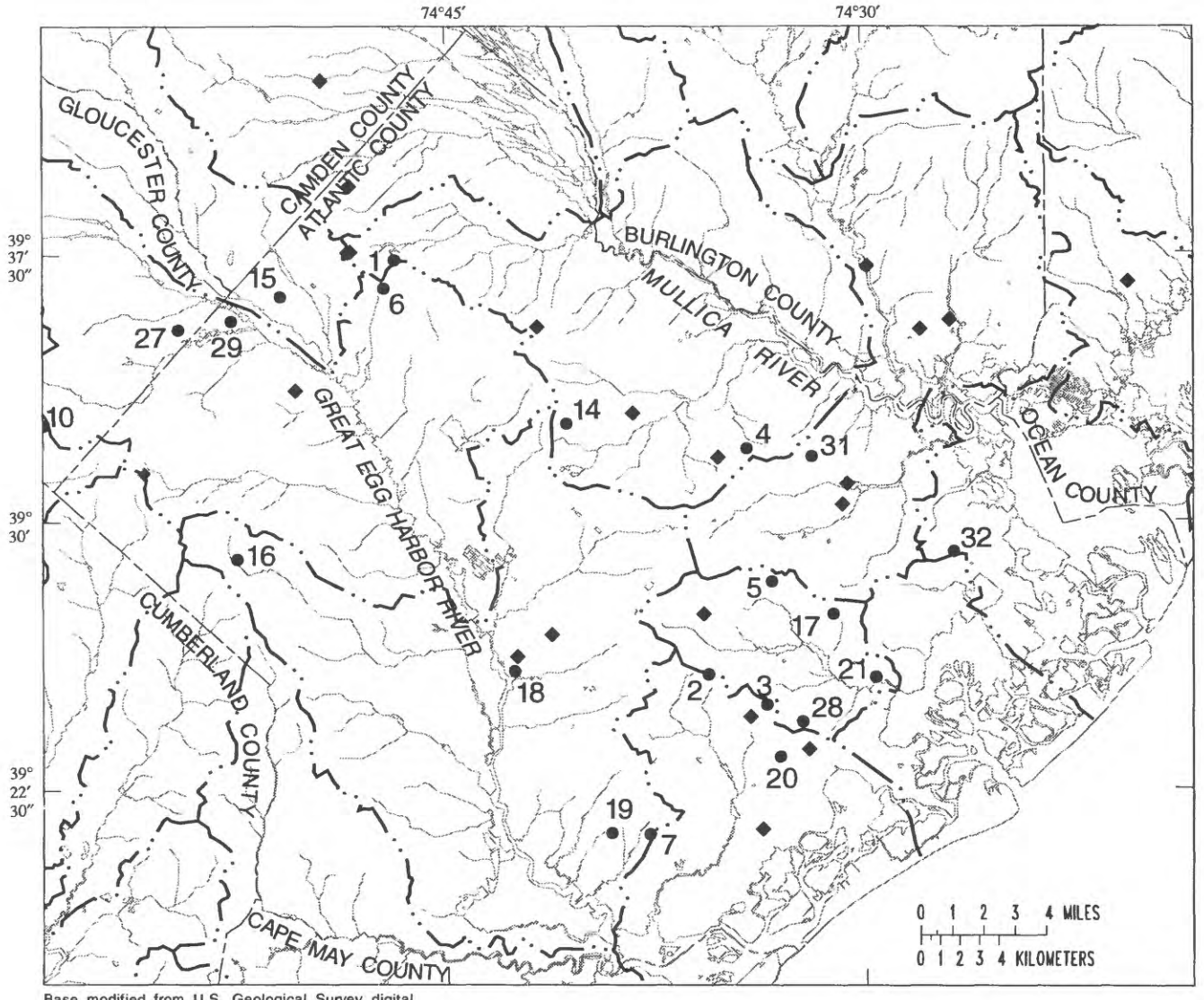


Figure 37. Locations of cemeteries and sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain.



Base modified from U.S. Geological Survey digital data, 1:100,000, 1983, Universal Transverse Mercator projection, Zone 18

EXPLANATION

DRAINAGE-BASIN BOUNDARY

19 LOCATION AND NUMBER OF SITE OF ELEVATED MERCURY CONCENTRATIONS IN GROUND WATER

LOCATION OF A CEMETERY

Figure 38. Locations of cemeteries and sites of elevated mercury concentrations in ground water in Atlantic County, New Jersey.

Available data indicate that hospitals can be point sources of mercury to ground water, but the two that are known sources are unlikely to be sources to any of the 34 sites of elevated mercury concentrations in ground water. Currently, no data are available to indicate whether school septic systems can be sources of mercury to ground water. Many of the 34 sites are within 3 mi of a school, but there are no data that support the hypothesis that these are possible sources of mercury contamination.

Mercury manometers used at gas industry metering sites along gas pipelines are another possible source of mercury. Spills that may occur through vandalism or leaking at fittings are usually confined to the metering house (Harju, 1992). Although this possible source has not yet been investigated, no contamination relating to such a source was found in the report "Known contaminated sites in New Jersey" recently released by NJDEP (N.J. Department of Environmental Protection, 1994).

Hypothesis 5: Atmospheric Deposition

Mercury can enter the atmosphere naturally through outgassing of mercury vapor from the ocean and continental rocks, and from volcanic emissions. Anthropogenic contributions to the atmosphere from industrial emissions, incinerators, fossil-fuel burning, and outgassing from numerous materials and compounds are substantial, however, and concentrations of mercury in the atmosphere have been shown to increase over time (Slemr and Langer, 1992). Lindqvist and others (1991) attribute 40 percent of mercury emissions to natural sources and the remaining 60 percent to anthropogenic emissions; however, researchers do not agree on the percentages contributed by various human activities.

Reported concentrations of total mercury detected in air, measured in several places in the Northern Hemisphere, range from 0.5 (remote ocean air) to 1,700 (power-plant plume) ng/m^3; measured values depend on location and proximity to an emissions source (Glass and others, 1991; Nriagu, 1990; Lindqvist and Rodhe, 1985; Lindberg, 1987; Johnson and Braman, 1974). Mercury concentrations in air in rural and remote areas generally have been found to be less than 10 ng/m^3 (N.J. Department of Environmental Protection and Energy, 1993a). Recent measurements of mercury in air in northern New Jersey indicate that background (ambient) levels, which range from 0.08 to 20 ng/m^3 (Greenberg and others, 1992), are similar to global background levels, which range from less than 1 to 9 ng/m^3 (N.J. Department of Environmental Protection and Energy, 1993a).

Most of the mercury (80-95 percent) in the atmosphere has been found to be either the elemental (Hg^0) or the oxidized form Hg^{2+}; mercury sorbed to particles constitutes the rest of the atmospheric mercury burden (N.J. Department of Environmental Protection and Energy, 1993a). The elemental mercury can be oxidized to soluble forms such as $HgCl_2$, which are then washed out in precipitation (Lindqvist and Rodhe, 1985). Although precipitation washes mercury out of the atmosphere, in some areas washout does not result in a substantial decrease in atmospheric mercury (Moore and Ramamoorthy, 1984, p. 135). It has been estimated that up to 10 percent of atmospheric mercury is actually washed out during a precipitation event (Glass and others, 1991).

Concentrations of mercury in precipitation generally range from 1 to 100 ng/L. Glass and others (1991) and WHO (World Health Organization, 1990) report ranges of 5 to 100 ng/L; Glass and others (1986) report a range of 50 to 100 ng/L; and Lindqvist and Rodhe (1985) report 5 to 75 ng/L. In pristine areas, mercury concentrations in precipitation have been reported to range from 1 to 60 ng/L (N.J. Department of Environmental Protection and Energy, 1993a). Concentrations as high as 3,400 ng/L have been measured in industrial areas, however (Glass and others, 1986). Recent analyses of mercury in precipitation in the Coastal Plain of New Jersey indicate a range of concentrations from 5 to 60 ng/L. In southern New Jersey, concentrations in the samples collected in the City of Camden ranged from 19 to 60 ng/L; samples collected in Lebanon State Forest in Burlington County, to the east of Camden, ranged from 14 to 18 ng/L (Edward Stevenson, N.J. Department of Environmental Protection, written commun., 1993). The data probably indicate a decrease in mercury concentration with distance from urban/industrial areas. Whether this distribution of concentrations would have been observed in precipitation 50 years ago is not known. Sources of mercury emissions not emitting today probably were present then: some houses may have been heated by coal; coal-burning railroad engines were in use 50 years ago; and scrubbers or similar devices may not have been in use on industrial smoke stacks.

Wet deposition (rain and snow) is not the only vehicle for mercury deposition on the land surface. Mercury also reaches the land surface as dry deposition. Few data are available on dry-deposition rates for mercury, but Lindqvist and others (1991) estimate 2.5 to 5 $(\mu g/m^2)/yr$ as urban and industrial values.

It is possible to calculate roughly the mass of mercury deposited on New Jersey soils. An elevated-emissions scenario could be assumed by using values input to a NJDEP generic model of above-background emissions from a hypothetical incinerator that burns waste with a composition typical of current municipal waste (N.J. Department of Environmental Protection and Energy, 1993a, p. 88-89). If dry deposition of mercury from the incinerator is 1.4 $(\mu g/m^2)/yr$ (N.J. Department of Environmental Protection and Energy, 1993a, p. 93) plus 2.5 $(\mu g/m^2)/yr$ as background urban dry deposition, and wet deposition is 47 $(\mu g/m^2)/yr$ (N.J. Department of Environmental Protection and Energy, 1993a, p. 42), then about 2.06×10^5 µg of mercury is deposited from the atmosphere each year on a 1-acre (0.4-hectare) plot in the immediate vicinity of the hypothetical incinerator. A mean value of 19.2 $(\mu g/m^2)/yr$ (N.J. Department of Environmental Protection and Energy, 1993a, p. A-13) from wet deposition rates reported by Glass and others (1991) is probably appropriate to represent regional background values. If values of 19.2 $(\mu g/m^2)/yr$ for background wet deposition and 1.4 $(\mu g/m^2)/yr$ from local-emissions dry deposition are used, then 8.34×10^4 µg of mercury could be deposited on 1 acre far (10 or more mi) from the incinerator and urban area each year. If the amount of dry deposition is the same far from the incinerator and urban area as near them, then 9.35×10^4 µg of mercury could be deposited on 1 acre each year.

The mercury-deposition data used in the calculations above are from the 1980's and 1990's. Data from earlier decades are sparse, and none are available from New Jersey. Some data for the United States indicate that mercury deposition has decreased in recent years. Interpretations of mercury levels in peat cores from Minnesota indicate that mercury deposition increased by an order of magnitude during the first half of the 20th century but that, by the 1980's, deposition had decreased by more than a factor of 2 (Douglas, 1994). If it is assumed that the mean mercury-

deposition rates in New Jersey in the 1950's were double the present rates, then 1 acre far from an urban area could have received about 1.67×10^5 to 1.87×10^5 µg/yr of mercury at a time when, on the basis of depth of affected ground water, it appears that mercury was being leached from soils into ground water.

The hypothesis that atmospheric deposition was the source of the mercury in ground water was advanced early in the course of the present study. Most of the incinerators and power plants in New Jersey that have the potential to disseminate mercury into the atmosphere are located more than 10 mi from the 34 sites of elevated mercury concentrations in ground water (fig. 39). Only the power plant in northern Cape May County is located within a few miles of one of the 34 sites. The incinerator in Mercer County began operation in 1993, so it cannot be considered a source of mercury to ground water at the 34 sites. Oil refineries, which can produce airborne mercury contaminants (Haidouti, 1991), are located along the Delaware River, more than 10 mi from the study area.

Spatial gradients in atmospheric-mercury deposition might be expected; mercury deposition would be higher near sources of mercury emissions, but would be relatively continuous over the landscape. Were atmospheric mercury the principal source of mercury in ground water, a relatively continuous pattern of mercury occurrences in ground water would be expected, if leaching from soils, ground-water flow velocities, and ground-water chemistry were relatively uniform.

Although most of the mercury-concentration data for ground water are clustered, data for areas other than the 34 sites indicate that the observed areal patterns of mercury occurrences in ground water appear to be scattered rather than continuous. The vertical distribution indicates that elevated concentrations of mercury typically are measured in samples of deep, older ground water, but seldom have been measured in samples of shallow, younger ground water. Water samples collected in 1978 from 36 shallow (15-46 ft) observation wells in Wharton State Forest in southern New Jersey contained no detectable concentrations of dissolved mercury. Several other shallow observation wells in forested areas were sampled in 1984; mercury was not detected in ground water at these sites either (see fig. 7 for locations). Results of recent (1992) sampling and analysis of shallow (35 ft) ground water at a site in Wharton State Forest indicated that dissolved mercury was not detectable. These data, coupled with an apparent paucity of mercury in elevated concentrations in water from wells less than 50 ft deep at the 34 sites of elevated mercury concentrations in ground water, appear to indicate that relatively little mercury is leaching into recently recharged ground water. Nevertheless, the number of shallow wells available for sampling is small relative to the number of deeper wells sampled.

The observed distributions of mercury detections in ground water, both areally and vertically, appear to indicate that mercury has leached from land surface to ground water in discrete areas and episodes. The available data do not support a conceptual model of atmospheric deposition of mercury that moves directly to ground water. If atmospherically deposited mercury has moved to ground water at any of the 34 sites, it has done so presumably because it was mobilized from the soils during some discrete time period by some agent or process, either chemical or physical or both. A comparison of the distribution of mercury in soils from forested areas with that in the disturbed soils at several of the sites of elevated mercury concentrations in ground water helps to illustrate this point.

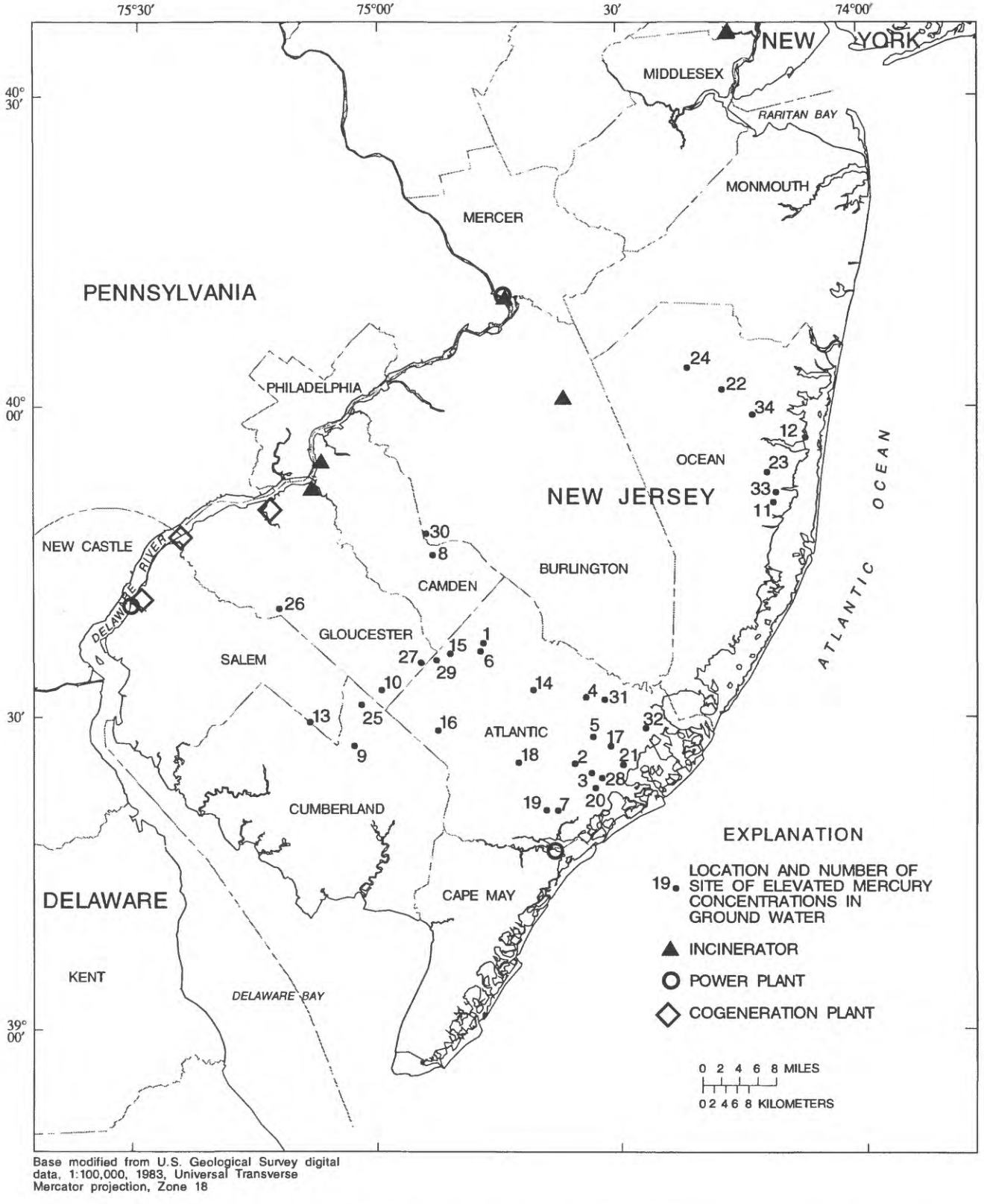


Figure 39. Locations of incinerators, power plants, and cogeneration plants and sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain.

The highest concentrations of mercury in two sets of forest-soil samples (WF-2a and 2d, 2-12a and c, table 10) were found in the organic (O) horizon, and the B horizon, where clays and iron oxides accumulate. Mercury is known to sorb to organic matter, to clays, and to iron oxides, which explains the distribution of mercury in the forest soils. Mercury in the disturbed soils was distributed relatively evenly throughout the soil column, however. Moreover, disturbed soils (table 10) sampled at several sites of elevated mercury concentrations in ground water contained substantially less mercury than did the forest soils, which could indicate that some mercury has been mobilized and has leached from the disturbed soils.

Hypothesis 6: Land-Applied Substances

Early histories of southern New Jersey report that industrial activity was located primarily along the Delaware River near Philadelphia, and the Great Egg Harbor, Maurice, and Mullica Rivers in the study area. Much of the land in the study area was undeveloped and the primary land use was farming. Aerial photographs from 1940-62 indicate that, in the period immediately after World War II, many of the areas underlain by ground water containing elevated mercury concentrations included farms on which row crops, ornamental plants, and tree fruit were grown. Pesticides containing mercury apparently were used routinely in the United States before and after World War II. Solutions of inorganic mercury compounds, both mercuric chloride and mercurous chloride, were used as pesticides as early as 1890 (Stevens, 1971), and their use continued during the first half of the 20th century. During the period from the mid-1950's to the 1970's, organomercurial pesticides, principally PMA (C_8H_8HgO), were used on ornamental plants and fruit trees. Organomercurials also were used as seed treatments for a variety of crops (Michael Aucott, N.J. Department of Environmental Protection, written commun., 1994). In a warning about the poisonous nature of various pesticides a brochure first issued in 1924 and revised in 1951 by the U.S. Department of Agriculture states, "When a chemical solution has been applied as a spray, any part of it remaining unused should be poured out in such a way that it will sink into the ground and not stand in puddles." (U.S. Department of Agriculture, 1951a, p. 14). Although this does not quantify historic contamination, it indicates that common practices could have affected quantity and distribution of contaminants applied to the land surface.

The land-use pattern in southern New Jersey began to change after World War II, and, from the 1950's to the present day, many of the farms have become housing developments. Nonetheless, agriculture still accounts for a substantial proportion of the various land uses in southern New Jersey, and the agronomic literature indicates that the use of PMA on various crops in the United States continued until this compound was banned for use on agricultural crops in 1972. Figure 40 shows the extent of agricultural land use in 1972, as well as locations of the 34 known sites of elevated mercury concentrations in ground water. The agricultural land depicted in figure 40 reflects the diminished extent of agriculture that resulted from the boom in residential development that occurred during the 1950's and 1960's. Figure 41 shows a representative aerial photograph of agricultural land and residential development that includes site 4, Atlantic County, taken in 1951; farm fields comprise about 35-40 percent of the land area shown, and some of the houses in the development at site 4 are already present.

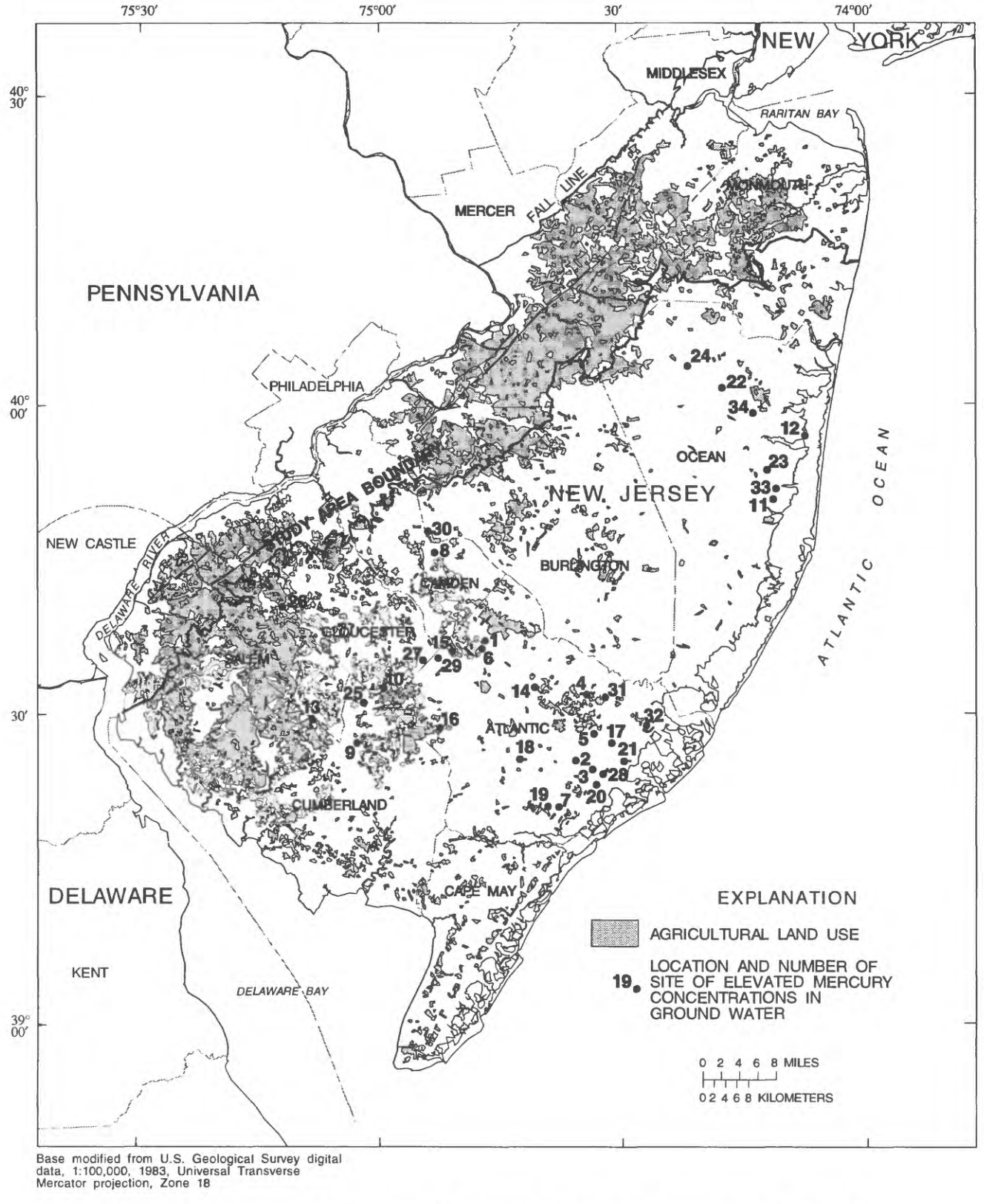


Figure 40. Extent of agricultural land in 1972, and locations of sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain.

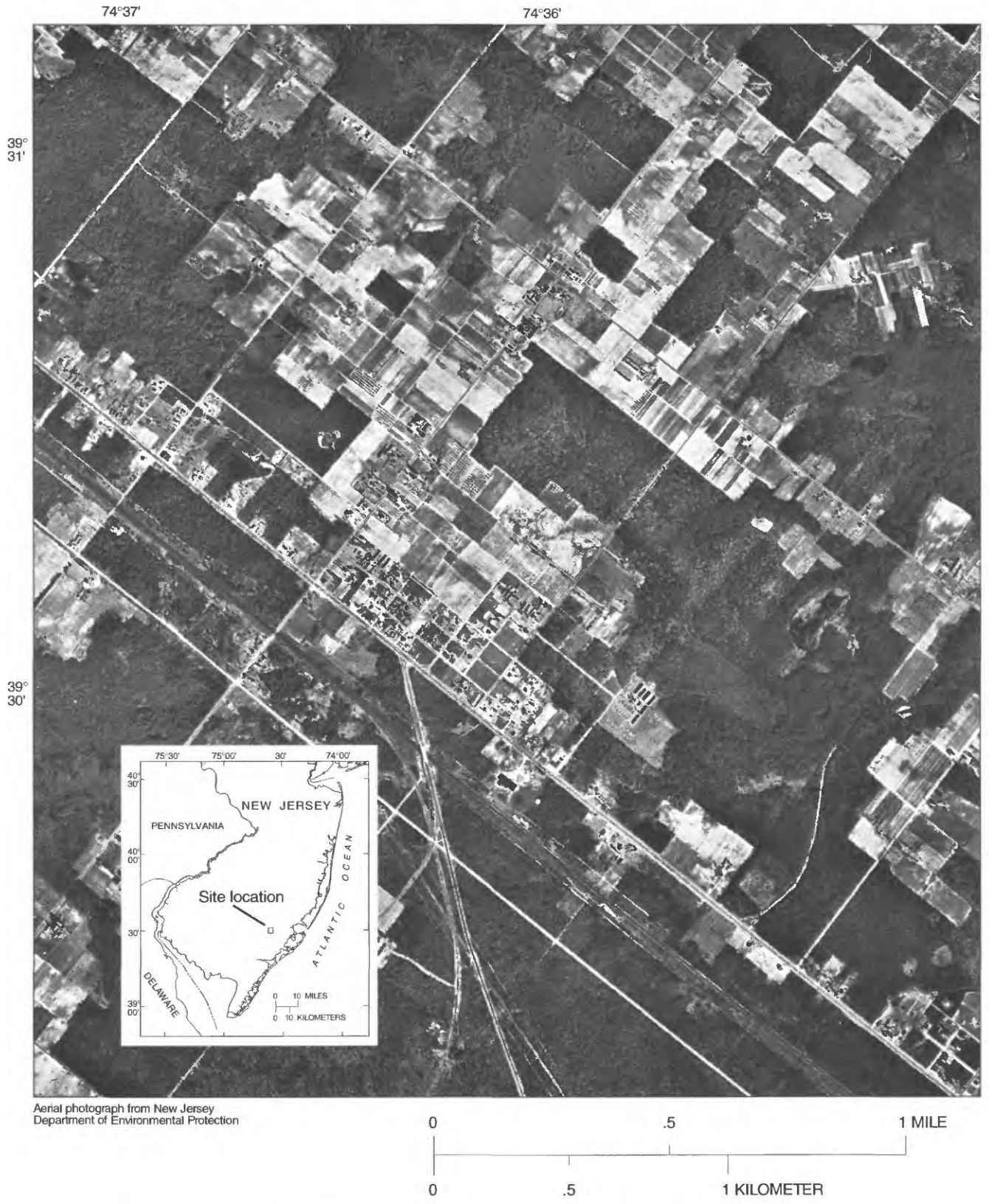


Figure 41. Aerial photograph of site 4 and vicinity, Atlantic County, New Jersey, 1951. (Site 4 is located just below the center of the photograph.)

Because the types of crops in a given area could have changed over time (Jerry Frecon, Gloucester County Agricultural Extension Agent, oral commun., 1993), it is not possible to know with certainty how long a particular type of crop might have been grown in a given area or to determine accurately either how much mercurial pesticide might have been applied to a given site, or for how long. Nevertheless, on the basis of recommended application rates from the agronomic literature, it is possible to calculate an amount of mercury that might have been applied to a given field in 1 year. For example, for mercuric chloride ($HgCl_2$) used to control cabbage maggot, the recommended rates of application could have resulted in 1 to 3 lbs/acre being applied during the 1940's and 1950's (Michael Aucott, N.J. Department of Environmental Protection, written commun., 1994). The $HgCl_2$ was prepared as a solution that contained 0.5 oz of $HgCl_2$ to 5 gal of water and was used to treat 200 to 300 plants. If recommended procedures were followed, the solution would have been applied twice during a growing season (U.S. Department of Agriculture, 1951b). If a cabbage crop of 7,000 plants per acre is assumed, depending on the number of plants treated with each 5-gal solution, from 23 to 35 oz (1.5 to 2.2 lbs) of $HgCl_2$ could have been used per acre per growing season. If a greater density of plants were planted (10,000 per acre) and only 200 plants per 5-gal solution were treated, then 50 oz (or 3.1 lbs) of $HgCl_2$ could have been used per acre per growing season.

The molecular weight of $HgCl_2$ is 271.4a, of which mercury is 73.9 percent. If an application of 3 lbs/acre of $HgCl_2$ is assumed, then 1,360,770 mg of $HgCl_2$ is applied, of which 1,005,600 mg (approximately 1.01×10^6 mg or 1.01×10^9 µg) is mercury. If a low rate of 1 lb/acre were used, then 3.37×10^8 µg of mercury would be applied to an acre during a growing season, which is about twice the amount of mercury estimated to be present in a single application (20 gallons) of house paint containing PMA added at the rate of 3 lb per 100 gallons of paint.

The other inorganic mercury pesticide in use during the first part of the 20th century was calomel, or mercurous chloride (Hg_2Cl_2). This compound contains twice the amount of mercury as does mercuric chloride, the solubility of which is 1 g in 13.5 mL water (Merck, 1983) or 7.4×10^7 µg/L $HgCl_2$. Mercurous chloride is, however, much less soluble in water than is $HgCl_2$ (2×10^3 µg/L) (Merck, 1983)).

If $HgCl_2$ were applied to crops, some of the mercury probably would volatilize. In a series of experiments to determine leachability of several mercury compounds on different soils, Hogg and others (1978) found that only about 80 percent of applied $HgCl_2$ was recovered from a soil containing 86 percent sand; they ascribed the loss either to direct volatilization or to microbial transformation to a more volatile form. These researchers also found that the soil that absorbed the most mercury lost the least through volatilization.

Amacher and others (1990) found that, of five soils used in $HgCl_2$ retention studies, the two with the lowest cation-exchange capacity and low pH (5.1 and 5.4) retained the least mercury in batch experiments. One of these soils was sandy, with characteristics not unlike the soils of the study area. It is possible that mercury is not strongly sorbed to the study-area soils or aquifer materials.

On the basis of data from currently available studies, it is possible to construct a scenario in which 80 percent of the mercury from applied $HgCl_2$ could

move into the soil column, and about 40 to 60 percent (from the Cecil and Windsor soils used by Amacher and others (1990)) could subsequently be released from the soils. At an application rate of 1 lb/acre (3.37×10^8 µg mercury), about 2.70×10^8 µg of that mercury could be available to leach to ground water beneath the 1-acre plot, of which from 1.08×10^8 to 1.62×10^8 µg could be released from the soil.

Although $HgCl_2$ use waned during the 1950's, use of PMA increased nationwide. This compound was also used in Japan, where Inoue and Aomine (1969) estimated maximum application rates at 100 g/ha as mercury (about 4.0×10^7 µg per acre). Saha and McKinlay (1973) report the use of up to 3.4×10^8 µg (as mercury) per acre for control of diseases in fruits and turf in Canada. In New Jersey, organomercurial compounds were recommended as sweet potato seed and sprout dips at a strength of 1 part mercurial compound to 10 parts water and also 1 part to 8 parts (Daines, 1948). Ethyl mercury phosphate was also recommended as a seed treatment for tomatoes (New Jersey Agricultural Experiment Station, 1941). Saha and McKinlay (1973) estimate that, in Canada, about 0.5 g (5×10^5 µg) of mercury is contributed to an acre by seed dressings--this is apparently a "per year" estimate. Although the amount of treated seed used in New Jersey is not known, some mercury from seed dressings could be added to the amount calculated to be applied as a pesticide on various crops.

It is apparent that large amounts of mercury could have been applied to crops in New Jersey in a given year in the past, and some of that mercury could be available to leach into ground water. The data collected on historic land use and summarized in table 12 indicate that agricultural land use was identified at or adjacent to 26 of the 34 sites of elevated mercury concentrations in ground water as far back as about 1950, and even earlier (1940) in some cases. Because fewer data are available for years prior to 1940, the extent of agricultural land use in the vicinity of the 34 sites earlier than 1940 generally is less well known.

On the basis of recommended practices (Pepper, 1942), homeowners also may have used inorganic mercurial pesticides on gardens during the 1940's. Organomercurial compounds were recommended for use on turf to control crabgrass (Wolf and Engel, 1948) and fungal diseases, and also may have been used on ornamental plants. Thus, individual residences as well as agricultural fields could be sources of mercury to the land surface.

Golf courses represent another land use where mercurial pesticides, used to control snow mold, have been registered for use in New Jersey. As of March 1994, both mercurous chloride and mercuric chloride compounds were still registered for use (Roy Meyer, N.J. Department of Environmental Protection, written commun., 1994). A total of about 700 pounds (about 300 Kg) of mercurial pesticides are reported to have been used on New Jersey golf courses in 1993 (N.J. Department of Environmental Protection and Energy, 1993b), which is a relatively small amount compared with that used in more northern, colder areas. (Estes and others (1973) estimate annual fungicide application of 2.1 Kg (as mercury) per hectare on a single golf course in New Hampshire.) Overall, southern New Jersey has fewer golf courses than northern New Jersey, and relatively few of the golf courses in the southern part of the State are located within the study area (fig. 42). Of those golf courses within the study area, most are not located adjacent to, or what appears to be upgradient from, the sites of

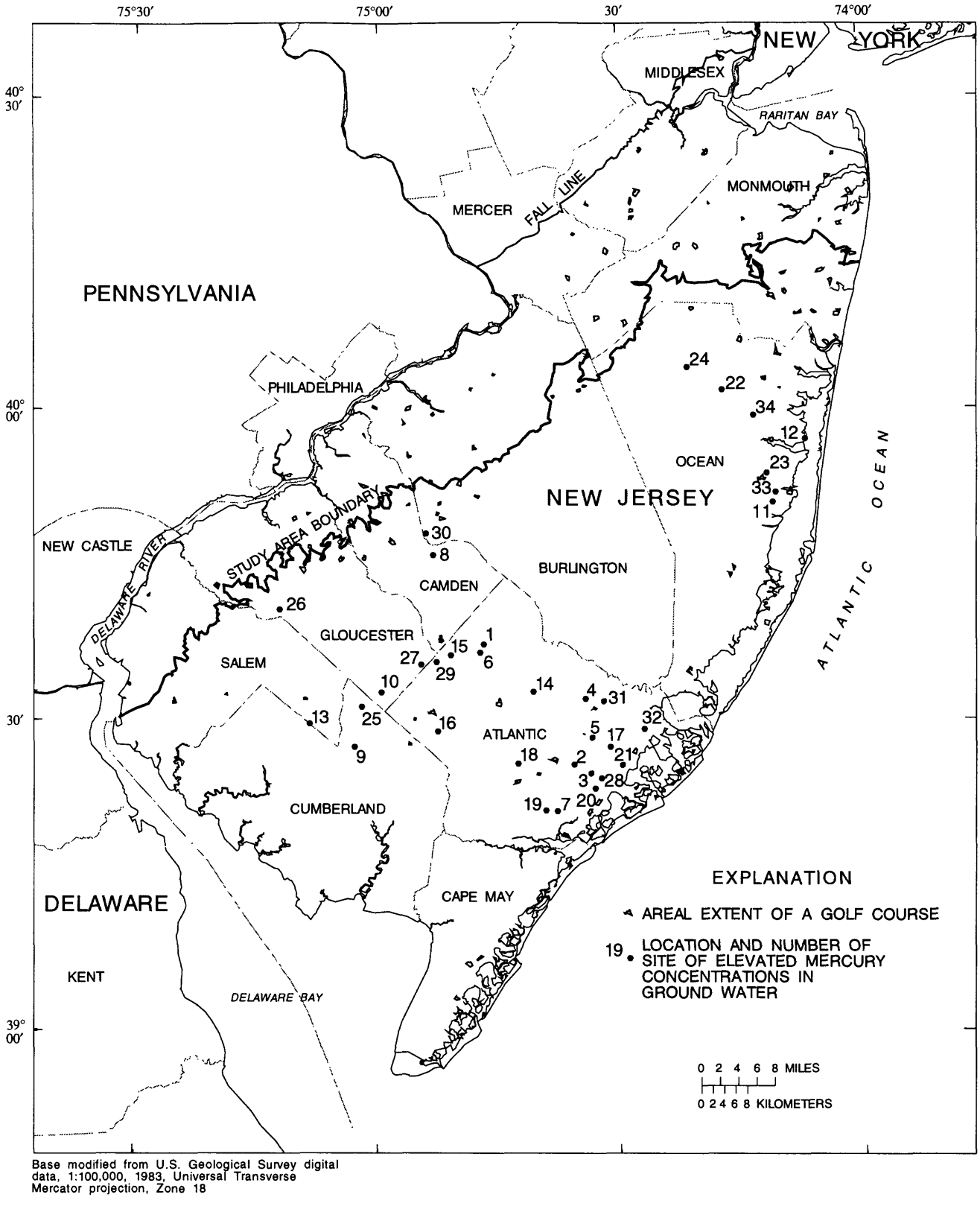


Figure 42. Locations of golf courses with reported pesticide use and locations of sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain.

elevated mercury concentrations in ground water. If mercurial pesticides used recently on golf courses are leaching through the soil, shallow ground water is likely to show the effects of the leaching. No data are available to show whether this is occurring.

Evaluation of the Six Hypotheses

Hypothesis 1: Sampling and Analysis

Significant evidence exists that the many incidences of mercury concentrations in ground water that exceed the MCL represent real environmental contamination and are not the result of contamination during sampling or analysis. Results have been reproducible, as shown in tables 3 and 8, and it is, therefore, likely that the mercury concentrations measured in nearly all of the samples collected and analyzed represent actual mercury concentrations in the ground water. The hypothesis that the observed mercury concentrations are the result of contamination during sample collection and analysis generally does not appear to be tenable.

Hypothesis 2: Pumps

Well-construction data for the 34 sites currently do not support the hypothesis that the pumps installed in private wells are contributing mercury to ground water insofar as no statistical relation was found between pump brand and mercury concentration. The available data are scanty, however, and the composition of the metals in the pumps installed in the wells that yield water with elevated concentrations of mercury is not known. Examination of details of pump construction indicates that the metals that are in contact with water do not include mercury (Karassik and others, 1986). Hypothesis 2 does not explain instances in which the first sampling of a well yields water with detectable mercury concentrations and a second sampling yields water in which mercury is not detected, or the reverse. At present, this hypothesis does not appear tenable, but cannot be ruled out completely without further study of pump materials and construction.

Hypothesis 3: Households

Few data are available that can be used to evaluate the hypothesis that household sources can contribute mercury to ground water. The mercury content of chlorine bleaches used in households at the 34 sites, and what constituted normal household use, are unknown, although it is probably safe to assume that any mercury in bleach would have been substantially diluted during normal household use, as shown by calculations presented earlier. Whether the presumed small amounts of mercury that might be contributed by bleach could accumulate in a septic system is not known, but the amount estimated earlier is negligible compared with other possible sources of mercury. The amount of mercury that could be contributed to the septic system from the washing of paint brushes is small relative to most other possible sources, but may not be negligible.

The presence of VOC's at many of the 34 sites (discussed in previous sections on the 13 original sites) is puzzling, although VOC's and elevated mercury concentrations were not found in the same water sample in many cases. The occurrence of mercury with VOC's in water from some of the wells may be coincidental

rather than an indication of a common source. The VOC's detected in ground water at many of the sites have yet to be traced to industrial or waste-disposal point sources. Because chlorinated solvents such as TCE were commonly used to clean septic tanks prior to the ban on their use in 1981, low concentrations of VOC's could be found in ground water in residential areas if septic-system effluent were reaching wells that contain potable water. Therefore, some instances of VOC contamination of ground water might be attributed to septic-system effluent, but this would not necessarily point to the septic system as the source of mercury as well. The mercury contamination may derive from a different source or sources.

No data are available to show that the mercury in ground water might have been contributed by chlorine used to disinfect wells. Although it is likely that normal household water use would rapidly flush both chlorine and mercury from the well bore and surrounding aquifer in a matter of hours, this supposition cannot currently be substantiated.

Exterior paint is a known source of mercury and could be a source of mercury to soils if mercury is leached from the paint or if mercury that outgasses is redeposited locally. The calculation presented in the earlier discussion on hypothesis 3 indicates that paint could contain a substantial amount of mercury. The amount that might leach from a freshly painted house is not known, nor are data available to indicate how much mercury (presumably elemental mercury) could be leached from Coastal Plain soils with subsequent movement to the water table. Some of the mercury outgassed by the paint could return to the area in precipitation. Data on the amount of mercury released from interior paints, discussed earlier, indicate that the mercury in paint is released over a period of years. The hypothesis that paint could contribute mercury to the 34 sites may be tenable, but additional data on the leachability of mercury from exterior paints are needed to determine the magnitude of that possible contribution. Considering the variety of possible sources of mercury in the New Jersey Coastal Plain, exterior paint, although it may be a substantial reservoir of mercury, is unlikely to be the only source of mercury to ground water. Moreover, were paint a major source of mercury to soils and ground water, the occurrences of elevated mercury concentrations in ground water probably would be substantially more widespread than they currently are known to be.

Hypothesis 4: Nonhousehold Point Sources

The existence of Superfund and other hazardous-waste sites is clear evidence that metals and/or other contaminants can and do leach from point sources such as landfills and industrial sites. Mercury concentrations in water from some of the monitoring wells at NJPDES permitted sites (app. 3) are extremely high, although the majority of the NJPDES sites appear to show little or, in some cases, no local mercury contamination of ground water. On the basis of proximity to the 34 sites and assessment of local hydrology, point sources such as permitted landfills or other known hazardous-waste sites are unlikely to have been sources of mercury to most of the 34 sites. In the few cases where such a possible point source is adjacent to one of the residential sites, only detailed hydrologic assessments, which include installation of monitoring wells at various depths and locations to define the extent of any contaminant plumes, can conclusively rule out such sources. These investigations have been undertaken at several of the hazardous-waste sites, as discussed earlier.

There is no way to assess possible contributions from illegal dumping unless such sites have already been identified and studied.

Small industrial operations, such as the thermometer factory at site 10, are difficult to identify. No data are currently available that conclusively link the thermometer factory at site 10 to the mercury in ground water there. The available land-use data, as well as visits to some sites, have not resulted in identification of other such operations, although others may exist. Available data for Seattle, Washington, indicate that discharges from dentists' offices can contribute large amounts of mercury to the waste streams. No data are currently available for southern New Jersey. Therefore, although small former industrial operations and commercial enterprises are possible sources of mercury to ground water, data currently are insufficient to evaluate these possible sources further, and these sources probably are unlikely to account for all observed occurrences of elevated mercury concentrations in ground water in the New Jersey Coastal Plain.

Military installations are possible sources of metals and other contaminants to ground water. Water-quality and hydrologic data collected and assessed during this study do not conclusively point to a military installation as a point source of mercury in the ground water at any of the 34 sites. Moreover, most of the 34 sites of elevated mercury concentrations in ground water are not near a military installation. Therefore, there is currently no evidence that military installations are major contributors of mercury to ground water at the 34 sites.

On the basis of proximity to the 34 sites, most cemeteries within the study area do not appear to be possible sources of mercury to most of the sites. In those few cases where cemeteries are immediately adjacent to sites of mercury-contaminated water, the possible effect of the cemeteries on ground-water quality cannot be assessed because detailed data on local hydrology are lacking, and no water-quality data are available to indicate whether any contaminants are emanating from the cemeteries. In general, it appears that 19th-century cemeteries would be more likely sources than cemeteries that date to the 20th century.

Overall, the assessment of the possibility that point sources have contributed mercury to ground water at the 34 sites is incomplete for lack of site-specific data on former possible point sources; however, NJDEP data bases on contaminants have been searched exhaustively for information on known point sources. Available data do not implicate most of the known contamination sites as sources of mercury to the 34 sites of elevated mercury concentrations in ground water. Overall, although various types of point sources cannot be ruled out completely, on the basis of available data they do not appear to be major contributors of mercury to ground water underlying most of the 34 sites.

Hypothesis 5: Atmospheric Deposition

On the basis of the calculations discussed earlier, substantial amounts of mercury from the atmosphere are deposited on the land surface. Results of analyses of two sets of undisturbed forest soil samples indicate that mercury deposited atmospherically tends to be sequestered in soils in either organic-rich or clay-rich horizons. The shallow ground water tapped by many observation wells in forested

areas (fig. 7) generally does not contain detectable concentrations of dissolved mercury, perhaps indicating that little if any mercury has recently (5 to 15 years ago) leached from those soils.

At 10 of the 34 sites where well-depth data were sufficient to assess the vertical distribution of mercury in the aquifer, most measurements of elevated concentrations of mercury appear to be located in water roughly between 50 and 120 ft. (Mercury in concentrations above the MCL has been detected as deep as 225 ft.) The depths at which elevated mercury concentrations are found indicate that mercury was introduced to the ground water at some time in the past, and that it currently resides in water that is several decades old. The apparent lack of elevated mercury concentrations in shallow (less than 50 ft) ground water may indicate that a past source, rather than one that has continued to recent times, has contributed much of the detectable mercury to ground water at many, if not all, of the 34 sites. Mercury-concentration data for shallow wells are not abundant, however, and many samples collected from shallow wells (see appendix 1b) are filtered. Therefore, the apparent vertical distribution of mercury concentrations in ground water does not conclusively rule out present-day leaching of mercury to ground water.

Mercury concentrations in soils at six sites of mercury-contaminated water were substantially less than those found in undisturbed forest soils. This may indicate that mercury has been leached from those soils; if so, then atmospherically deposited mercury probably would be leached, as would mercury deposited on the soil from some other source or sources. The mechanism by which the mercury could be mobilized is not clear. It appears plausible that some of the mercury now detected in ground water at the 34 sites could have been deposited atmospherically. Nevertheless, other sources of mercury are possible as well.

Hypothesis 6: Land-Applied Substances

The potential of pesticides as a source of mercury has been recognized; "crop runoff" is the first entry under "Sources of Contaminant in Drinking Water" for mercury in USEPA's recent release National Primary Drinking Water Standards (U.S. Environmental Protection Agency, 1994). As discussed earlier, pesticides that contained mercury were used in agriculture until about 20 years ago. The most soluble compound, $HgCl_2$, was probably used most extensively during the period from the 1930's through the 1950's. On the basis of the information available in various agronomic handbooks (Daines, 1948; New Jersey Agricultural Experiment Station, 1941; Pepper, 1942; Wolf and Engel, 1948) and the calculations presented earlier, large amounts of mercury may have been applied to the land surface in the United States in the past. Given the highly permeable nature of the sandy soils in the New Jersey Coastal Plain, most crop runoff that might contain mercury is likely to infiltrate, rather than be lost as overland flow to streams.

Use of mercurial pesticides, which for the most part had ceased by the early 1970's, appears, on the basis of available data, to have the potential for having contributed mercury to many of the 34 sites. This conclusion is reinforced by past land-use data, which indicate that 26 of the 34 sites are located in or adjacent to former agricultural areas. Continued use of mercurial pesticides in residential neighborhoods that succeeded the farms also could have provided a source for the

mercury in ground water in those areas. Farm fields are not likely sources of mercury to those sites where former agricultural land use was not present. Mercurial pesticide use on lawns potentially could have contributed mercury to the land surface at all of the 34 sites of elevated mercury concentrations in ground water, however.

Comparison of the Scenarios Developed for Hypotheses 3, 5, and 6

It is clear that there currently are numerous anthropogenic sources of mercury, and that 30 to 50 years ago there were sources of mercury that do not exist today. Although the data shown in appendix 3 indicate that some point sources in New Jersey can contribute substantial amounts of mercury to ground water, the lack of evidence of any known point sources that could affect most of the 34 sites points to the necessity to evaluate other possible sources. In the discussion that follows, the relative effects of inputs of mercury from several sources proposed earlier (hypotheses 3, 5, and 6) on the land surface or the subsurface are compared. One of the possible sources is a nonpoint source (atmospheric deposition), a second may be a nonpoint source (land-applied substances); the third (households) is, at the individual household level, a point source. The houses in a development, however, when aggregated, constitute a nonpoint source as well.

In Hypothesis 3, possible mercury contamination from households was discussed, and scenarios were constructed for mercury inputs from chlorine bleach and from exterior latex paint. To make comparisons viable, the scenarios are compared on the basis of mercury inputs on 1 acre for a period of 10 years.

If housing density is four houses per acre and use of chlorine bleach results in a contribution of mercury at a rate of 1.12×10^2 µg mercury per year, 4,480 µg mercury would be contributed to the septic systems by four households using chlorine bleach over 10 yr. Septic-system flow for an average household typically ranges from 200 to 350 gal/d, which is 757 to 1,325 L/d (Miller, 1980, p. 467), most of which could be expected to contain virtually no mercury. Expected flow for each of the four houses, therefore, would be approximately 2.76×10^5 L/yr to 4.84×10^5 L/yr. Over 10 yr, the flow for the four houses could be expected to range from 1.10×10^7 to 1.94×10^7 L. The estimated input of mercury from chlorine bleach (at a concentration of 0.018 µg/L) in that volume of septic-system flow appears to be negligible, because if it remained soluble, it would be diluted to nondetectable levels by household water use and, ultimately, by recharge. For the four houses, assuming the equivalent of 80 paint brushes per house washed during 10 years, the estimated masses of mercury (6.85×10^6 to 1.71×10^7 µg) would be diluted to about 0.35 to 1.55 µg/L in the septic-system flow. Subsequent dilution of the septic system effluent by recharge would further decrease the calculated concentrations.

The calculated possible amount of mercury in exterior paint is not negligible. In the calculation for one house in the previous section, 20 gal of paint with 3 lb of PMA added per 100 gal of paint was assumed. The amount of mercury in the paint was calculated to be 1.62×10^8 µg, of which 50 percent was assumed to volatilize, leaving 8.1×10^7 µg in paint on the hypothetical house. At a density of four houses per acre, if each is painted once in a 10-yr period and 50 percent is volatilized, the amount of mercury available for leaching from paint used on 1 acre over a 10-yr period in a residential area is estimated at 3.24×10^8 µg.

There are no available data on the amounts of mercury that might be leached from house paint by precipitation. Nor is it known how much of the elemental mercury vapor that volatilizes from the paint is redeposited in the vicinity of the house that was painted. The concentrations of mercury measured in soil samples from the yards of houses at several of the 34 sites were found to be lower than the concentrations measured in soil samples from two undisturbed forest areas. This appears to indicate that the accumulation of mercury in soils in the immediate vicinity of the houses investigated is less than that in the forest areas. Although housepaint appears to be a substantial reservoir of mercury, there is no evidence that mercury leaches from it to the soils; the major contribution of mercury from paint probably is to the atmosphere. This contribution is likely to be larger in densely populated areas, such as the shore communities of Ocean and Atlantic Counties, rather than some inland areas where housing developments are sparsely distributed.

The amount of mercury estimated to be contributed to 1 acre in 1 yr by atmospheric deposition is substantial (8.34×10^4 μg), and could be larger (9.35×10^4 μg) if the dry deposition rate used in the previous calculation is low. In 10 years, with a constant rate, this would be 8.34×10^5 to 9.35×10^5 μg of mercury. If a rate twice that is assumed for the 1950's and 1960's, then 1.67×10^6 to 1.87×10^6 μg of mercury would be deposited to 1 acre over a 10-yr period.

The amount of mercury deposited from the atmosphere can be directly compared to land applications of mercury, such as the use of mercurial pesticides. Calculations in a previous section, based on recommended rates of application of $HgCl_2$, indicated that possible amounts of mercury applied to 1 acre in a growing season could range from 3.37×10^8 to 1.01×10^9 μg. If, over a 10-yr period (with some rotation of crops), a crop requiring $HgCl_2$ treatment were planted every 3 yrs, it would be planted four times in 10 yr, and mercury inputs to 1 acre would range from 1.34×10^9 to 4.04×10^9 μg.

Whatever the fate of the mercury deposited might be, pesticide applications on 1 acre that follow recommended rates would exceed the amount of mercury estimated to be deposited on 1 acre by wet and dry deposition. In fact, using the largest estimated atmospheric deposition values, about 3,600 yr of atmospheric deposition on 1 acre would be needed to equal the amount of mercury applied as pesticide at the rate of 1 lb/acre in 1 yr. If the atmospheric contribution is doubled for the 1950's and 1960's estimate, then about 1,800 yr of atmospheric deposition would be needed to equal the estimated (1 lb/acre)/yr pesticide input.

Therefore, on the hypothetical acre assumed in these estimates, the amount of mercury that would be added by atmospheric deposition in 1 yr to a single growing season's application of mercury pesticide is relatively negligible. Regionally, however, atmospheric deposition of mercury has been continuous for a longer period of time than the sporadic land application of pesticides. Furthermore, atmospheric deposition of mercury occurs over the entire study area, whereas pesticides would have been applied only to parts of the study area. Nevertheless, because elevated mercury concentrations in ground water apparently are found spatially in clusters, either the major mercury sources or the mobilizing mechanisms, or both, also may be spatially clustered rather than widely distributed.

The amounts of mercury estimated to be present in the 1-acre house-paint and pesticide scenarios can be compared, although the amounts that may actually leach cannot be compared because no data are available for mercury leaching from paint. The amount of mercury estimated to be present in the paint applied in 10 yr to four houses on 1 acre (3.24×10^8 µg) is less than the amount of mercury estimated to be present in the $HgCl_2$ applied to the crops grown on 1 acre over 10 yr at 1 lb/acre (1.07×10^9 µg) with 50-percent vaporization from the paint and 20-percent vaporization from the farm field. The maximum application of $HgCl_2$ to crops (at 3 lb/acre), 3.23×10^9 µg of mercury, is about 10 times the maximum amount estimated in the house-paint scenario, again with volatilizations of 50 percent for paint and 20 percent for pesticide. The percentages of volatilization used in the estimates could be lower for mercury in paint and higher for mercury in pesticide, however. Because little is known about the chemical behavior of mercury in paint (except that it vaporizes as elemental mercury), the only other comparison that can be made is of the solubilities of the various compounds. $HgCl_2$ is more soluble in water than PMA (1g/13.5 mL or 7.4×10^7 µg/L (Merck, 1983) and 4.37×10^6 µg/L (Verschueren, 1983), respectively), and both are more soluble than elemental mercury (6.39×10^{-1} µg/L (Cotton and Wilkinson, 1980)).

An average of the mercury retention rates in soil measured by Amacher and others (1990) may provide a realistic rate (50 percent) of leaching from soils in the New Jersey Coastal Plain. Table 14 summarizes the mercury loads calculated for the various scenarios and shows the possible concentration of mercury in 10 yr of recharge, with a 50-percent rate of leaching from soil and an annual recharge of 22.9 in. to 1 acre. The calculations show that the concentrations resulting from this 50-percent leaching of mercuric chloride pesticide and paint (here assumed to be leached 100 percent by rain and subsequently 50 percent from the soil) are similar to some of the concentrations of mercury encountered in ground water at the sites of elevated mercury concentrations in ground water. As discussed earlier, on the basis of relative solubilities, leaching of the mercuric chloride pesticide appears to be more likely to occur than leaching of mercury in paint. Leaching of PMA pesticide before it degrades to elemental mercury, although not calculated, also may be a realistic possibility that could result, in some cases, in substantial concentrations of mercury in recharge to the aquifer system.

The comparison of all the 1-acre scenarios, with estimated amounts of mercury present in various substances used in what are assumed to be realistic amounts, indicates that (1) use of chlorine bleach probably results in negligible inputs of mercury to septic systems because of dilution, whereas washing paint brushes may result in larger inputs of mercury to septic systems; (2) atmospheric deposition of mercury results in significant amounts that reach the land surface; and (3) these atmospheric amounts, when calculated for a single acre, are substantially smaller than the amounts in exterior paint and in mercurial pesticides. Of these latter two sources, the amounts of mercury estimated to be contributed by inorganic mercurial pesticides in a maximum-application scenario for 1 acre is about 10 times that estimated for paint (on 4 houses on 1 acre) containing 3 lb of PMA per 100 gal of paint, given the assumed volatilization rates. Moreover, of the mercurial pesticides, mercuric chloride is more soluble than PMA and also is more than 7 orders of magnitude more soluble than elemental mercury. Because no data on paint use during the last 60 years are available and data on actual use of pesticides were not available until recently (only recommended rates of application are available for past decades), the relative importance of the various sources cannot be assessed. Nevertheless, of the various mercury sources discussed (excluding industrial, commercial, or waste

Table 14. Estimated mercury loads to an acre over 10 years from bleach, paint, mercuric chloride pesticide, and atmospheric deposition, and calculated concentrations in recharge* in the New Jersey Coastal Plain

[PMA, phenylmercuric acetate; gal, gallons; lb, pounds; lb/acre, pounds per acre; ($\mu g/m^2$)/yr, micrograms per square meter per year; (μg/acre)/10 yr; micrograms per acre per 10 years; Hg, mercury; %, percent; $\mu g/L$, micrograms per liter; max., maximum; min., minimum; ?, unknown]

	Bleach** (4 houses/ acre)	Paint (3 lb PMA/ 100 gal) (4 houses/ acre)	Pesticide (max.) (3 lb/acre)	Pesticide (min.) (1 lb/acre)	Atmospheric deposition (regional max.) (46.2 ($\mu g/m^2$)/ yr)	Atmospheric deposition (regional min.) (20.6($\mu g/m^2$)/ yr)
Potential Hg load (μg/acre/10 yr)	4.48×10^3	6.48×10^8	4.04×10^9	1.34×10^9	1.87×10^6	8.34×10^5
% volatilization	0	50	20	20	?	?
Amount Hg available $\left(\text{potential Hg load} \times \left(1 - \frac{\%\text{ volatilization}}{100}\right)\right)$ (μg/acre)/10 yr)	4.48×10^3	3.24×10^8	3.23×10^9	1.07×10^9	1.87×10^6	8.34×10^5
Hg concentration ($\mu g/L$) in recharge (50% leaching by 2.35×10^7 L of recharge in 10 yr)	9.5×10^{-5}	6.89	68.7	22.7	3.98×10^{-2}	1.77×10^{-2}

* Mean annual precipitation in the study area was 45.8 in. during 1951-80 (National Oceanic and Atmospheric Administration (1982), and evapotranspiration is estimated to be about 50 percent (Rhodehamel, 1970).

**Calculation assumes no dilution by wastewater.

disposal point-source large releases to the subsurface), use of pesticides on crops, on trees, and on turf potentially represents a substantial, and perhaps the largest, amount of mercury that might be applied locally to the land surface. For the eight sites where no former agricultural land use has been identified, possible sources would not include pesticide use on crops, but could include use of mercurial pesticides on lawns.

Possible Mechanisms of Mercury Mobilization

Past research has indicated that inorganic mercury is not very mobile in soils; up to 90 percent of mercury deposited on soils is believed to be retained, either through complexation with organic matter, by cation exchange on clays, or as some particulate form (Nater and Grigal, 1992). Mercury becomes more mobile when it is transformed to an organic form, either methyl- or dimethyl-mercury. Methylated mercury was found to constitute only a small percentage of the total mercury present in ground-water samples collected from the Kirkwood-Cohansey aquifer system (Windom and Smith, 1992); however, the rate of mercury methylation has been shown to be greater in waters with pH less than 6.0 than in waters with pH in excess of 6.0 (Wood, 1988). The Kirkwood-Cohansey aquifer system and the soils of the Coastal Plain can provide an acidic geochemical environment that enhances the methylation process, but no data are available to indicate whether this process occurs to any significant extent in New Jersey soils or aquifer materials.

Mercury could be deposited on the land surface in southern New Jersey in several forms--elemental, as part of an organic compound such as PMA, or as a salt such as $HgCl_2$. The mercury could then complex with organic matter, exchange with a cation and become bound to clays, or be adsorbed to iron or aluminum hydroxides. The accumulation of mercury in the organic horizons and in the clay- and hydroxide-rich B horizons in undisturbed forest soils is evidence that these processes do take place. Introduction of mercury and mercury compounds into the subsurface also is possible; whether subsurface mercury inputs can accumulate in aquifer sediments has not been established, nor is it known what effect septic-system effluent would have on mercury introduced into the subsurface.

Results of studies by ACHD and NJDEP indicate that the mercury in water from wells at sites in New Jersey Coastal Plain might be present in a negatively charged form (see table 6). Results of the study of filtered and unfiltered water samples by NJDEP and the presence of lower concentrations of mercury than previously measured in some filtered samples collected by the USGS indicate that some of the mercury probably is not dissolved, but colloidal (particulate). Further, various VOC's also were found in ground-water samples at many of the same sites, although, in many cases, not in the same water samples as elevated mercury concentrations. Although in most cases little, if any, evidence exists to indicate that the mercury and the VOC's are derived from the same sources, the possibility remains that the presence of VOC's enhances the mobility of mercury. Mercury halides, primarily $HgCl_2$, have been shown to be soluble in benzene and various alcohols (Cotton and Wilkinson, 1980), and chloroform and carbon tetrachloride are used as extractants for metals such as mercury (Reeves and Brooks, 1978), but apparently little is known about the effects of dilute solutions of these compounds or of diluted chlorinated solvents such as TCE or PCE.

Forstner and Wittmann (1983) suggest that deicing salts may enhance the movement of trace metals to ground water. Studies have confirmed this possibility (for example, Bauske and Goetz, 1993). Because mercury forms complexes with chloride ions, road-deicing salts could be expected to enhance the mobility of mercury in soils. Feick and others (1972) demonstrated that this is a viable mechanism for mobilizing mercury; their results indicated that mercury was released from freshwater sediments by runoff containing deicing salt. Additionally, Behra (1986) found that sodium hypochlorite (bleach) could release mercury from saturated porous media.

Information on agricultural practices and land-use data collected during this study indicate that mercurial compounds used as pesticides could be an important source of mercury to ground water in the New Jersey Coastal Plain. The effects of other inorganic agricultural chemicals, such as phosphate or ammoniacal fertilizers, lime, or potassium chloride, on the mobility of mercury are not known, however. Chloride and ammonium are major constituents of sewage; if septic systems release these constituents to soils, they may complex with, or desorb, sorbed mercury and thus permit it to become mobilized from the soils or aquifer materials to the ground water. "Acid rain" has been implicated in the mobilizing of some metals; its effect on mercury in soils has received relatively little attention. Hanson and others (1982), in a study of metal deposition in sediment cores from lakes in New England and Canada, suggest that precipitation was acidified as early as 1880. Cogbill and Likens (1974) indicate that acidification of precipitation intensified in the United States in the 1940's, 1950's, and 1960's. Increasingly acidic precipitation may have coincided with inputs of mercury as industrial emissions, as pesticides, or as a component of house paint. Finally, the mechanical disruption of soils by excavation and grading, or burying beneath fill with its own burden of atmospheric mercury, may provide a mechanism for releasing mercury bound to soils.

Figure 43 shows a conceptual model of some of the possible mechanisms of mercury mobilization. The model includes scenario A, in which mercury is sequestered in the soil and does not mobilize to ground water. Evidence gathered to date indicates this may be the case in some forested areas. In scenario B, mercury does not remain in the soils but leaches directly to ground water as "acid rain" recharges the aquifer. Three other scenarios in the model include mobilization by substances, such as phosphates and ammonia, found in fertilizers (both chemical and manure) and sewage from septic systems (C); mobilization by chloride salts such as those used to deice roads (D); and mobilization through mechanical disturbance (E). The length of time needed to move mercury in any of several forms deposited at or beneath the land surface through the soil to the water table and from the water table to depths now tapped by the wells known to yield mercury-contaminated water is unknown, however. Determination of leaching rates will improve the understanding of the timing between date of input at or near the surface and arrival at depth in the aquifer.

SUMMARY AND CONCLUSIONS

Total-mercury-concentration data for water samples from 2,270 wells that tap the Kirkwood-Cohansey aquifer system in the New Jersey Coastal Plain were collected during a study by the U.S. Geological Survey in cooperation with New Jersey Department of Environmental Protection. The mercury-concentration data, collected

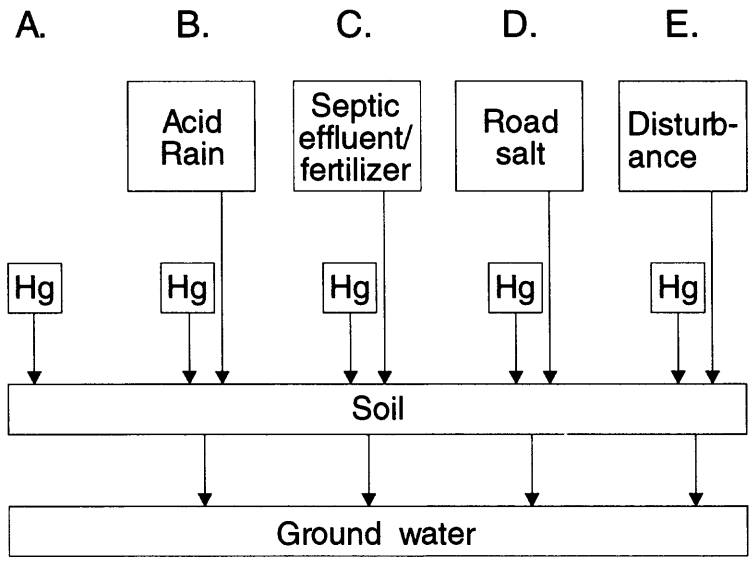


Figure 43. Conceptual model of some of the possible mechanisms by which mercury is mobilized in the New Jersey Coastal Plain.

from State and county files of analytical results, show that mercury has been detected in the most recent sampling of water from about 1,300 wells; mercury concentrations in the most recent water samples from 265 of these wells exceeded the USEPA MCL of 2 µg/L. Thirty-four sites have been identified in seven counties where one or more wells have yielded water containing mercury in concentrations equal to or greater than 1 µg/L. Data for 2,239 wells at these sites were available. At 32 of these sites, one or more wells have yielded water on at least one sampling occasion with a mercury concentration in excess of the MCL. Background concentrations of mercury in the ground water have been determined during a previous study to be typically less than 10 ng/L.

The mercury data base compiled during this study consists of mercury-concentration data, well-construction data, and geographic-location data. Analysis of these data indicates that most elevated mercury concentrations are found in ground water from about 50 to at least 120 ft in depth. Additional data indicate that mercury has been found in water samples from a 225-ft-deep well. The depths at which the elevated mercury concentrations are present in ground water indicate that the water probably is several decades old and, therefore, any mercury found at depth and introduced at the land surface would derive from past activities rather than present practices. In most cases, the mercury is detected in water from domestic wells with small screened intervals (5-10 ft). In some areas, longer screens in irrigation and public supply wells may result in the dilution of contaminated water by uncontaminated water, masking the presence of mercury.

Results of analysis of soil samples from undisturbed forest soils and from disturbed soils at 6 of the 34 sites demonstrated that mercury is concentrated in the O and B horizons of undisturbed forest soils, but that it is distributed fairly evenly throughout the soil columns of disturbed soils found at sites of contaminated ground water. Moreover, the concentrations of mercury in undisturbed soils are greater than the concentrations in disturbed soils; the concentrations of mercury in disturbed and undisturbed soils are within the range of naturally occurring mercury concentrations reported in the literature, however. Results of analysis of a core from the unsaturated zone in an area known to have been surficially contaminated with vaporous elemental mercury indicate that mercury has been retained in the upper 18 in. of the soil profile.

Of the 34 sites defined during this study, 13 had been identified and investigated at the time the study began. Previous land use at all 34 sites was determined by examination of aerial photographs and topographic maps from the last 4 to 6 decades. Thirty-two of the 34 sites are residential; 2 are in a rural setting. The 32 residential sites exhibit varying degrees of housing density. Some portion of previous land use at 26 of the sites was determined to be agricultural, and the residential development at most sites began during the 1950's and 1960's. Several sites are located adjacent to landfills, waste transfer stations, or Superfund sites. In these cases, the possible contribution of contaminants from these potential point sources has been investigated previously. During this study, data on possible point sources, such as landfills, military installations, industrial sites, commercial operations, and cemeteries, was collected. Local hydrology at the 13 original sites was evaluated in detail, and hydrology at the other sites also was assessed.

Six hypotheses as to the sources of the mercury are advanced:

1. Mercury was introduced to the water samples during collection and/or analysis;
2. Mercury was introduced to the water samples by materials in a particular type of pump;
3. Mercury was contributed to the land surface or subsurface by household materials, through the septic system, or through the well, or was leached from exterior paint;
4. Mercury was contributed from a nearby point source, such as a landfill, military installation, industrial site, commercial operation, or cemetery;
5. Mercury was contributed by atmospheric deposition;
6. Mercury was contributed by land-applied substances such as mercurial pesticides.

Results of quality-assurance measures carried out in this and previous studies indicate that the mercury-concentration data are reproducible and consistent, and represent real contamination in the aquifer rather than artifacts of sampling or analysis.

On the basis of results of statistical analysis of available data, the mercury in the ground-water samples at the 34 sites does not appear to be related to a brand of pump in the affected wells. Chlorine bleaches have been shown to contain mercury, but available data do not permit a rigorous evaluation of the amount of mercury that might be contributed to ground water, either through the septic system or through the well during disinfection with chlorine. The amounts are estimated to be negligible. Mercury in exterior paints appears to be a potentially large source of mercury to the environment; whether it is leached from paint to the soils at the base of any house is not known. The amounts of mercury contributed by paint are difficult to determine because, although the amount of mercury in paint can be large, the amount that could be leached by precipitation is not known. Mercury also may be contributed to septic systems through washing of paintbrushes.

Point sources, such as landfills, industrial sites, military installations, and cemeteries, are possible sources of mercury to the environment, as are various enterprises, such as laboratories and dentists' offices that use mercury and hospitals and school laboratories that discharge mercury to septic systems. No data were discovered during this study that conclusively link any of these possible sources to the presence of mercury at the 34 sites. On the basis of proximity to known point sources and assessment of available hydrologic and water-quality data, many of the 34 sites appear unlikely to be affected by such a source. The hypothesis that such point sources have contributed mercury to some of the 34 sites cannot be proved or disproved without additional site-specific data, however.

Mercury is deposited on the land surface from the atmosphere, but on the basis of calculations of possible inputs, this does not appear to be the largest possible

source of mercury to ground water on an annual basis. Calculations of recommended rates of application indicate that a large amount of mercury could have been deposited locally on the land surface from past use of mercurial pesticides during the first 7 decades of the 20th century. Mercuric chloride, which is highly soluble in water, was used on crops from the 1930's through the 1950's. Phenyl mercuric acetate was used during the 1950's and 1960's; its use on crops was banned in 1972. Twenty-six of the 34 sites are located on or adjacent to what was formerly agricultural land. Mercurial pesticides also have been used on turf to control snow mold and crabgrass.

Because few of the wells that have been sampled for mercury tap the aquifer deeper than 120 ft, the deepest extent of mercury contamination in the aquifer is not well-known. Further, the true areal distribution of mercury-contaminated ground water is not known because the distribution indicated by the data examined during this study does not represent random sampling of ground water, but rather sampling targeted to areas where contaminants had been discovered. Further, there is no indication that all or most of the instances of mercury-contaminated ground water have been discovered.

As a result of this investigation, it appears that no one source of mercury or one mode of transport is likely to be solely responsible for the observed occurrences of elevated concentrations of mercury in ground water in the Coastal Plain of New Jersey. Further research may provide additional information about the combination of sources and transport processes that has led to this regional problem. Nevertheless, elevated mercury concentrations in ground water appear to occur when both a source and chemical and/or physical processes conducive to mercury mobilization and transport are present.

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APPENDIXES

Appendix 1. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells at 34 sites of elevated mercury concentrations in ground water; and mercury concentrations in samples from 168 wells listed in the U.S. Geological Survey data base, 31 additional wells in State and County files, and 26 wells included in Skidaway Institute of Oceanography/N.J. Department of Environmental Protection study

1a. Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2, 239 wells* screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain.

Figure 1a. Map showing municipalities in which 34 sites of elevated mercury concentrations in ground water are located, New Jersey Coastal Plain.

1b. Table 1b. Mercury concentrations in water samples from 168 wells screened in the Kirkwood-Cohansey aquifer system, New Jersey Coastal Plain.

1c. Table 1c. Mercury concentrations in water samples from, and well-construction data for, 31 wells* sampled during State and county investigations; mercury concentrations less than 1 microgram per liter for all wells in a given area.

Figure 1c. Map showing locations of areas not included in sites of elevated mercury concentrations in ground water for which mercury concentrations in ground water are less than 1 microgram per liter, and locations of 34 sites of elevated mercury concentration in ground water, New Jersey Coastal Plain.

1d. Table 1d. Total-mercury concentrations in water from wells* sampled during study of background mercury concentrations by Skidaway Institute of Oceanography and New Jersey Department of Environmental Protection, 1991.

Figure 1d. Map showing locations of wells yielding water with background concentrations of total mercury, and location of 34 sites of elevated mercury concentrations in ground water.

*Data for wells sampled by State, county, and local agencies are not maintained in U.S. Geological Survey electronic data base.

APPENDIX 1

Collection of Water Samples by State, County, and Local Agencies

Water samples from 2,270 wells, the most recent (as of June 1993) data for which are included in appendix 1a and appendix 1c, were collected by State, county, or local agencies, principally the county health departments and the NJDEP.

The sampling protocol followed the procedures outlined in the NJDEP Field Sampling Procedures Manual for sampling domestic wells (N.J. Department of Environmental Protection, 1992, p. 181-186). The sampling point was chosen to be as close to the well head as possible. In order to evacuate plumbing and the water-storage tank, water was run for a minimum of 15 minutes prior to sample collection. Where faucets within the houses were the sample-collection point, aerators were removed prior to sample collection. Treatment units, such as water softeners or carbon filters, were bypassed. Whenever possible, confirmatory samples were collected at a later date at the same sampling point. Selected duplicate samples were collected routinely by sampling teams from NJDEP. Samples were not filtered. New, clean sample containers were provided by individual laboratories. Upon collection of the water sample, the sample bottles were acidified with concentrated nitric acid in order to preserve the sample, and were transported in clean coolers, with chain-of-custody documentation, to the laboratory.

All samples were analyzed by laboratories certified by the NJDEP to perform analyses for mercury in drinking water by using the USEPA Method 245.1 (U.S. Environmental Protection Agency, 1979), cold vapor atomic absorption. Analyses were performed within the 14-day holding time specified by Method 245.1.

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain

[Hg, mercury; µg/L, micrograms per liter; ft, feet; *, no data available; PVC, polyvinyl chloride; g steel, galvanized steel; sub, submersible pump; DW, deep well; SW, shallow well; n.i., none installed; R, replacement well; N, new well; A, abandoned well; all analytical results are for unfiltered samples except those analyzed by Princeton University Geology Department laboratory; unkn, unknown; <, less than]

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Hammonton Town - Site 1									
1001	10-3-91	ACHD	0.59	*	*	*	*	*	*
1002	*	ACHD	1.25	92	10	steel		12-52	28
1003	*	ACHD	<0.20	*	*	*	*	*	*
1004	*	ACHD	0.57	*	*	*	*	*	*
1005	11-12-91	ACHD	0.59	100	10	PVC	sub	12-87	29
1006	12-11-91	ACHD	0.40	102	10	PVC	sub	2-87	14
1007	11-20-91	ACHD	<0.20	*	*	*	*	*	*
1008	12-10-91	ACHD	<0.20	103	10	PVC	sub	4-87	10
1009	11-1-91	ACHD	0.85	103	*	*	*	*	*
1010	*	ACHD	0.38	90	10	PVC	sub	10-78	18
1011	11-1-91	ACHD	0.51	*	*	*	*	*	*
1012	10-28-91	ACHD	0.13	*	*	*	*	*	*
1013	10-3-91	ACHD	0.59	*	*	*	*	*	*
1014	10-28-91	ACHD	0.53	*	*	*	*	*	*
1015	10-3-91	ACHD	0.68	*	*	*	*	*	*
1016	10-8-91	ACHD	<0.20	*	*	*	*	*	*
1017	10-3-91	ACHD	0.48	*	*	*	*	*	*
1018	10-9-91	ACHD	0.39	134	10	PVC	sub	11-81	18
1019	12-11-91	ACHD	0.73	*	*	*	*	*	*
1020	10-23-91	ACHD	3.57	80	10	PVC	jet	6-78	12
1021	10-3-91	ACHD	2.60	*	*	*	*	*	*
1022	12-5-91	ACHD	0.12	*	*	*	*	*	*
1023	10-16-91	ACHD	0.14	80	10	PVC	sub	10-87	6
1024	10-16-91	ACHD	0.19	75	10	PVC	sub	7-84	3
1025	10-3-91	ACHD	0.49	90	15	PVC	sub	9-86	10
1026	12-9-91	ACHD	<0.20	80	10	PVC	unkn	6-86	10
1027	11-12-91	ACHD	0.59	*	*	*	*	*	*
1028	10-18-91	ACHD	6.01	*	*	*	*	*	*
1029	10-15-91	ACHD	0.42	*	*	*	*	*	*
1030	10-3-91	ACHD	1.03	*	*	*	*	*	*
1031	10-23-91	ACHD	0.38	72	10	PVC	sub	11-86	10
1032	11-4-91	ACHD	0.89	*	*	*	*	*	*
1033	10-22-91	ACHD	0.19	*	*	*	*	*	*
1034	11-7-91	ACHD	0.52	*	*	*	*	*	*
1035	10-16-91	ACHD	5.48	90	10	PVC	sub	12-78	5

[1]First digits of well-identification number represent site number; following digits represent well number assigned by N.J. Department of Environmental Protection or U.S. Geological Survey.

[2]Abbreviations for laboratories listed at end of table.

[3]Use of company names is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Hammonton Town - Site 1--Continued									
1036	10-16-91	ACHD	1.33	*	*	*	*	*	*
1037	11-4-91	ACHD	2.38	73	6	steel	*	5-64	*
1038	10-29-91	ACHD	6.99	*	*	*	*	*	*
1039	10-14-91	ACHD	5.50	80	10	PVC	sub	11-86	9
1040	10-16-91	ACHD	8.37	*	*	*	*	*	*
1041	9-25-91	ACHD	7.24	*	*	*	*	*	*
1042	9-26-91	ACHD	3.00	*	*	*	*	*	*
1043	11-4-91	ACHD	8.80	*	*	*	*	*	*
1044	10-16-91	ACHD	5.59	80	10	PVC	sub	6-86	10
1045	11-12-91	ACHD	0.98	*	*	*	*	*	*
1046	10-8-91	ACHD	3.15	*	*	*	*	*	*
1047	10-16-91	ACHD	2.71	*	*	*	*	*	*
1048	10-23-91	ACHD	12.51	80	10	PVC	sub	8-87	18
1049	11-8-91	ACHD	18.20	*	*	*	*	*	*
1050	10-23-91	ACHD	2.31	85	10	PVC	sub	8-82	12
1051	10-16-91	ACHD	2.48	*	*	*	*	*	*
1052	10-22-91	ACHD	0.97	*	*	*	*	*	*
1053	12-3-91	ACHD	<0.20	80	*	*	*	*	*
1054	10-16-91	ACHD	0.34	*	*	*	*	*	*
1055	10-22-91	ACHD	3.16	*	*	*	*	*	*
1056	10-16-91	ACHD	2.48	*	*	*	*	*	*
1057	10-3-91	ACHD	0.68	*	*	*	*	*	*
1058	10-22-91	ACHD	2.17	*	*	*	*	*	*
1059	10-22-91	ACHD	<0.20	*	*	*	*	*	*
1060	12-9-91	ACHD	<0.20	*	*	*	*	*	*
1061	10-16-91	ACHD	0.14	*	*	*	*	*	*
1062	10-22-91	ACHD	0.19	*	*	*	*	*	*
1063	10-22-91	ACHD	0.83	60	10	PVC	jet	6-78	6
1064	10-16-91	ACHD	0.63	*	*	*	*	*	*
1065	10-15-91	ACHD	1.53	*	*	*	*	*	*
1066	10-9-91	ACHD	0.39	*	*	*	*	*	*
1067	9-23-91	ACHD	0.49	*	*	*	*	*	*
1068	9-24-91	ACHD	1.11	90	10	PVC	jet	4-79	12
1069	9-23-91	ACHD	0.49	*	*	*	*	*	*
1070	10-15-91	ACHD	0.42	100	10	PVC	sub	1-89	16
1071	10-28-91	ACHD	0.73	95	10	PVC	sub	10-84	5
1072	10-15-91	ACHD	0.42	85	10	PVC	sub	7-86	14
1073	10-8-91	ACHD	3.43	80	10	PVC	sub	8-85	14
1074	11-4-91	ACHD	<0.20	20	*	*	*	*	*
1075	10-22-91	ACHD	0.28	95	10	PVC	sub	10-84	10
1076	9-23-91	ACHD	0.60	*	*	*	*	*	*
1077	10-9-91	ACHD	3.73	*	*	*	*	*	*
1078	10-9-91	ACHD	0.31	103	10	PVC	jet	4-87	7
1079	10-9-91	ACHD	0.71	*	*	*	*	*	*
1080	10-3-91	ACHD	<0.20	120	10	PVC	sub	8-86	18

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Hammonton Town - Site 1--Continued									
1081	9-25-91	ACHD	0.40	*	*	*	*	*	*
1082	9-11-91	ACHD	13.52	*	*	*	*	*	*
1083	10-9-91	ACHD	2.73	*	*	*	*	*	*
1084	9-25-91	ACHD	5.70	104	10	PVC	sub	10-88	20
1085	9-23-91	ACHD	3.54	104	10	PVC	sub	7-88	20
1086	10-23-91	ACHD	0.73	*	*	*	*	*	*
1087	10-9-91	ACHD	0.57	*	*	*	*	*	*
1088	10-16-91	ACHD	3.04	*	*	*	*	*	*
1089	10-9-91	ACHD	1.53	*	*	*	*	*	*
1090	9-23-91	ACHD	4.23	*	*	*	*	*	*
1091	10-9-91	ACHD	0.49	*	*	*	*	*	*
1092	9-23-91	ACHD	0.60	*	*	*	*	*	*
1093	10-29-91	ACHD	0.13	*	*	*	*	*	*
1094	10-31-91	ACHD	0.57	*	*	*	*	*	*
1095	10-9-91	ACHD	<0.20	90	10	PVC	sub	10-87	15
1096	10-29-91	ACHD	0.53	*	*	*	*	*	*
1097	10-23-91	ACHD	0.38	150	20	PVC	sub	6-84R	20
1098	10-16-91	ACHD	0.28	*	*	*	*	*	*
1099	10-29-91	ACHD	0.33	*	*	*	*	*	*
1100	9-25-91	ACHD	0.40	105	10	PVC	sub	7-84	18
1101	9-25-91	ACHD	0.40	*	*	*	*	*	*
1102	10-28-91	ACHD	0.43	*	*	*	*	*	*
1103	11-20-91	ACHD	0.33	90	10	PVC	sub	6-78	20
1104	11-1-91	ACHD	0.76	*	*	*	*	*	*
1105	10-29-91	ACHD	0.23	*	*	*	*	*	*
1106	10-31-91	ACHD	0.48	132	10	PVC	sub	10-87	23
1107	11-12-91	ACHD	0.59	84	*	*	*	*	*
1108	10-28-91	ACHD	0.53	155	10	PVC	sub	4-84	18
1109	10-31-91	ACHD	0.76	80	15	PVC	sub	9-86	17
1110	10-23-91	ACHD	<0.20	*	*	*	*	*	*
1111	11-20-91	ACHD	<0.20	*	*	*	*	*	*
1112	11-19-91	ACHD	<0.20	*	*	*	*	*	*
1113	12-9-91	ACHD	<0.20	*	*	*	*	*	*
1114	10-30-91	ACHD	4.07	*	*	*	*	*	*
1115	10-30-91	ACHD	0.48	*	*	*	*	*	*
1116	10-8-91	ACHD	7.76	*	*	*	*	*	*
1117	10-30-91	ACHD	3.15	*	*	*	*	*	*
1118	10-29-91	ACHD	0.33	95	10	PVC	sub	12-87	12
1119	10-28-91	ACHD	0.13	*	*	*	*	*	*
1120	12-10-91	ACHD	<0.20	*	*	*	*	*	*
1121	12-9-91	ACHD	<0.20	*	*	*	*	*	*
1122	12-3-91	ACHD	0.33	120	10	PVC	sub	12-88	27
1123	10-28-91	ACHD	0.23	*	*	*	*	*	*
1124	10-31-91	ACHD	0.48	70	10	PVC	jet	11-78	12
1125	11-6-91	ACHD	0.52	130	15	PVC	sub	4-87	12

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Hammonton Town - Site 1--Continued									
1126	10-23-91	ACHD	0.39	92	15	PVC	sub	4-87	24
1127	1-29-92	ACHD	0.96	*	*	*	*	*	*
1128	1-14-92	ACHD	0.73	*	*	*	*	*	*
1129	5-12-92	ACHD	0.17	*	*	*	*	*	*
1130	5-12-92	ACHD	<0.10	*	*	*	*	*	*
1131	10-15-91	ACHD	1.68	*	*	*	*	*	*
1132	10-20-92	ACHD	0.17	*	*	*	*	*	*
Atlantic County - Egg Harbor Township- Site 2									
2000	*	*	0.12	*	*	*	*	*	*
2001	1-28-91	P&P	<2.00	*	*	*	*	*	*
2003	6-19-90	ACHD	<0.10	*	*	*	*	*	*
2004	6-14-90	TWC	<0.10	106	*	PVC	*	*	*
2005	7-11-90	ACHD	<0.10	86	*	PVC	*	*	*
2006	6-14-90	TWC	<0.10	*	*	*	*	*	*
2007	6-14-90	TWC	<0.10	81	*	PVC	*	*	*
2008	6-14-90	TWC	<0.10	86	*	PVC	*	*	*
2009	6-26-90	ACHD	0.04	83	*	PVC	*	*	*
2010	8-14-90	*	<0.10	81	*	PVC	*	*	*
2012	10-18-90	TWC	1.32	*	*	*	*	*	*
2013	3-6-91	*	0.37	*	*	*	*	*	*
2014	10-31-90	ACHD	0.14	*	*	*	*	*	*
2015	6-24-92	ACHD	0.43	*	*	*	*	*	*
2016	10-31-90	*	<0.10	*	*	*	*	*	*
2017	12-20-90	P&P	<2.00	*	*	*	*	*	*
2018	6-19-90	ACHD	<0.10	*	*	*	*	*	*
2019	6-18-90	ACHD	1.26	*	*	*	*	*	*
2020	6-25-90	ACHD	<0.10	*	*	*	*	*	*
2021	6-21-90	TWC	0.04	*	*	*	*	*	*
2022	6-18-90	ACHD	2.84	*	*	*	*	*	*
2023	8-9-90	*	0.68	*	*	*	*	*	*
2024	7-17-90	ACHD	0.29	96	*	*	*	*	*
2025	8-8-90	*	0.68	*	*	*	*	*	*
2026	6-25-90	ACHD	<0.10	85	*	PVC	*	*	*
2027	10-24-90	ACHD	<0.10	81	*	PVC	*	*	*
2028	6-11-90	ACHD	0.28	85	*	PVC	*	*	*
2029	7-2-90	ACHD	1.70	85	*	PVC	*	*	*
2030	6-12-90	ACHD	<0.10	85	*	PVC	*	*	*
2031	6-25-90	ACHD	1.03	85	*	PVC	*	*	*
2032	5-15-90	ACHD	<0.10	85	*	PVC	*	*	*
2034	3-19-91	ACHD	<0.10	81	*	PVC	*	*	*
2035	7-17-90	ACHD	0.43	*	*	*	*	*	*
2036	6-15-90	TWC	5.00	85	*	PVC	*	*	*
2037	6-21-90	ACHD	<0.10	86	*	PVC	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township- Site 2--Continued									
2038	7-3-90	ACHD	0.34	*	*	*	*	*	*
2039	6-21-90	ACHD	<0.10	*	*	*	*	*	*
2040	6-15-90	TWC	3.10	*	*	*	*	*	*
2042	11-20-90	ACHD	2.30	*	*	*	*	*	*
2043	6-14-90	TWC	<0.50	100	*	*	*	*	*
2044	7-24-90	ACHD	4.43	*	*	*	*	*	*
2045	6-21-90	ACHD	<0.10	*	*	*	*	*	*
2046	6-25-90	ACHD	1.28	*	*	*	*	*	*
2047	6-4-92	ACHD	2.00	125	*	*	*	*	*
2048	9-27-90	ACHD	<0.10	*	*	*	*	*	*
2049	4-24-91	ACHD	1.39	*	*	*	*	*	*
2050	10-17-90	ACHD	0.30	*	*	*	*	*	*
2051	9-13-90	ACHD	0.41	83	*	PVC	SW Jet	8-89R	20
2052	10-16-90	ACHD	0.97	85	*	PVC	SW Jet	8-84R	17
2053	5-29-91	ACHD	1.90	*	*	*	*	*	*
2054	10-23-90	ACHD	1.47	50	*	*	*	*	*
2055	6-14-90	ACHD	0.27	*	*	*	*	*	*
2056	11-7-90	ACHD	0.13	*	*	*	*	*	*
2057	9-13-90	ACHD	<0.10	*	*	*	*	*	*
2059	6-25-90	ACHD	<0.10	80	*	PVC	*	*	*
2060	6-11-90	ACHD	7.50	*	*	*	*	*	*
2061	6-25-90	ACHD	0.17	81	*	PVC	*	*	*
2062	5-23-91	ACHD	22.50	81	*	PVC		*	*
2063	6-11-90	ACHD	<0.10	*	*	*	*	*	*
2064	10-24-90	ACHD	1.11	*	*	*	*	*	*
2065	4-26-91	ACHD	0.55	*	*	*	*	*	*
2066	4-23-91	ACHD	0.24	*	*	*	*	*	*
2067	4-23-91	ACHD	0.35	*	*	*	*	*	*
2068	4-23-91	ACHD	0.24	*	*	*	*	*	*
2069	7-25-90	ACHD	0.57	106	*	*	*	*	*
2070	6-18-90	ACHD	1.26	*	*	*	*	*	*
2071	7-11-90	ACHD	0.21	*	*	*	*	*	*
2072	6-19-90	ACHD	<0.10	*	*	*	*	*	*
2073	6-11-90	ACHD	<0.10	*	*	*	*	*	*
2074	6-20-90	ACHD	<0.10	*	*	*	*	*	*
2075	6-12-90	ACHD	<0.10	*	*	*	*	*	*
2076	6-21-90	ACHD	<0.10	180	*	*	*	*	*
2077	6-12-90	ACHD	<0.10	*	*	*	*	*	*
2078	6-18-90	ACHD	1.60	*	*	*	*	*	*
2079	6-21-90	ACHD	<0.10	120	*	*	*	*	*
2080	8-7-90	ACHD	0.20	110	*	*	*	*	*
2081	6-21-90	ACHD	<0.10	*	*	*	*	*	*
2083	6-18-90	ACHD	0.25	110	*	*	*	*	*
2084	6-18-90	ACHD	0.36	*	*	*	*	*	*
2085	6-19-90	ACHD	<0.10	85	*	PVC	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township- Site 2--Continued									
2086	6-14-90	ACHD	<0.10	80	*	PVC	*	*	*
2087	8-1-90	ACHD	0.28	80	5	PVC	n.i.	*	*
2088	6-11-90	ACHD	0.33	105	5	PVC	n.i.	1-83N	22
2089	7-25-90	ACHD	0.36	101	*	PVC	*	*	*
2090	6-21-90	ACHD	<0.10	105	*	PVC	*	*	*
2093	6-12-90	ACHD	<0.10	82	*	PVC	*	*	*
2094	7-19-90	ACHD	2.60	81	*	PVC	*	*	*
2095	6-21-90	TWC	0.60	85	*	PVC	*	*	*
2097	8-28-90	ACHD	6.36	92	*	PVC	*	*	*
2098	6-14-90	ACHD	<0.10	*	*	*	*	*	*
2100	7-31-90	ACHD	0.30	*	*	*	*	*	*
2101	4-10-91	ACHD	<0.10	*	*	*	*	*	*
2102	6-11-90	ACHD	<0.10	*	*	*	*	*	*
2103	6-15-90	ACHD	<0.10	120	*	*	*	*	*
2104	6-11-90	ACHD	<0.10	*	*	*	*	*	*
2105	6-26-90	ACHD	0.40	*	*	*	*	*	*
2106	6-11-90	ACHD	<0.10	86	*	*	*	*	*
2107	12-5-90	ACHD	1.06	107	*	*	*	*	*
2108	9-13-90	ACHD	0.62	*	*	*	*	*	*
2109	9-4-90	ACHD	9.20	*	*	*	*	*	*
2110	9-26-90	ACHD	<0.10	120	*	*	*	*	*
2111	6-24-92	ACHD	2.32	81	*	*	*	*	*
2112	10-23-90	ACHD	<0.10	105	*	*	*	*	*
2113	4-17-91	ACHD	<0.10	*	*	*	*	*	*
2114	9-4-90	ACHD	0.20	81	*	PVC	*	*	*
2116	6-27-90	ACHD	0.15	85	*	PVC	*	*	*
2117	6-15-90	ACHD	<0.10	85	*	PVC	*	*	*
2118	6-15-90	ACHD	<0.10	*	*	*	*	*	*
2119	6-14-90	ACHD	6.30	85	*	PVC	*	*	*
2120	7-25-90	ACHD	3.04	*	*	*	*	*	*
2121	6-29-90	ACHD	5.50	*	*	*	*	*	*
2122	2-22-91	BE	1.90	*	*	*	*	*	*
2123	10-24-90	ACHD	0.25	75	*	*	*	*	*
2124	8-12-92	ACHD	6.52	*	*	*	*	*	*
2125	10-24-90	ACHD	0.13	*	*	*	*	*	*
2126	11-7-90	ACHD	0.24	*	*	*	*	*	*
2128	4-16-91	ACHD	0.37	*	*	*	*	*	*
2129	6-21-90	ACHD	<0.10	*	*	*	*	*	*
2130	8-28-90	ACHD	<0.10	*	*	*	*	*	*
2131	6-15-90	ACHD	<0.10	85	*	g steel	*	*	*
2132	6-22-90	ACHD	<0.10	85	*	PVC	*	*	*
2133	7-17-90	ACHD	0.23	*	*	*	*	*	*
2134	7-24-90	ACHD	<0.10	85	*	PVC	*	*	*
2135	6-14-90	ACHD	<0.10	85	*	g steel	*	*	*
2136	7-17-90	ACHD	0.23	85	5	PVC	DW Jet	2-83N	25

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township- Site 2--Continued									
2139	5-23-91	ACHD	13.92	85	5	PVC	DW Jet	8-84N	25
2140	8-22-90	ACHD	5.60	85	5	PVC	n.i.	11-83N	26
2141	7-18-89	ACHD	4.20	*	*	*	*	*	*
2142	4-12-90	ACHD	0.41	*	*	*	*	*	*
2144	8-28-90	ACHD	9.22	81	*	PVC	*	*	*
2145	7-2-90	ACHD	0.19	80	*	PVC	*	*	*
2146	7-2-90	ACHD	<0.10	82	*	PVC	*	*	*
2147	10-24-90	ACHD	<0.10	*	*	*	*	*	*
2148	6-14-90	ACHD	0.57	81	*	PVC	*	*	*
2150	6-18-90	ACHD	<0.10	85	*	PVC	*	*	*
2151	11-7-90	ACHD	0.13	81	*	PVC	*	*	*
2152	6-25-90	ACHD	0.17	86	*	PVC	*	*	*
2153	6-18-90	ACHD	<0.10	*	*	*	*	*	*
2154	9-11-90	ACHD	0.49	83	*	PVC	*	*	*
2155	5-15-91	ACHD	5.61	*	*	*	*	*	*
2156	1-16-91	ACHD	<0.10	*	*	*	*	*	*
2157	6-11-90	ACHD	<0.10	*	*	*	*	*	*
2158	7-2-90	ACHD	0.19	105	*	PVC	*	*	*
2159	6-12-90	ACHD	<0.10	*	*	*	*	*	*
2165	3-12-91	ACHD	0.21	40	*	*	*	*	*
2166	6-25-90	ACHD	<0.10	*	*	*	*	*	*
2167	6-15-90	ACHD	<0.10	85	*	PVC	*	*	*
2168	7-19-90	ACHD	0.14	85	5	steel	n.i.	5-82	18
2169	4-24-91	ACHD	0.31	84	*	PVC	*	*	*
2170	6-15-90	ACHD	1.40	85	*	steel	*	*	*
2171	6-14-90	ACHD	<0.10	86	*	PVC	*	*	*
2172	6-14-90	ACHD	<0.10	85	*	PVC	*	*	*
2173	7-18-90	ACHD	0.19	85	5	PVC	SW Jet	1-83N	18
2174	6-19-90	ACHD	<0.10	85	*	PVC	*	*	*
2175	6-28-90	ACHD	0.23	81	6	steel	SW Jet	7-82N	17
2176	2-17-89	ACHD	0.37	*	*	*	*	*	*
2177	6-11-90	ACHD	0.60	*	*	*	*	*	*
2178	8-15-90	ACHD	1.10	*	*	*	*	*	*
2179	8-8-90	ACHD	2.60	*	*	*	*	*	*
2180	6-12-90	ACHD	0.13	*	*	*	*	*	*
2181	7-24-90	ACHD	<0.10	*	*	*	*	*	*
2182	6-14-90	ACHD	<0.10	*	*	*	*	*	*
2183	6-12-90	ACHD	0.33	*	*	*	*	*	*
2185	6-21-90	ACHD	<0.10	*	*	*	*	*	*
2187	6-15-90	ACHD	<0.10	*	*	*	*	*	*
2188	6-27-90	ACHD	0.25	*	*	*	*	*	*
2189	6-18-90	ACHD	<0.10	*	*	*	*	*	*
2191	9-26-90	ACHD	<0.10	*	*	*	*	*	*
2192	6-15-90	ACHD	<0.10	*	*	*	*	*	*
2193	6-13-90	ACHD	<0.10	86	*	PVC	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township- Site 2--Continued									
2194	7-18-90	ACHD	0.20	85	5	steel	n.i	9-82N	19
2195	6-11-90	ACHD	<0.10	83	*	PVC	*	*	*
2196	7-2-90	ACHD	0.34	85	*	PVC	*	*	*
2197	6-11-90	ACHD	<0.10	85	*	PVC	*	*	*
2199	5-23-91	ACHD	16.30	85	5	PVC	SW Jet	5-83N	20
2200	5-23-91	ACHD	9.51	85	5	PVC	DW Jet	8-83	24
2201	6-27-90	ACHD	0.15	85	*	PVC	*	*	*
2203	6-25-90	ACHD	<0.10	85	*	PVC	*	*	*
2205	6-11-90	ACHD	5.30	85	*	PVC	*	*	*
2206	8-8-90	ACHD	4.10	80	*	PVC	*	*	*
2207	5-15-90	ACHD	2.70	*	*	*	*	*	*
2208	7-2-90	ACHD	5.90	*	*	*	*	*	*
2210	6-25-90	ACHD	<0.10	83	*	PVC	*	*	*
2211	6-15-90	ACHD	<0.10	*	*	*	*	*	*
2212	7-17-90	ACHD	0.23	*	*	*	*	*	*
2213	7-25-90	ACHD	0.39	*	*	*	*	*	*
2214	7-2-90	ACHD	0.19	*	*	*	*	*	*
2215	6-12-90	ACHD	0.10	*	*	*	*	*	*
2216	6-11-90	ACHD	<0.10	*	*	*	*	*	*
2217	6-14-90	ACHD	0.67	81	*	PVC	*	*	*
2218	6-18-90	ACHD	0.25	*	*	*	*	*	*
2219	10-10-90	ACHD	<0.10	*	*	*	*	*	*
2220	6-15-90	ACHD	<0.10	81	*	PVC	*	*	*
2221	6-21-90	ACHD	<0.10	*	*	*	*	*	*
2222	6-27-90	ACHD	<0.10	91	*	PVC	*	*	*
2223	6-19-90	ACHD	<0.10	106	*	PVC	*	*	*
2224	7-18-90	ACHD	0.20	*	*	*	*	*	*
2225	6-26-90	ACHD	0.58	60	*	*	*	*	*
2226	6-21-90	ACHD	<0.10	50	*	*	*	*	*
2227	6-14-90	ACHD	<0.10	86	*	PVC	*	*	*
2229	10-10-90	ACHD	<0.10	85	*	PVC	*	*	*
2230	6-21-90	ACHD	0.10	85	*	PVC	*	*	*
2231	7-23-90	ACHD	0.26	85	*	PVC	*	*	*
2232	6-15-90	ACHD	<0.10	85	*	PVC	*	*	*
2233	6-21-90	ACHD	<0.10	85	*	PVC	*	*	*
2234	6-13-90	ACHD	<0.10	85	*	PVC	*	*	*
2235	6-19-90	ACHD	<0.10	85	*	PVC	*	*	*
2236	6-21-90	ACHD	11.10	86	*	PVC	*	*	*
2237	4-16-90	ACHD	<0.10	*	*	*	*	*	*
2240	*	ACHD	1.65	*	*	*	*	*	*
2241	9-3-91	EMA	4.30	*	*	*	*	*	*
2242	8-14-91	ACHD	0.50	*	*	*	*	*	*
2243	7-7-92	ACHD	0.68	*	*	*	*	*	*
2244	6-15-90	ACHD	<0.10	60	*	*	*	*	*
2245	4-17-91	ACHD	<0.10	*	*	*	*	*	*

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Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township- Site 2--Continued									
2246	11-14-90	ACHD	0.30	*	*	*	*	*	*
2247	10-10-92	ACHD	34.50	*	*	*	*	*	*
2248	6-2-92	ACHD	0.26	*	*	*	*	*	*
2249	6-16-92	ACHD	1.14	*	*	*	*	*	*
2250	6-16-92	ACHD	0.36	*	*	*	*	*	*
2251	7-11-92	ACHD	<0.10	*	*	*	*	*	*
2252	6-2-92	ACHD	0.15	*	*	*	*	*	*
2253	6-2-92	ACHD	0.76	*	*	*	*	*	*
2254	6-2-92	ACHD	0.15	*	*	*	*	*	*
2255	6-23-92	ACHD	0.15	*	*	*	*	*	*
2256	6-23-92	ACHD	0.74	*	*	*	*	*	*
2257	6-23-92	ACHD	0.22	*	*	*	*	*	*
2258	6-23-92	ACHD	0.22	*	*	*	*	*	*
2259	6-23-92	ACHD	0.12	*	*	*	*	*	*
2260	6-23-92	ACHD	0.22	*	*	*	*	*	*
2261	6-23-92	ACHD	0.64	*	*	*	*	*	*
2262	6-23-92	ACHD	0.12	*	*	*	*	*	*
2263	1-13-92	ACHD	0.37	*	*	*	*	*	*
2264	7-8-92	ACHD	0.27	*	*	*	*	*	*
2265	7-1-92	ACHD	0.38	*	*	*	*	*	*
2266	7-1-92	ACHD	0.17	*	*	*	*	*	*
2267	6-30-92	ACHD	0.12	*	*	*	*	*	*
2268	7-15-92	ACHD	0.82	*	*	*	*	*	*
2269	7-15-92	ACHD	<0.10	*	*	*	*	*	*
2270	7-15-92	ACHD	<0.10	*	*	*	*	*	*
2271	7-21-92	ACHD	<0.10	*	*	*	*	*	*
2272	7-15-92	ACHD	<0.50	*	*	*	*	*	*
Atlantic County -Egg Harbor Township - Site 3									
3001	1-10-89	ACHD	0.29	*	*	*	*	*	*
3002	3-13-89	ACHD	<0.20	*	*	*	*	*	*
3003	2-2-89	ACHD	0.33	*	*	*	*	*	*
3004	1-23-89	ACHD	0.36	*	*	*	*	*	*
3005	1-10-89	ACHD	0.49	*	*	*	*	*	*
3006	1-11-89	AA	0.35	*	*	*	*	*	*
3007	2-15-89	ACHD	0.48	*	*	*	*	*	*
3008	1-10-89	ACHD	3.71	*	*	*	*	*	*
3009	1-10-89	ACHD	0.82	*	*	*	*	*	*
3010	3-22-89	ACHD	0.23	*	*	*	*	*	*
3011	1-23-89	ACHD	7.17	105	5	steel	SW Jet	*	*
3012	1-17-89	ACHD	0.65	*	*	*	*	*	*
3013	3-14-89	ACHD	6.07	*	*	*	*	*	*
3014	1-26-89	ACHD	0.43	*	*	*	*	*	*
3015	3-14-89	ACHD	<0.20	*	*	*	*	*	*
3016	3-9-89	ACHD	<0.20	*	*	*	*	*	*
3017	1-31-89	ACHD	0.47	125	10	*	*	*	*
3018	3-29-89	ACHD	0.01	*	*	*	*	*	*
3019	3-7-89	ACHD	<0.20	*	*	*	*	*	*
3020	1-10-89	ACHD	1.34	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township - Site 3--Continued									
3021	3-13-89	ACHD	0.18	*	*	*	*	*	*
3022	1-26-89	ACHD	0.31	*	*	*	*	*	*
3023	1-19-89	ACHD	9.08	*	*	*	*	*	*
3024	3-6-89	ACHD	0.51	95	5	PVC	sub	*	*
3025	3-15-89	ACHD	<0.20	*	*	*	*	*	*
3026	2-15-89	ACHD	0.61	*	*	*	*	*	*
3027	2-8-89	ACHD	0.25	*	*	*	*	*	*
3028	3-21-89	ACHD	0.32	*	*	*	*	*	*
3029	1-10-89	ACHD	<0.20	*	*	*	*	*	*
3030	1-27-89	ACHD	24.43	*	*	*	*	*	*
3031	1-20-89	ACHD	0.32	*	*	*	*	*	*
3032	1-10-89	ACHD	2.08	*	*	*	*	*	*
3033	1-10-89	ACHD	14.07	*	*	*	*	*	*
3034	1-20-89	ACHD	1.35	*	*	*	*	*	*
3035	3-8-89	ACHD	0.12	*	*	*	*	*	*
3036	3-15-89	ACHD	<0.20	*	*	*	*	*	*
3037	3-9-89	ACHD	<0.20	*	*	*	*	*	*
3038	12-6-88	ACHD	1.40	*	*	*	*	*	*
3039	1-10-89	ACHD	0.95	*	*	*	*	*	*
3040	1-26-89	ACHD	2.65	*	*	*	*	*	*
3041	3-6-89	ACHD	0.24	*	*	*	*	*	*
3042	1-19-89	ACHD	1.68	*	*	*	*	*	*
3043	3-13-89	ACHD	<0.20	*	*	*	*	*	*
3044	1-23-89	ACHD	3.42	130	10	PVC	sub	*	*
3045	1-10-89	ACHD	2.09	*	*	*	*	*	*
3046	3-15-89	ACHD	<0.20	*	*	*	*	*	*
3047	1-18-89	ACHD	10.98	120	10	PVC	sub	*	*
3048	1-23-89	ACHD	0.55	*	*	*	*	*	*
3049	3-6-89	ACHD	0.45	*	*	*	*	*	*
3050	1-19-89	ACHD	11.49	*	*	*	*	*	*
3051	1-25-89	ACHD	0.15	*	*	*	*	*	*
3052	1-25-89	ACHD	0.09	*	*	*	*	*	*
3053	1-24-89	ACHD	3.19	*	*	*	*	*	*
3054	12-14-88	ACHD	0.50	*	*	*	*	*	*
3055	2-8-89	ACHD	0.76	*	*	*	*	*	*
3056	1-20-89	ACHD	0.02	*	*	*	*	*	*
3057	1-25-89	ACHD	0.37	*	*	*	*	*	*
3058	2-8-89	ACHD	0.16	*	*	*	*	*	*
3059	1-26-89	ACHD	0.50	*	*	*	*	*	*
3060	1-10-89	ACHD	0.41	*	*	*	*	*	*
3061	1-27-89	ACHD	0.20	*	*	*	*	*	*
3062	2-8-89	ACHD	0.26	*	*	*	*	*	*
3063	3-15-89	ACHD	1.04	*	*	*	*	*	*
3064	1-18-89	ACHD	0.54	*	*	*	*	*	*
3065	1-20-89	ACHD	0.44	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township - Site 3--Continued									
3066	1-10-89	ACHD	0.75	*	*	*	*	*	*
3067	1-10-89	ACHD	<0.10	113	7	PVC	SW Jet	*	*
3068	1-24-89	ACHD	0.16	*	*	*	*	*	*
3069	3-9-89	ACHD	<0.20	*	*	*	*	*	*
3070	1-19-89	ACHD	18.59	*	*	*	*	*	*
3071	1-19-89	ACHD	1.05	*	*	*	*	*	*
3072	3-9-89	ACHD	<0.20	*	*	*	*	*	*
3073	1-19-89	ACHD	0.52	*	*	*	*	*	*
3074	3-9-89	ACHD	<0.20	*	*	*	*	*	*
3075	1-25-89	ACHD	0.07	*	*	*	*	*	*
3076	1-11-89	ACHD	0.41	*	*	*	*	*	*
3077	3-15-89	ACHD	<0.20	*	*	*	*	*	*
3078	3-13-89	ACHD	<0.20	*	*	*	*	*	*
3079	1-26-89	ACHD	0.20	*	*	*	*	*	*
3080	1-31-89	ACHD	0.39	*	*	*	*	*	*
3081	1-24-89	ACHD	0.16	*	*	*	*	*	*
3082	1-10-89	ACHD	0.32	101	5	PVC	SW Jet	*	*
3083	9-19-88	EMA	5.89	*	*	*	*	*	*
3084	1-18-89	ACHD	0.87	*	*	*	*	*	*
3085	1-20-89	ACHD	1.00	*	*	*	*	*	*
3086	1-27-89	ACHD	0.27	*	*	*	*	*	*
3087	1-10-89	ACHD	0.22	*	*	*	*	*	*
3088	1-25-89	ACHD	0.05	*	*	*	*	*	*
3089	3-13-89	ACHD	<0.20	*	*	*	*	*	*
3090	1-24-89	ACHD	0.19	*	*	*	*	*	*
3091	3-9-89	ACHD	<0.20	*	*	*	*	*	*
3092	3-22-89	ACHD	0.21	*	*	*	*	*	*
3093	4-5-89	ACHD	0.24	*	*	*	*	*	*
3094	1-25-89	ACHD	0.21	*	*	*	*	*	*
3095	1-25-89	ACHD	1.96	115	5	PVC	SW Jet	*	*
3096	3-1-89	ACHD	0.50	*	*	*	*	*	*
3097	1-18-89	ACHD	0.66	*	*	*	*	*	*
3098	1-23-89	ACHD	2.37	*	*	*	*	*	*
3099	2-2-89	ACHD	0.91	*	*	*	*	*	*
3100	1-10-89	ACHD	0.37	*	*	*	*	*	*
3101	3-9-89	ACHD	<0.20	*	*	*	*	*	*
3102	3-6-89	ACHD	0.76	*	*	*	*	*	*
3103	1-27-89	ACHD	0.29	*	*	*	*	*	*
3104	2-15-89	ACHD	0.45	*	*	*	*	*	*
3105	1-24-89	ACHD	<0.20	*	*	*	*	*	*
3106	1-18-89	ACHD	1.15	111	3	PVC	sub	*	*
3107	3-22-89	ACHD	0.18	*	*	*	*	*	*
3108	1-10-89	ACHD	0.14	*	*	*	*	*	*
3109	1-18-89	ACHD	2.60	*	*	*	*	*	*
3110	1-11-89	ACHD	0.50	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township - Site 3--Continued									
3111	3-22-89	ACHD	0.17	115	5	PVC	sub	*	*
3112	1-19-89	ACHD	1.15	*	*	*	*	*	*
3113	1-25-89	ACHD	0.10	*	*	*	*	*	*
3114	3-7-89	ACHD	<0.20	*	*	*	*	*	*
3115	1-25-89	ACHD	0.09	*	*	*	*	*	*
3116	1-18-89	ACHD	1.84	*	*	*	*	*	*
3117	1-19-89	ACHD	2.08	*	*	*	*	*	*
3118	3-9-89	ACHD	<0.20	*	*	*	*	*	*
3119	1-10-89	ACHD	0.53	*	*	*	*	*	*
3120	1-24-89	ACHD	0.22	*	*	*	*	*	*
3121	1-10-89	ACHD	0.74	*	*	*	*	*	*
3122	1-23-89	ACHD	0.74	*	*	*	*	*	*
3123	1-24-89	ACHD	0.28	*	*	*	*	*	*
3124	1-24-89	ACHD	<0.20	*	*	*	*	*	*
3125	1-10-89	ACHD	0.34	*	*	*	*	*	*
3126	10-3-89	ACHD	2.58	*	*	*	*	*	*
3127	1-23-89	ACHD	0.40	*	*	*	*	*	*
3128	1-18-89	ACHD	4.05	*	*	*	*	*	*
3129	1-24-89	ACHD	0.25	*	*	*	*	*	*
3130	4-5-89	ACHD	0.12	*	*	*	*	*	*
3131	3-14-89	ACHD	0.64	*	*	*	*	*	*
3132	1-10-89	ACHD	0.76	*	*	*	*	*	*
3133	1-10-89	ACHD	2.00	*	*	*	*	*	*
3134	1-11-89	ACHD	0.62	*	*	*	*	*	*
3135	1-23-89	ACHD	0.89	*	*	*	*	*	*
3136	3-22-89	ACHD	0.37	*	*	*	*	*	*
3137	3-14-89	ACHD	<0.20	*	*	*	*	*	*
3138	2-17-89	ACHD	0.25	*	*	*	*	*	*
3139	3-7-89	ACHD	<0.20	*	*	*	*	*	*
3140	1-26-89	ACHD	7.09	*	*	*	*	*	*
3141	1-10-89	ACHD	1.62	*	*	*	*	*	*
3142	1-10-89	ACHD	6.54	*	*	*	*	*	*
3143	3-7-89	ACHD	<0.20	*	*	*	*	*	*
3144	1-17-89	ACHD	2.51	*	*	*	*	*	*
3145	3-14-89	ACHD	<0.20	*	*	*	*	*	*
3146	1-10-89	ACHD	0.25	*	*	*	*	*	*
3147	1-10-89	ACHD	1.00	*	*	*	*	*	*
3148	1-26-89	ACHD	0.24	*	*	*	*	*	*
3149	1-20-89	ACHD	0.36	*	*	*	*	*	*
3150	3-7-89	ACHD	0.14	*	*	*	*	*	*
3151	2-8-89	ACHD	2.39	*	*	*	*	*	*
3152	1-19-89	ACHD	0.49	*	*	*	*	*	*
3153	1-11-89	ACHD	1.18	*	*	*	*	*	*
3154	1-11-89	ACHD	0.55	*	*	*	*	*	*
3155	1-20-89	ACHD	0.34	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township - Site 3--Continued									
3156	3-6-89	ACHD	0.43	*	*	*	*	*	*
3157	1-25-89	ACHD	0.76	*	*	*	*	*	*
3158	1-24-89	ACHD	0.76	*	*	*	*	*	*
3159	1-25-89	ACHD	0.12	*	*	*	*	*	*
3160	3-6-89	ACHD	0.43	*	*	*	*	*	*
3161	2-22-89	ACHD	6.91	*	*	*	*	*	*
3162	2-8-89	ACHD	0.24	*	*	*	*	*	*
3163	2-22-89	ACHD	3.08	*	*	*	*	*	*
3164	2-22-89	ACHD	0.19	*	*	*	*	*	*
3165	2-22-89	ACHD	0.34	*	*	*	*	*	*
3166	2-22-89	ACHD	0.50	*	*	*	*	*	*
3167	2-22-89	ACHD	0.86	*	*	*	*	*	*
3168	2-22-89	ACHD	2.44	*	*	*	*	*	*
3169	2-22-89	ACHD	0.65	*	*	*	*	*	*
3170	2-22-89	ACHD	0.21	*	*	*	*	*	*
3171	2-22-89	ACHD	0.20	*	*	*	*	*	*
3172	2-22-89	ACHD	0.06	*	*	*	*	*	*
3173	2-22-89	ACHD	2.44	*	*	*	*	*	*
3174	2-22-89	ACHD	0.06	*	*	*	*	*	*
3175	3-9-89	ACHD	<0.20	*	*	*	*	*	*
3176	1-27-89	ACHD	0.22	*	*	*	*	*	*
3177	1-27-89	ACHD	0.28	*	*	*	*	*	*
3178	1-27-89	ACHD	0.31	*	*	*	*	*	*
3179	3-1-89	ACHD	2.12	*	*	*	*	*	*
3180	4-5-89	ACHD	0.42	*	*	*	*	*	*
3181	3-13-89	ACHD	<0.20	*	*	*	*	*	*
3182	1-20-89	ACHD	1.24	*	*	*	*	*	*
3183	2-8-89	ACHD	2.91	105	5	*	DW Jet	*	*
3184	3-9-89	ACHD	<0.20	*	*	*	*	*	*
3185	1-10-89	ACHD	7.34	*	*	*	*	*	*
3186	1-26-89	ACHD	0.31	*	*	*	*	*	*
3187	3-7-89	ACHD	<0.20	*	*	*	*	*	*
3188	1-10-89	ACHD	0.78	*	*	*	*	*	*
3189	1-25-89	ACHD	0.26	*	*	*	*	*	*
3190	1-26-89	ACHD	0.21	*	*	*	*	*	*
3191	1-20-89	ACHD	0.49	*	*	*	*	*	*
3192	1-10-89	ACHD	0.39	*	*	*	*	*	*
3193	2-15-89	ACHD	0.25	*	*	*	*	*	*
3194	1-10-89	ACHD	0.45	*	*	*	*	*	*
3195	1-10-89	ACHD	0.48	60	10	*	sub	*	*
3196	1-23-89	ACHD	0.75	*	*	*	*	*	*
3197	1-19-89	ACHD	3.89	*	*	*	*	*	*
3198	1-19-89	ACHD	1.30	111	8	*	DW Jet	*	*
3199	1-26-89	ACHD	0.15	*	*	*	*	*	*
3200	1-24-89	ACHD	8.43	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township - Site 3--Continued									
3201	1-10-89	ACHD	0.52	*	*	*	*	*	*
3202	3-7-89	ACHD	<0.20	*	*	*	*	*	*
3203	1-10-89	ACHD	3.43	*	*	*	*	*	*
3204	3-14-89	ACHD	<0.20	*	*	*	*	*	*
3205	1-23-89	ACHD	0.42	*	*	*	*	*	*
3206	4-5-89	ACHD	4.87	*	*	*	*	*	*
3207	1-23-89	ACHD	0.54	*	*	*	*	*	*
3208	1-28-89	ACHD	0.22	*	*	*	*	*	*
3209	1-10-89	ACHD	0.10	*	*	*	*	*	*
3210	1-18-89	ACHD	15.79	*	*	*	*	*	*
3211	1-18-89	ACHD	1.08	*	*	*	*	*	*
3212	3-16-89	ACHD	0.21	*	*	*	*	*	*
3213	3-16-89	ACHD	0.21	*	*	*	*	*	*
3214	1-24-89	ACHD	6.97	115	5	*	jet	*	*
3215	1-25-89	ACHD	12.91	*	*	*	*	*	*
3216	1-23-89	ACHD	13.89	*	*	*	*	*	*
3217	3-21-89	ACHD	11.73	*	*	*	*	*	*
3218	1-10-89	ACHD	1.01	*	*	*	*	*	*
3219	2-17-89	ACHD	0.37	*	*	*	*	*	*
3220	2-15-89	ACHD	1.12	*	*	*	*	*	*
3221	3-8-89	ACHD	<0.20	*	*	*	*	*	*
3222	1-11-89	ACHD	10.25	*	*	*	*	*	*
3223	3-15-89	ACHD	<0.20	*	*	*	*	*	*
3224	1-25-89	ACHD	0.11	116	5	*	DW Jet	*	*
3225	12-6-88	ACHD	0.45	*	*	*	*	*	*
3226	1-26-89	ACHD	1.90	131	6	*	SW Jet	*	*
3227	2-2-89	ACHD	2.17	*	*	*	*	*	*
3228	3-6-89	ACHD	0.80	*	*	*	*	*	*
3229	2-20-89	ACHD	0.39	122	10	*	sub	*	*
3230	1-15-89	ACHD	0.15	*	*	*	*	*	*
3231	1-25-89	ACHD	0.14	*	*	*	*	*	*
3232	1-10-89	ACHD	<0.20	105	5	*	DW Jet	*	*
3233	1-23-89	ACHD	0.56	*	*	*	*	*	*
3234	1-20-89	ACHD	0.87	*	*	*	*	*	*
3235	3-6-89	ACHD	0.19	*	*	*	*	*	*
3236	1-10-89	ACHD	1.14	*	*	*	*	*	*
3237	1-10-89	ACHD	0.37	*	*	*	*	*	*
3238	1-10-89	ACHD	0.75	*	*	*	*	*	*
3239	1-10-89	ACHD	0.71	*	*	*	*	*	*
3240	1-24-89	ACHD	3.94	*	*	*	*	*	*
3241	1-23-89	ACHD	0.59	*	*	*	*	*	*
3242	1-26-89	ACHD	0.11	*	*	*	*	*	*
3243	1-10-89	ACHD	4.30	120	10	*	sub	*	*
3244	1-19-89	ACHD	0.93	124	5	*	DW Jet	*	*
3245	1-20-89	ACHD	0.78	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township - Site 3--Continued									
3246	1-10-89	ACHD	1.40	*	*	*	*	*	*
3247	1-26-89	ACHD	0.15	*	*	*	*	*	*
3248	3-6-89	ACHD	0.15	*	*	*	*	*	*
3249	1-24-89	ACHD	2.79	*	*	*	*	*	*
3250	3-16-89	ACHD	0.21	*	*	*	*	*	*
3251	3-13-89	ACHD	0.11	105	5	*	SW Jet	*	*
3252	1-18-89	ACHD	0.58	*	*	*	*	*	*
3253	1-26-89	ACHD	0.35	*	*	*	*	*	*
3254	1-12-89	ACHD	0.30	*	*	*	*	*	*
3255	1-10-89	ACHD	1.32	*	*	*	*	*	*
3256	12-12-88	ACHD	<0.20	*	*	*	*	*	*
3257	1-19-89	ACHD	8.29	*	*	*	*	*	*
3258	3-8-89	ACHD	4.43	*	*	*	*	*	*
3259	1-26-89	ACHD	0.32	*	*	*	*	*	*
3260	2-2-89	ACHD	0.84	*	*	*	*	*	*
3261	3-6-89	ACHD	0.19	*	*	*	*	*	*
3262	1-25-89	ACHD	0.35	*	*	*	*	*	*
3263	2-8-89	ACHD	0.20	*	*	*	*	*	*
3264	1-25-89	ACHD	0.08	*	*	*	*	*	*
3265	1-20-89	ACHD	0.31	*	*	*	*	*	*
3266	1-10-89	ACHD	1.63	*	*	*	*	*	*
3267	3-1-89	ACHD	0.68	*	*	*	*	*	*
3268	3-6-89	ACHD	0.19	*	*	*	*	*	*
3269	2-23-89	ACHD	0.43	*	*	*	*	*	*
3270	1-10-89	ACHD	7.43	*	*	*	*	*	*
3271	10-3-89	ACHD	3.22	*	*	*	*	*	*
3272	1-18-89	ACHD	0.69	*	*	*	*	*	*
3273	1-10-89	ACHD	1.52	*	*	*	*	*	*
3274	3-14-89	ACHD	<0.20	*	*	*	*	*	*
3275	1-23-89	ACHD	0.67	*	*	*	*	*	*
3276	1-10-89	ACHD	<0.10	*	*	*	*	*	*
3277	1-18-89	ACHD	15.15	*	*	*	*	*	*
3278	3-8-89	ACHD	<0.20	*	*	*	*	*	*
3279	1-18-89	ACHD	0.91	*	*	*	*	*	*
3280	1-18-89	ACHD	0.80	*	*	*	*	*	*
3281	1-24-89	ACHD	7.42	*	*	*	*	*	*
3282	2-15-89	ACHD	0.96	*	*	*	*	*	*
3283	1-10-89	ACHD	6.22	102	4	*	DW Jet	*	*
3284	1-25-89	ACHD	0.76	*	*	*	*	*	*
3285	4-14-89	ACHD	0.32	*	*	*	*	*	*
3286	1-31-89	ACHD	2.29	120	10	*	sub	*	*
3287	3-14-89	ACHD	<0.20	*	*	*	*	*	*
3288	3-7-89	ACHD	<0.20	*	*	*	*	*	*
3289	3-7-89	ACHD	<0.20	*	*	*	*	*	*
3290	2-8-89	ACHD	0.33	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township - Site 3--Continued									
3291	1-23-89	ACHD	0.33	*	*	*	*	*	*
3292	1-11-89	ACHD	<0.20	*	*	*	*	*	*
3294	1-20-89	ACHD	7.60	60	5	*	SW Jet	*	*
3295	3-15-89	ACHD	<0.20	*	*	*	*	*	*
3296	1-10-89	ACHD	5.66	*	*	*	*	*	*
3298	1-19-89	ACHD	1.28	*	*	*	*	*	*
3299	1-27-89	ACHD	0.33	*	*	*	*	*	*
3300	1-10-89	ACHD	<0.10	*	*	*	*	*	*
3302	12-27-88	ACHD	0.12	*	*	*	*	*	*
3303	1-19-89	ACHD	1.14	*	*	*	*	*	*
3304	1-10-89	ACHD	1.26	*	*	*	*	*	*
3305	1-19-89	ACHD	0.94	112	5	*	DW Jet	*	*
3306	2-8-89	ACHD	0.61	*	*	*	*	*	*
3307	1-20-89	ACHD	3.41	*	*	*	*	*	*
3308	3-1-89	ACHD	0.68	*	*	*	*	*	*
3309	3-8-89	ACHD	1.41	*	*	*	*	*	*
3310	1-10-89	ACHD	3.99	*	*	*	*	*	*
3311	1-23-89	ACHD	0.45	*	*	*	*	*	*
3312	1-10-89	ACHD	0.80	*	*	*	*	*	*
3313	1-27-89	ACHD	0.10	*	*	*	*	*	*
3314	3-14-89	ACHD	2.47	*	*	*	*	*	*
3315	1-20-89	ACHD	0.33	*	*	*	*	*	*
3316	1-19-89	ACHD	1.79	*	*	*	*	*	*
3317	1-11-89	ACHD	0.80	*	*	*	*	*	*
3318	1-23-89	ACHD	0.57	*	*	*	*	*	*
3319	1-10-89	ACHD	1.12	*	*	*	*	*	*
3320	2-8-89	ACHD	0.16	*	*	*	*	*	*
3321	1-18-89	ACHD	4.59	123	5	*	DW Jet	*	*
3322	2-15-89	ACHD	0.46	*	*	*	*	*	*
3323	1-23-89	ACHD	0.38	*	*	*	*	*	*
3324	1-25-89	ACHD	0.13	*	*	*	*	*	*
3325	1-20-89	ACHD	1.20	*	*	*	*	*	*
3326	3-10-89	ACHD	0.07	80	10	*	sub	*	*
3327	3-8-89	ACHD	<0.20	*	*	*	*	*	*
3328	1-10-89	ACHD	2.09	107	10	*	sub	*	*
3329	1-10-89	ACHD	0.73	*	*	*	*	*	*
3330	3-7-89	ACHD	<0.20	*	*	*	*	*	*
3331	2-17-89	ACHD	0.25	*	*	*	*	*	*
3332	2-17-89	ACHD	0.25	*	*	*	*	*	*
3333	2-17-89	ACHD	3.03	*	*	*	*	*	*
3334	2-17-89	ACHD	15.57	*	*	*	*	*	*
3335	1-10-89	ACHD	<0.50	*	*	*	*	*	*
3336	1-10-89	ACHD	<0.50	*	*	*	*	*	*
3337	1-10-89	ACHD	<0.50	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Galloway Township - Site 4									
4001	3-4-92	ACHD	10.20	110	*	*	*	*	*
4002	10-10-90	ACHD	<0.10	43	*	*	*	*	*
4003	9-3-92	ACHD	2.75	*	*	*	*	*	*
4004	10-10-90	ACHD	1.20	120	*	*	*	*	*
4005	10-31-90	ACHD	0.32	*	*	*	*	*	*
4006	5-7-91	ACHD	0.30	*	*	*	*	*	*
4007	5-28-91	TWC	<0.50	*	*	*	*	*	*
4008	10-31-90	ACHD	<0.10	*	*	*	*	*	*
4009	10-17-90	ACHD	<0.10	60	*	*	*	*	*
4010	3-12-91	ACHD	0.38	*	*	*	*	*	*
4011	10-10-90	ACHD	<0.10	*	*	*	*	*	*
4012	7-2-91	ACHD	<0.10	*	*	*	*	*	*
4013	11-10-92	ACHD	<0.10	100	*	*	*	*	*
4014	11-10-92	ACHD	<0.10	100	*	*	*	*	*
4015	11-10-92	ACHD	5.16	100	*	*	*	*	*
4016	10-3-90	ACHD	<0.10	55	*	*	*	*	*
4017	10-30-90	ACHD	0.12	104	*	*	*	*	*
4018	11-14-90	ACHD	<0.10	100	*	*	*	*	*
4019	10-2-90	ACHD	0.10	103	*	*	*	*	*
4020	9-17-90	ACHD	0.22	80	*	*	*	*	*
4021	8-15-91	ACHD	7.60	105	5	steel	SW Jet	10-80	17
4022	12-26-90	ACHD	1.40	*	*	*	*	*	*
4023	11-14-90	ACHD	1.10	*	*	*	*	*	*
4024	10-9-90	ACHD	<0.10	*	*	*	*	*	*
4025	8-19-92	ACHD	2.66	*	*	*	*	*	*
4026	11-7-90	ACHD	1.43	*	*	*	*	*	*
4027	10-16-90	ACHD	<0.10	117	5	steel	1/2 jet	7-82	14
4028	11-7-90	ACHD	0.56	*	*	*	*	*	*
4029	*	ACHD	0.19	*	*	*	*	*	*
4030	10-16-90	ACHD	0.19	*	*	*	*	*	*
4031	10-2-90	ACHD	0.50	105	10	PVC	jet	2-89N	13
4032	9-17-90	ACHD	<0.10	*	*	*	*	*	*
4033	10-31-90	ACHD	0.20	*	*	*	*	*	*
4034	10-3-90	ACHD	1.90	120	*	*	*	*	*
4035	10-9-90	ACHD	0.23	*	*	*	*	*	*
4036	8-25-92	ACHD	3.62	80	*	*	*	*	*
4037	10-9-90	ACHD	<0.20	*	*	*	*	*	*
4038	6-3-92	ACHD	0.15	*	*	*	*	*	*
4039	5-15-91	ACHD	0.46	*	*	*	*	*	*
4040	5-20-92	ACHD	0.61	*	*	*	*	*	*
4041	10-9-90	ACHD	<0.10	110	*	*	*	*	*
4042	10-31-90	ACHD	<0.10	*	*	*	*	*	*
4043	1-6-92	ACHD	<0.10	100	*	*	*	*	*
4044	10-23-92	ACHD	9.51	200	*	*	*	*	*
4045	9-15-92	ACHD	4.21	120	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Galloway Township - Site 4--Continued									
4046	8-29-91	SJTL	<0.10	*	*	*	*	*	*
4047	1-10-91	ACHD	6.50	109	*	*	*	*	*
4048	1-22-91	ACHD	3.14	120	*	*	*	*	*
4049	9-1-92	ACHD	<0.10	*	*	*	*	*	*
4050	3-10-92	SJTL	2.00	105	5	PVC	SW Jet	9-88R	10
4051	10-10-90	ACHD	<0.10	*	*	*	*	*	*
4052	10-31-90	ACHD	0.41	*	*	*	*	*	*
4053	7-2-91	ACHD	<0.10	40	*	*	*	*	*
4054	10-23-90	ACHD	0.13	*	*	*	*	*	*
4055	11-10-92	ACHD	<0.10	*	*	*	*	*	*
4056	10-16-90	ACHD	<0.10	*	*	*	*	*	*
4057	10-9-90	ACHD	<0.10	*	*	*	*	*	*
4058	11-7-90	ACHD	0.02	*	*	*	*	*	*
4059	8-19-92	ACHD	0.30	*	*	*	*	*	*
4060	10-31-90	ACHD	<0.10	69	*	*	*	*	*
4061	10-10-90	ACHD	0.71	*	*	*	*	*	*
4062	11-28-90	ACHD	<0.10	*	*	*	*	*	*
4063	8-27-92	ACHD	0.21	43	*	*	*	*	*
4064	10-2-90	ACHD	1.40	109	7	PVC	SW Jet	9-88R	11
4065	10-17-90	ACHD	<0.20	103	*	*	*	*	*
4066	2-6-92	ACHD	5.10	*	*	*	*	*	*
4067	10-6-92	ACHD	0.19	*	*	*	*	*	*
4068	10-24-90	ACHD	<0.10	*	*	*	*	*	*
4069	10-3-90	ACHD	0.50	103	*	*	*	*	*
4070	9-15-92	ACHD	2.71	*	*	*	*	*	*
4071	10-30-90	ACHD	<0.10	100	*	*	*	*	*
4072	8-20-92	ACHD	2.42	*	*	*	*	*	*
4073	11-12-92	ACHD	<0.10	105	*	*	*	*	*
4074	10-31-90	ACHD	<0.10	32	*	*	*	*	*
4075	10-9-90	ACHD	<0.10	*	*	*	*	*	*
4076	11-7-90	ACHD	0.35	*	*	*	*	*	*
Atlantic County - Galloway Township - Site 5									
5001	6-12-91	ACHD	0.70	*	*	*	*	*	*
5003	8-28-89	ACHD	1.20	*	*	*	*	*	*
5004	8-28-89	ACHD	1.20	*	*	*	*	*	*
5006	7-2-90	ACHD	0.19	*	*	*	*	*	*
5007	7-2-90	ACHD	1.60	*	*	*	*	*	*
5008	5-30-90	ACHD	0.22	*	*	*	*	*	*
5014	4-8-91	JRH	<0.50	*	*	*	*	*	*
5015	9-13-90	ACHD	<0.20	*	*	*	*	*	*
5016	8-28-90	ACHD	<0.20	*	*	*	*	*	*
5017	10-2-90	ACHD	0.20	*	*	*	*	*	*
5018	7-24-90	ACHD	<0.20	81	*	PVC	*	*	*
5020	6-12-90	ACHD	<0.50	*	*	*	*	*	*
5021	8-8-90	ACHD	<0.20	*	*	*	*	*	*
5022	4-8-91	SJTL	<0.20	*	*	*	*	*	*
5023	8-21-90	ACHD	<0.20	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Galloway Township - Site 5--Continued									
5024	8-1-90	ACHD	<0.10	*	*	*	*	*	*
5030	8-7-90	ACHD	1.10	*	*	*	*	*	*
5032	8-15-90	ACHD	<0.20	88	*	PVC	*	*	*
5033	7-25-90	ACHD	0.33	*	*	*	*	*	*
5034	1-29-91	ACHD	1.71	92	*	PVC	*	*	*
5039	7-2-90	ACHD	0.19	*	*	*	*	*	*
5040	8-8-90	ACHD	0.98	*	*	*	*	*	*
5041	6-12-90	ACHD	2.70	*	*	*	*	*	*
5043	9-5-90	ACHD	<0.10	*	*	*	*	*	*
5047	7-18-90	ACHD	<0.20	*	*	*	*	*	*
5048	8-1-90	ACHD	<0.20	*	*	*	*	*	*
5049	4-9-90	ACHD	<0.20	*	*	*	*	*	*
5050	7-18-90	ACHD	0.29	64	*	PVC	*	*	*
5051	5-8-90	ACHD	0.50	64	*	PVC	*	*	*
5052	6-27-90	ACHD	0.15	*	*	*	*	*	*
5053	7-11-90	ACHD	<0.10	64	*	PVC	*	*	*
5054	5-8-90	ACHD	<0.10	64	*	PVC	*	*	*
5055	5-16-90	ACHD	<0.20	64	*	PVC	*	*	*
5057	5-29-90	ACHD	1.30	64	*	PVC	*	*	*
5058	5-15-90	ACHD	0.20	64	*	PVC	*	*	*
5059	3-19-91	ACHD	<0.20	64	*	PVC	*	*	*
5060	4-9-90	ACHD	0.10	64	*	PVC	*	*	*
5061	5-8-90	ACHD	<0.20	64	*	PVC	*	*	*
5062	6-11-91	ACHD	1.00	*	*	*	*	*	*
5063	7-2-90	ACHD	0.12	64	*	PVC	*	*	*
5064	5-8-90	ACHD	<0.20	64	*	PVC	*	*	*
5065	5-15-90	ACHD	<0.20	64	*	PVC	*	*	*
5066	4-9-90	ACHD	0.10	*	*	*	*	*	*
5067	7-25-90	ACHD	0.88	*	*	*	*	*	*
5068	9-12-89	ACHD	0.83	64	*	PVC	*	*	*
5069	7-18-90	ACHD	2.70	*	*	*	*	*	*
5070	7-18-91	ACHD	2.70	64	*	PVC	*	*	*
5072	5-31-91	P&P	8.87	83	*	PVC	*	*	*
5073	5-23-91	ACHD	0.39	83	*	PVC	*	*	*
5074	7-25-90	ACHD	1.07	*	*	*	*	*	*
5076	8-1-90	ACHD	0.28	*	*	*	*	*	*
5077	8-28-89	ACHD	0.20	*	*	*	*	*	*
5078	8-28-89	ACHD	0.20	*	*	*	*	*	*
5079	7-11-90	ACHD	<0.10	*	*	*	*	*	*
5080	7-11-90	ACHD	<0.20	*	*	*	*	*	*
5081	5-29-90	ACHD	1.30	*	*	*	*	*	*
5082	5-30-91	TWC	<0.50	*	*	*	*	*	*
5084	7-17-90	ACHD	0.43	*	*	*	*	*	*
5085	6-12-90	ACHD	<0.20	*	*	*	*	*	*
5086	5-8-90	ACHD	<0.20	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Galloway Township - Site 5--Continued									
5087	5-2-90	ACHD	2.79	81	*	g steel	*	*	*
5088	5-9-90	ACHD	<0.20	*	*	*	*	*	*
5089	5-2-90	ACHD	1.71	*	*	*	*	*	*
5090	12-18-90	ACHD	<0.10	*	*	*	*	*	*
5091	5-8-90	ACHD	0.40	*	*	*	*	*	*
5092	6-6-90	ACHD	5.90	*	*	*	*	*	*
5093	5-2-90	ACHD	4.00	*	*	*	*	*	*
5094	5-22-90	ACHD	4.10	*	*	*	*	*	*
5096	7-31-90	ACHD	3.59	*	*	*	*	*	*
5097	6-5-91	ACHD	1.23	*	*	*	*	*	*
5098	8-14-90	ACHD	4.20	*	*	*	*	*	*
5099	11-28-90	ACHD	0.80	*	*	*	*	*	*
5100	8-8-90	ACHD	<0.20	*	*	*	*	*	*
5101	7-3-90	ACHD	0.12	*	*	*	*	*	*
5102	8-28-89	ACHD	0.40	*	*	*	*	*	*
5103	7-18-90	ACHD	<0.10	*	*	*	*	*	*
5104	6-2-90	ACHD	<0.10	*	*	*	*	*	*
5105	7-18-90	ACHD	<0.20	*	*	*	*	*	*
5106	7-11-90	ACHD	<0.10	*	*	*	*	*	*
5107	7-17-90	ACHD	<0.20	*	*	*	*	*	*
5108	7-10-90	ACHD	<0.20	*	*	*	*	*	*
5109	5-14-91	ACHD	0.46	*	*	*	*	*	*
5110	7-24-90	ACHD	<0.20	*	*	*	*	*	*
5111	2-5-91	ACHD	0.56	*	*	*	*	*	*
5112	5-9-90	ACHD	<0.20	*	*	*	*	*	*
5113	5-23-90	ACHD	0.29	*	*	*	*	*	*
5114	5-2-90	USEPA	1.80	*	*	*	*	*	*
5115	5-2-90	USEPA	3.90	*	*	*	*	*	*
5116	8-1-90	ACHD	2.73	*	*	*	*	*	*
5118	8-1-90	ACHD	0.28	*	*	*	*	*	*
5119	5-22-91	ACHD	0.33	*	*	*	*	*	*
5120	7-10-90	ACHD	<0.20	*	*	*	*	*	*
5121	11-28-90	ACHD	<0.20	*	*	*	*	*	*
5123	8-7-90	ACHD	<0.20	*	*	*	*	*	*
5124	3-27-91	ACHD	0.33	*	*	*	*	*	*
5125	8-28-89	*	0.20	*	*	*	*	*	*
5126	4-9-90	ACHD	1.38	*	*	*	*	*	*
5127	6-26-90	ACHD	2.42	*	*	*	*	*	*
5128	8-28-89	CCJM	0.20	*	*	*	*	*	*
5129	5-2-90	ACHD	<0.10	*	*	*	*	*	*
5130	8-28-89	CCJM	0.20	*	*	*	*	*	*
5131	7-5-91	TWC	0.50	*	*	*	*	*	*
5133	8-29-89	USEPA	0.80	*	*	*	*	*	*
5134	8-8-90	ACHD	0.48	*	*	*	*	*	*
5135	12-24-90	TWC	0.90	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Galloway Township - Site 5--Continued									
5136	8-12-91	P&P	<1.00	*	*	*	*	*	*
5137	8-21-90	ACHD	<0.10	*	*	*	*	*	*
5138	8-5-91	*	1.00	*	*	*	*	*	*
5139	1-8-92	ACHD	0.50	*	*	*	*	*	*
5140	9-9-91	ACHD	0.39	*	*	*	*	*	*
5141	1-8-92	ACHD	0.61	*	*	*	*	*	*
5142	11-12-91	ACHD	0.59	*	*	*	*	*	*
5143	1-6-92	ACHD	<0.20	*	*	*	*	*	*
5144	10-13-92	ACHD	0.17	*	*	*	*	*	*
5145	10-18-91	ACHD	7.63	*	*	*	*	*	*
5146	8-20-92	ACHD	<0.10	*	*	*	*	*	*
5147	11-19-91	ACHD	<0.20	*	*	*	*	*	*
5148	11-6-91	ACHD	0.22	*	*	*	*	*	*
5149	1-14-92	ACHD	7.15	*	*	*	*	*	*
5150	*	SJTL	<0.50	*	*	*	*	*	*
5151	11-4-91	ACHD	0.52	*	*	*	*	*	*
5152	3-3-92	ACHD	0.97	*	*	*	*	*	*
5153	4-8-92	P&P	<1.00	*	*	*	*	*	*
5154	7-23-92	SJTL	<0.50	*	*	*	*	*	*
5155	8-18-92	ACHD	<0.10	*	*	*	*	*	*
5156	1-14-92	ACHD	0.37	*	*	*	*	*	*
5157	1-21-92	ACHD	0.19	*	*	*	*	*	*
5158	8-28-89	USEPA	0.20	*	*	*	*	*	*
5159	1-14-92	ACHD	<0.20	*	*	*	*	*	*
5160	9-27-91	SJTL	<0.50	*	*	*	*	*	*
Atlantic County - Hammonton Town - Site 6									
6001	12-8-92	ACHD	2.23	*	*	*	*	*	*
6002	11-19-91	ACHD	1.58	*	*	*	*	*	*
6003	9-17-92	NJDEP	<0.20	*	*	*	*	*	*
6004	9-17-92	NJDEP	<0.20	*	*	*	*	*	*
6005	1-21-92	ACHD	0.99	*	*	*	*	*	*
6006	5-20-92	ACHD	0.38	*	*	*	*	*	*
6007	2-18-92	ACHD	0.87	*	*	*	*	*	*
6008	9-17-92	NJDEP	6.70	*	*	*	*	*	*
6009	9-17-92	NJDEP	<0.20	*	*	*	*	*	*
6010	6-11-92	ACHD	2.40	*	*	*	*	*	*
6011	12-5-91	ACHD	<0.20	*	*	*	*	*	*
6012	12-4-91	ACHD	0.80	*	*	*	*	*	*
6013	9-17-92	NJDEP	<0.20	*	*	*	*	*	*
6014	12-4-91	ACHD	<0.20	*	*	*	*	*	*
6015	1-7-92	ACHD	<0.20	*	*	*	*	*	*
6016	11-12-91	ACHD	0.59	*	*	*	*	*	*
6017	11-6-92	TWC	3.20	*	*	*	*	*	*
6018	11-12-91	ACHD	0.72	*	*	*	*	*	*
6019	10-2-92	TWC	1.30	*	*	*	*	*	*
6020	6-2-92	ACHD	<0.10	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Hammonton Town - Site 6--Continued									
6021	3-3-92	ACHD	13.40	*	*	*	*	*	*
6022	9-29-92	TWC	1.50	*	*	*	*	*	*
6023	10-22-92	TWC	2.20	*	*	*	*	*	*
6024	1-7-92	ACHD	0.50	*	*	*	*	*	*
6025	12-4-91	ACHD	<0.20	*	*	*	*	*	*
6026	6-4-92	ACHD	<0.20	*	*	*	*	*	*
6027	11-4-92	TWC	2.10	*	*	*	*	*	*
6028	5-28-92	ACHD	0.20	*	*	*	*	*	*
6029	11-19-91	ACHD	0.33	*	*	*	*	*	*
6030	12-8-92	ACHD	1.50	*	*	*	*	*	*
6031	12-5-91	ACHD	<0.20	*	*	*	*	*	*
6032	1-6-92	ACHD	0.92	*	*	*	*	*	*
6033	10-9-92	TWC	0.66	*	*	*	*	*	*
6034	9-17-92	NJDEP	<0.20	*	*	*	*	*	*
6035	9-17-92	NJDEP	4.30	*	*	*	*	*	*
6036	12-5-91	ACHD	0.36	*	*	*	*	*	*
6037	10-14-92	ACHD	<0.10	*	*	*	*	*	*
6038	12-10-91	ACHD	<0.20	*	*	*	*	*	*
6039	12-9-91	ACHD	0.27	*	*	*	*	*	*
6040	11-18-91	ACHD	0.93	*	*	*	*	*	*
6041	6-2-92	ACHD	<0.10	*	*	*	*	*	*
6042	11-19-92	ACHD	<0.20	*	*	*	*	*	*
6043	12-10-91	ACHD	<0.20	*	*	*	*	*	*
6044	10-29-91	ACHD	0.67	*	*	*	*	*	*
6045	10-14-92	ACHD	5.20	*	*	*	*	*	*
6046	9-17-92	NJDEP	<0.20	*	*	*	*	*	*
6047	3-9-92	ACHD	<0.10	*	*	*	*	*	*
6048	3-13-92	ACHD	0.16	*	*	*	*	*	*
6049	12-4-91	ACHD	1.08	*	*	*	*	*	*
6050	5-27-92	ACHD	0.20	*	*	*	*	*	*
6051	9-17-92	NJDEP	<0.20	*	*	*	*	*	*
6052	12-24-91	ACHD	<0.20	*	*	*	*	*	*
6053	7-14-92	ACHD	<0.10	*	*	*	*	*	*
6054	8-5-92	TWC	<0.50	*	*	*	*	*	*
6055	7-14-92	ACHD	<0.10	*	*	*	*	*	*
6056	12-23-91	ACHD	<0.20	*	*	*	*	*	*
6057	6-23-92	ACHD	0.22	*	*	*	*	*	*
6058	11-13-91	ACHD	1.11	*	*	*	*	*	*
6059	5-18-92	ACHD	0.30	*	*	*	*	*	*
6060	5-12-92	ACHD	<0.20	*	*	*	*	*	*
6061	9-17-92	NJDEP	<0.20	*	*	*	*	*	*
6062	9-23-92	ACHD	7.14	90	*	*	*	*	*
6063	12-10-92	ACHD	0.17	*	*	*	*	*	*
6064	9-17-92	NJDEP	<0.20	*	*	*	*	*	*
6065	12-3-91	ACHD	<0.20	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Hammonton Town - Site 6—Continued									
6066	9-16-92	ACHD	0.12	*	*	*	*	*	*
6067	12-4-91	ACHD	<0.20	*	*	*	*	*	*
6068	12-4-91	ACHD	<0.20	*	*	*	*	*	*
6069	9-30-92	ACHD	0.30	*	*	*	*	*	*
6070	12-4-91	ACHD	<0.20	*	*	*	*	*	*
6071	9-30-92	ACHD	0.10	175	*	*	*	*	*
6072	9-30-92	ACHD	0.50	*	*	*	*	*	*
Atlantic County - Egg Harbor Township - Site 7									
7006	3-27-91	ACHD	0.35	*	*	*	*	*	*
7008	7-24-90	ACHD	0.41	*	*	*	*	*	*
7013	9-19-90	ACHD	0.19	*	*	*	*	*	*
7014	7-19-90	ACHD	0.33	*	*	*	*	*	*
7016	7-12-90	ACHD	1.30	*	*	*	*	*	*
7017	7-24-90	ACHD	<0.10	*	*	*	*	*	*
7020	7-12-90	ACHD	<0.10	*	*	*	*	*	*
7022	7-12-90	ACHD	0.80	*	*	*	*	*	*
7024	3-20-91	ACHD	<0.10	*	*	*	*	*	*
7025	7-12-90	ACHD	<0.10	*	*	*	*	*	*
7026	7-11-90	ACHD	<0.10	*	*	*	*	*	*
7028	7-31-90	ACHD	0.50	115	*	PVC	*	*	*
7029	7-18-90	ACHD	0.63	*	*	*	*	*	*
7030	10-10-90	ACHD	0.83	111	6	PVC	SW Jet	3-85N	21
7034	3-26-91	ACHD	<0.10	*	*	*	*	*	*
7035	4-3-91	ACHD	<0.10	106	*	PVC	*	*	*
7036	4-3-91	ACHD	<0.10	106	*	PVC	*	*	*
7037	6-17-91	TWC	<0.10	*	*	*	*	*	*
7039	5-25-91	ACHD	0.25	*	*	*	*	*	*
7041	4-2-91	ACHD	0.40	*	*	*	*	*	*
7042	4-2-91	ACHD	<0.10	*	*	*	*	*	*
7045	3-19-91	ACHD	<0.10	*	*	*	*	*	*
7046	6-5-91	ACHD	0.19	*	*	*	*	*	*
7049	8-14-90	ACHD	0.60	*	*	*	*	*	*
7051	7-26-90	ACHD	0.39	*	*	*	*	*	*
7053	4-9-91	ACHD	0.21	*	*	*	*	*	*
7057	8-7-90	ACHD	1.60	*	*	*	*	*	*
7058	7-25-90	ACHD	1.56	*	*	*	*	*	*
7059	7-19-90	ACHD	<0.10	*	*	*	*	*	*
7061	7-12-90	ACHD	0.80	*	*	*	*	*	*
7063	4-16-91	TWC	<0.10	*	*	*	*	*	*
7064	4-9-91	ACHD	0.38	*	*	*	*	*	*
7065	5-7-91	ACHD	0.47	*	*	*	*	*	*
7066	7-19-90	ACHD	0.14	*	*	*	*	*	*
7068	7-19-90	ACHD	1.20	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township - Site 7--Continued									
7069	7-25-90	ACHD	2.50	*	*	*	*	*	*
7070	2-13-91	P&P	<0.10	*	*	*	*	*	*
7071	8-14-90	ACHD	0.10	*	*	*	*	*	*
7072	7-12-90	*	0.10	*	*	*	*	*	*
7073	7-19-90	ACHD	0.46	*	*	*	*	*	*
7075	4-10-91	ACHD	3.50	*	*	*	*	*	*
7077	4-30-91	ACHD	1.34	*	*	*	*	*	*
7078	4-2-91	ACHD	0.20	107	7	PVC	SW Jet	11-85N	16
7080	10-24-90	ACHD	<0.10	*	*	*	*	*	*
7081	10-23-90	ACHD	<0.10	*	*	*	*	*	*
7082	8-15-90	ACHD	<0.10	*	*	*	*	*	*
7083	4-10-91	ACHD	0.30	*	*	*	*	*	*
7086	7-19-90	ACHD	<0.10	105	*	PVC	*	*	*
7088	7-12-90	ACHD	0.90	105	*	PVC	*	*	*
7089	7-12-90	ACHD	<0.10	*	*	*	*	*	*
7090	7-12-90	ACHD	<0.10	*	*	*	*	*	*
7091	11-13-90	ACHD	1.70	*	*	*	*	*	*
7092	7-19-90	ACHD	1.50	*	*	*	*	*	*
7093	6-19-90	ACHD	1.40	*	*	*	*	*	*
7094	7-26-90	ACHD	0.88	*	*	*	*	*	*
7095	3-20-91	ACHD	<0.10	*	*	*	*	*	*
7096	7-19-90	ACHD	0.65	*	*	*	*	*	*
7097	5-28-91	ACHD	1.70	*	*	*	*	*	*
7098	5-28-91	ACHD	0.40	*	*	*	*	*	*
7104	8-21-91	ACHD	0.81	*	*	*	*	*	*
7105	8-7-90	ACHD	0.21	*	*	*	*	*	*
7107	7-2-90	ACHD	0.12	*	*	*	*	*	*
7109	4-10-91	ACHD	0.21	*	*	*	*	*	*
7110	9-11-90	ACHD	0.22	*	*	*	*	*	*
7111	9-26-90	ACHD	0.90	*	*	*	*	*	*
7113	7-19-90	ACHD	<0.10	110	*	PVC	*	*	*
7115	4-17-91	ACHD	<0.10	*	*	*	*	*	*
7117	4-3-91	ACHD	0.30	*	*	*	*	*	*
7118	4-16-91	ACHD	0.97	*	*	*	*	*	*
7121	3-27-91	ACHD	0.53	*	*	*	*	*	*
7122	9-26-90	*	<0.10	*	*	*	*	*	*
7123	8-22-90	ACHD	1.00	*	*	*	*	*	*
7124	7-16-91	ACHD	<0.10	*	*	*	*	*	*
7125	7-17-91	ACHD	<0.10	*	*	*	*	*	*
7126	7-25-90	ACHD	0.39	*	*	*	*	*	*
7127	1-7-92	ACHD	2.02	*	*	*	*	*	*
7128	3-18-92	ACHD	2.77	*	*	*	*	*	*
Camden County - Waterford Township - Site 8									
8001	1-14-92	TWC	<0.50	*	*	*	*	*	*
8002	12-24-91	TWC	<0.50	*	*	*	*	*	*
8004	2-8-92	TWC	2.80	*	*	*	*	*	*
8006	2-22-92	TWC	<0.50	*	*	*	*	*	*
8008	3-10-92	TWC	<0.50	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Camden County - Waterford Township - Site 8--Continued									
8009	3-13-92	TWC	<0.50	*	*	*	*	*	*
8011	2-25-92	TWC	<0.50	123	12	steel	jet	11-77	17
8012	12-2-91	TWC	0.60	*	*	*	*	*	*
8014	11-19-91	TWC	<0.80	*	*	*	*	*	*
8032	11-23-91	TWC	1.80	89	7	steel	jet	4-78	26
8033	12-19-91	TWC	<0.50	*	*	*	*	*	*
8034	12-5-91	TWC	<0.50	80	10	PVC	sub	4-89	25
8036	11-26-91	TWC	<0.50	*	*	*	*	*	*
8037	12-12-91	P&P	<1.00	*	*	*	*	*	*
8038	12-12-91	P&P	<1.00	*	*	*	*	*	*
8039	12-12-91	P&P	<1.00	*	*	*	*	*	*
8040	6-24-91	P&P	<1.00	*	*	*	*	*	*
8041	3-8-91	P&P	<1.00	*	*	*	*	*	*
8042	11-21-91	TWC	<0.50	*	*	*	*	*	*
8043	11-26-91	TWC	<0.50	*	*	*	*	*	*
8044	12-17-91	TWC	<0.50	*	*	*	*	*	*
8045	12-26-91	TWC	<0.50	*	*	*	*	*	*
8046	2-22-92	TWC	<0.50	*	*	*	*	*	*
8047	1-18-92	TWC	<0.50	84	10	PVC	sub	7-81	35
8048	12-12-91	TWC	<0.50	74	10	PVC	sub	8-80	25
8050	1-4-92	TWC	<0.50	*	*	*	*	*	*
8051	2-22-92	TWC	<0.50	*	*	*	*	*	*
8052	1-28-92	TWC	<0.50	*	*	*	*	*	*
8053	11-30-91	TWC	<0.50	*	*	*	*	*	*
8055	12-30-91	TWC	<0.50	*	*	*	*	*	*
8056	12-17-91	TWC	<0.50	*	*	*	*	*	*
8057	2-6-92	TWC	<0.50	*	*	*	*	*	*
8058	1-22-92	TWC	0.80	*	*	*	*	*	*
8059	1-29-92	TWC	<0.50	80	10	PVC	sub	12-87	22
8060	12-16-91	TWC	<0.50	*	*	*	*	*	*
8061	12-12-91	TWC	<0.50	*	*	*	*	*	*
8062	12-23-91	TWC	<0.50	*	*	*	*	*	*
8063	12-10-91	TWC	<0.50	*	*	*	*	*	*
8065	12-9-91	TWC	<0.50	*	*	*	*	*	*
8066	11-27-91	TWC	0.50	*	*	*	*	*	*
8067	11-22-91	TWC	<0.50	*	*	*	*	*	*
8068	2-22-92	TWC	1.40	*	*	*	*	*	*
8069	3-19-92	TWC	<0.50	*	*	*	*	*	*
8070	12-16-91	TWC	<0.50	74	10	PVC	sub	10-84	12
8071	12-9-91	TWC	<0.50	*	*	*	*	*	*
8072	12-3-91	TWC	<0.50	*	*	*	*	*	*
8074	11-21-91	TWC	<0.50	*	*	*	*	*	*
8075	12-4-91	TWC	0.50	*	*	*	*	*	*
8076	4-25-92	TWC	2.50	*	*	*	*	*	*
8082	12-13-91	P&P	<1.00	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Camden County - Waterford Township - Site 8--Continued									
8083	12-12-91	P&P	<1.00	*	*	*	*	*	*
8084	2-8-92	TWC	2.80	*	*	*	*	*	*
8085	12-18-91	TWC	<0.50	*	*	*	*	*	*
8086	12-12-91	P&P	<1.00	*	*	*	*	*	*
8087	1-2-92	TWC	<0.50	*	*	*	*	*	*
8088	1-23-92	TWC	3.60	*	*	*	*	*	*
8089	2-1-92	TWC	1.20	*	*	*	*	*	*
8090	12-5-91	TWC	<0.50	*	*	*	*	*	*
8091	12-12-91	P&P	<1.00	*	*	*	*	*	*
8093	3-30-92	TWC	<0.50	56	7	steel	jet	11-52N	30
8096	2-7-92	TWC	<0.50	*	*	*	*	*	*
8097	12-11-91	TWC	<0.50	72	5	steel	*	10-51	35
8098	12-2-91	TWC	<0.50	86	10	PVC	sub	12-87	27
8100	12-26-91	TWC	<0.50	*	*	*	*	*	*
8101	11-21-91	TWC	<0.50	*	*	*	*	*	*
8103	1-3-92	TWC	<0.50	*	*	*	*	*	*
8105	12-6-91	TWC	<0.50	*	*	*	*	*	*
8106	12-10-91	TWC	<0.50	*	*	*	*	*	*
8107	12-16-91	TWC	<0.50	*	*	*	*	*	*
8109	12-23-91	TWC	1.90	*	*	*	*	*	*
8110	12-27-91	TWC	<0.50	*	*	*	*	*	*
8111	12-17-91	TWC	<0.50	*	*	*	*	*	*
8112	2-15-92	TWC	<0.50	*	*	*	*	*	*
8113	1-10-92	TWC	2.20	*	*	*	*	*	*
8114	2-1-92	TWC	2.30	*	*	*	*	*	*
8116	1-9-92	TWC	<0.50	*	*	*	*	*	*
8117	3-5-92	TWC	<0.50	*	*	*	*	*	*
8118	1-3-92	TWC	<0.50	*	*	*	*	*	*
8119	11-21-91	TWC	<0.50	*	*	*	*	*	*
8120	12-2-91	TWC	<0.50	*	*	*	*	*	*
8121	12-23-91	TWC	<0.50	*	*	*	*	*	*
8124	1-7-92	TWC	<0.50	64	10	PVC	jet	10-73	14
8126	12-16-91	TWC	0.60	*	*	*	*	*	*
8127	3-24-92	TWC	<0.50	*	*	*	*	*	*
8128	12-13-91	P&P	<1.00	*	*	*	*	*	*
8129	1-29-92	TWC	1.70	*	*	*	*	*	*
8130	11-19-91	TWC	<0.50	*	*	*	*	*	*
8131	12-5-91	TWC	<0.50	*	*	*	*	*	*
8132	2-1-92	TWC	0.60	*	*	*	*	*	*
8133	1-18-92	TWC	<0.50	*	*	*	*	*	*
8135	12-28-91	TWC	<0.50	*	*	*	*	*	*
8136	12-21-91	TWC	<0.50	*	*	*	*	*	*
8138	12-16-91	TWC	<0.50	*	*	*	*	*	*
8139	11-22-91	TWC	0.50	*	*	*	*	*	*
8140	11-21-91	TWC	<0.50	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Camden County - Waterford Township - Site 8--Continued									
8141	3-10-92	TWC	<0.50	*	*	*	*	*	*
8142	1-13-92	TWC	0.60	*	*	*	*	*	*
8143	2-5-92	TWC	<0.50	*	*	*	*	*	*
8144	12-3-91	TWC	<0.50	*	*	*	*	*	*
8145	11-9-91	TWC	1.80	*	*	*	*	*	*
8146	12-14-91	TWC	1.40	*	*	*	*	*	*
8147	1-2-92	TWC	<0.50	*	*	*	*	*	*
8148	12-24-91	TWC	<0.50	*	*	*	*	*	*
8149	12-13-91	P&P	<1.00	*	*	*	*	*	*
8156	12-21-91	TWC	<0.50	*	*	*	*	*	*
8157	12-18-91	TWC	0.60	*	*	*	*	*	*
8158	11-21-91	TWC	0.50	*	*	*	*	*	*
8159	11-18-91	TWC	<0.50	*	*	*	*	*	*
8161	1-8-92	TWC	<0.50	*	*	*	*	*	*
8162	11-20-91	TWC	<0.50	*	*	*	*	*	*
8163	12-2-91	TWC	0.60	*	*	*	*	*	*
8166	11-7-91	TWC	<0.50	*	*	*	*	*	*
8168	11-27-91	TWC	<0.50	*	*	*	*	*	*
8169	2-7-92	TWC	<0.50	*	*	*	*	*	*
8170	2-7-92	TWC	<0.50	*	*	*	*	*	*
8171	3-9-92	TWC	<0.50	*	*	*	*	*	*
8172	11-11-91	TWC	<0.50	*	*	*	*	*	*
8173	11-30-91	TWC	<0.50	*	*	*	*	*	*
8176	12-31-91	TWC	<0.50	*	*	*	*	*	*
8177	2-12-92	TWC	<0.50	*	*	*	*	*	*
8178	3-16-92	TWC	<0.50	*	*	*	*	*	*
8179	2-17-92	TWC	0.70	*	*	*	*	*	*
8181	2-6-92	TWC	<0.50	*	*	*	*	*	*
8184	11-22-91	TWC	<0.50	70	10	steel	*	7-55	12
8185	12-10-91	TWC	<0.50	*	*	*	*	*	*
8186	11-27-91	TWC	<0.50	*	*	*	*	*	*
8188	12-21-91	TWC	<0.50	*	*	*	*	*	*
8189	1-2-92	TWC	<0.50	*	*	*	*	*	*
8190	11-21-91	TWC	<0.50	*	*	*	*	*	*
8191	11-21-91	TWC	<0.50	*	*	*	*	*	*
8193	2-12-92	TWC	20.90	*	*	*	*	*	*
8194	12-7-91	TWC	<0.50	65	10	PVC	sub	7-88	9
8198	1-21-92	TWC	0.60	*	*	*	*	*	*
8199	1-3-92	TWC	<0.50	*	*	*	*	*	*
8200	2-7-92	TWC	1.00	*	*	*	*	*	*
8201	1-7-92	TWC	<0.50	*	*	*	*	*	*
8202	12-27-91	TWC	<0.50	*	*	*	*	*	*
8203	12-4-91	TWC	<0.50	*	*	*	*	*	*
8204	11-22-91	TWC	<0.50	*	*	*	*	*	*
8206	12-19-91	TWC	1.80	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Camden County - Waterford Township - Site 8--Continued									
8207	12-2-91	TWC	0.80	*	*	*	*	*	*
8208	12-13-91	TWC	<0.50	*	*	*	*	*	*
8209	12-7-91	TWC	0.90	*	*	*	*	*	*
8210	12-5-91	TWC	<0.50	*	*	*	*	*	*
8211	12-7-91	TWC	<0.50	*	*	*	*	*	*
8216	2-12-92	TWC	<0.50	80	7	steel	jet	6-83	20
8217	11-21-91	TWC	1.30	*	*	*	*	*	*
8218	12-3-91	TWC	<0.50	*	*	*	*	*	*
8219	11-27-91	TWC	<0.50	*	*	*	*	*	*
8220	12-19-91	TWC	<0.50	*	*	*	*	*	*
8222	12-16-91	TWC	<0.50	*	*	*	*	*	*
8223	1-23-92	TWC	0.90	*	*	*	*	*	*
8225	12-11-91	TWC	<0.50	*	*	*	*	*	*
8226	12-11-91	TWC	<0.50	*	*	*	*	*	*
8227	2-25-92	TWC	<0.50	*	*	*	*	*	*
8228	11-11-91	TWC	<0.50	81	10	PVC	sub	11-87	5
8229	3-18-92	TWC	2.00	*	*	*	*	*	*
8230	1-25-92	TWC	<0.50	*	*	*	*	*	*
8231	4-6-92	TWC	21.70	*	*	*	*	*	*
8232	4-22-92	TWC	2.10	*	*	*	*	*	*
8233	12-26-91	TWC	<0.50	*	*	*	*	*	*
8234	2-6-92	TWC	<0.50	*	*	*	*	*	*
8235	1-14-92	TWC	<0.50	*	*	*	*	*	*
8237	12-20-91	TWC	0.50	*	*	*	*	*	*
8238	2-4-92	TWC	<0.50	*	*	*	*	*	*
8239	12-5-91	TWC	<0.50	*	*	*	*	*	*
8240	12-11-91	TWC	<0.50	*	*	*	*	*	*
8241	1-7-92	TWC	<0.50	*	*	*	*	*	*
8242	12-20-91	TWC	<0.50	*	*	*	*	*	*
8243	2-21-92	TWC	<0.50	*	*	*	*	*	*
8244	12-12-92	TWC	<0.50	*	*	*	*	*	*
8245	2-21-92	TWC	1.40	*	*	*	*	*	*
8247	2-1-92	TWC	<0.50	*	*	*	*	*	*
8248	12-11-91	TWC	<0.50	*	*	*	*	*	*
8249	12-30-91	TWC	<0.50	*	*	*	*	*	*
8250	1-10-92	TWC	<0.50	*	*	*	*	*	*
8251	12-11-91	TWC	<0.50	*	*	*	*	*	*
8252	11-21-91	TWC	<0.50	*	*	*	*	*	*
8253	5-7-92	TWC	8.30	*	*	*	*	*	*
8254	12-28-91	TWC	7.30	*	*	*	*	*	*
8255	5-11-92	TWC	5.30	*	*	*	*	*	*
8256	5-7-92	TWC	2.90	*	*	*	*	*	*
8237	12-12-91	P&P	<1.00	*	*	*	*	*	*
8258	2-15-92	TWC	<0.50	*	*	*	*	*	*
8259	2-15-92	TWC	<0.50	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Camden County - Waterford Township - Site 8--Continued									
8260	2-15-92	TWC	<0.50	*	*	*	*	*	*
8261	12-12-91	P&P	<1.00	*	*	*	*	*	*
8262	10-31-91	TWC	<0.50	*	*	*	*	*	*
8263	12-28-91	TWC	<0.50	*	*	*	*	*	*
8265	12-12-91	P&P	<1.00	*	*	*	*	*	*
8271	12-7-91	TWC	<0.50	63	7	steel	jet	8-77	12
8272	11-13-91	TWC	<0.50	*	*	*	*	*	*
8273	12-10-91	TWC	<0.50	90	2	PVC	sub	12-88	16
8274	2-7-92	TWC	<0.50	*	*	*	*	*	*
8275	12-3-91	TWC	<0.50	*	*	*	*	*	*
8276	11-20-91	TWC	0.80	*	*	*	*	*	*
8277	11-20-91	TWC	0.70	*	*	*	*	*	*
8278	12-5-91	TWC	0.60	*	*	*	*	*	*
8279	11-13-91	TWC	<0.50	*	*	*	*	*	*
8280	12-4-91	TWC	<0.50	*	*	*	*	*	*
8282	12-13-91	P&P	<0.50	*	*	*	*	*	*
8283	3-18-92	TWC	2.90	*	*	*	*	*	*
8284	2-7-92	TWC	1.30	*	*	*	*	*	*
8285	3-18-92	TWC	3.50	*	*	*	*	*	*
8286	1-23-92	TWC	0.90	*	*	*	*	*	*
8287	12-27-91	TWC	<0.50	*	*	*	*	*	*
8288	12-9-91	TWC	<0.50	*	*	*	*	*	*
8289	1-2-92	TWC	<0.50	*	*	*	*	*	*
8291	12-31-91	TWC	<0.50	*	*	*	*	*	*
8292	11-26-91	TWC	0.50	*	*	*	*	*	*
8293	11-26-91	TWC	<0.50	*	*	*	*	*	*
8294	11-27-91	TWC	<0.50	*	*	*	*	*	*
8295	11-26-91	TWC	<0.50	*	*	*	*	*	*
8296	1-15-92	TWC	2.00	*	*	*	*	*	*
8297	3-5-92	TWC	<0.50	*	*	*	*	*	*
8298	11-26-91	TWC	<0.50	*	*	*	*	*	*
8301	3-9-92	TWC	1.10	*	*	*	*	*	*
8302	12-13-91	P&P	<1.00	*	*	*	*	*	*
8303	3-26-92	TWC	<0.50	*	*	*	*	*	*
8305	12-5-91	TWC	<0.50	*	*	*	*	*	*
8306	12-12-91	TWC	<0.50	*	*	*	*	*	*
8309	12-12-91	P&P	<1.00	*	*	*	*	*	*
8310	12-17-91	PANA	<0.10	*	*	*	*	*	*
8311	12-30-91	TWC	<0.50	*	*	*	*	*	*
8314	11-19-91	TWC	0.80	*	*	*	*	*	*
8316	1-8-92	TWC	1.80	*	*	*	*	*	*
8317	12-20-91	TWC	<0.50	67	5	steel	sub	5-80	18
8318	12-18-91	TWC	<0.50	*	*	*	*	*	*
8319	12-17-91	TWC	<0.50	*	*	*	*	*	*
8320	12-12-91	TWC	0.80	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Camden County - Waterford Township - Site 8--Continued									
8321	11-27-91	TWC	<0.50	*	*	*	*	*	*
8322	11-20-91	TWC	<0.50	*	*	*	*	*	*
8323	11-27-91	TWC	<0.50	*	*	*	*	*	*
8325	12-9-91	TWC	<0.50	*	*	*	*	*	*
8326	12-14-91	TWC	<0.50	*	*	*	*	*	*
8328	11-22-91	TWC	<0.50	*	*	*	*	*	*
8329	12-18-91	TWC	<0.50	*	*	*	*	*	*
8330	12-27-91	TWC	<0.50	*	*	*	*	*	*
8331	11-18-91	TWC	<0.50	*	*	*	*	*	*
8335	12-7-91	TWC	<0.50	*	*	*	*	*	*
8336	12-2-91	TWC	<0.50	*	*	*	*	*	*
8337	1-10-92	TWC	<0.50	*	*	*	*	*	*
8338	12-3-91	TWC	<0.50	*	*	*	*	*	*
8339	11-29-91	TWC	0.60	*	*	*	*	*	*
8340	1-3-92	TWC	<0.50	*	*	*	*	*	*
8341	12-7-91	TWC	<0.50	*	*	*	*	*	*
8342	12-18-91	TWC	<0.50	*	*	*	*	*	*
8344	11-27-91	TWC	<0.50	*	*	*	*	*	*
8345	11-25-91	TWC	<0.50	*	*	*	*	*	*
8346	11-21-91	TWC	0.60	*	*	*	*	*	*
8347	12-2-91	TWC	<0.50	*	*	*	*	*	*
8348	12-4-91	TWC	0.90	*	*	*	*	*	*
8349	12-13-91	TWC	<0.50	*	*	*	*	*	*
8350	11-21-91	TWC	0.50	*	*	*	*	*	*
8351	11-25-91	TWC	0.50	*	*	*	*	*	*
8352	12-28-91	TWC	2.80	*	*	*	*	*	*
8353	12-30-91	TWC	<0.50	*	*	*	*	*	*
8354	12-14-91	TWC	0.50	*	*	*	*	*	*
8355	12-12-91	TWC	<0.50	*	*	*	*	*	*
8356	12-11-91	TWC	<0.50	*	*	*	*	*	*
8357	12-13-91	TWC	<0.50	*	*	*	*	*	*
8358	2-10-92	TWC	<0.50	*	*	*	*	*	*
8359	1-10-92	TWC	<0.50	*	*	*	*	*	*
8360	12-30-91	TWC	<0.50	*	*	*	*	*	*
8362	12-12-91	P&P	<1.00	*	*	*	*	*	*
8364	1-10-92	TWC	0.50	*	*	*	*	*	*
8365	12-9-91	TWC	<0.50	*	*	*	*	*	*
8366	12-13-91	TWC	<0.90	*	*	*	*	*	*
8367	1-8-92	TWC	1.10	*	*	*	*	*	*
8368	12-12-91	TWC	<0.50	*	*	*	*	*	*
8369	2-12-92	TWC	<0.50	*	*	*	*	*	*
8371	2-10-92	TWC	<0.50	*	*	*	*	*	*
8372	2-21-92	TWC	0.90	*	*	*	*	*	*
8373	12-19-91	TWC	1.00	*	*	*	*	*	*
8374	12-13-91	P&P	<1.00	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Camden County - Waterford Township - Site 8--Continued									
8375	2-1-92	TWC	2.00	*	*	*	*	*	*
8376	12-13-91	P&P	<1.00	*	*	*	*	*	*
8377	12-6-91	TWC	<0.50	*	*	*	*	*	*
8378	12-4-91	TWC	<0.50	*	*	*	*	*	*
8379	1-23-92	TWC	<0.50	*	*	*	*	*	*
8380	11-26-91	TWC	<0.50	*	*	*	*	*	*
8381	11-25-91	TWC	<0.50	*	*	*	*	*	*
8382	11-25-91	TWC	<0.50	*	*	*	*	*	*
8383	1-21-92	TWC	<0.50	*	*	*	*	*	*
8384	12-4-91	TWC	<0.50	*	*	*	*	*	*
8388	11-25-91	TWC	<0.50	*	*	*	*	*	*
8389	2-5-92	TWC	0.80	*	*	*	*	*	*
8390	12-17-91	TWC	0.80	*	*	*	*	*	*
8391	12-21-91	TWC	<0.50	*	*	*	*	*	*
8392	12-7-91	TWC	<0.50	*	*	*	*	*	*
8394	11-26-91	TWC	<0.50	*	*	*	*	*	*
8395	11-22-91	TWC	<0.50	*	*	*	*	*	*
8396	11-25-91	TWC	<0.50	*	*	*	*	*	*
8397	11-12-91	TWC	0.80	*	*	*	*	*	*
8398	12-12-91	TWC	<0.50	*	*	*	*	*	*
8399	11-27-91	TWC	<0.50	*	*	*	*	*	*
8400	12-2-91	TWC	<0.50	*	*	*	*	*	*
8401	12-13-91	TWC	<0.50	*	*	*	*	*	*
8402	11-21-91	TWC	0.90	*	*	*	*	*	*
8403	11-25-91	TWC	<0.50	*	*	*	*	*	*
8404	11-22-91	TWC	<0.50	*	*	*	*	*	*
8405	11-29-91	TWC	<0.50	*	*	*	*	*	*
8406	12-4-91	TWC	<0.50	*	*	*	*	*	*
8408	12-3-91	TWC	<0.50	*	*	*	*	*	*
8409	2-22-92	TWC	<0.50	*	*	*	*	*	*
8410	11-29-91	TWC	<0.50	*	*	*	*	*	*
8411	11-22-91	TWC	<0.50	*	*	*	*	*	*
8412	2-22-92	TWC	<0.50	*	*	*	*	*	*
8413	11-26-91	TWC	<0.50	*	*	*	*	*	*
8414	1-2-92	TWC	<0.50	*	*	*	*	*	*
8415	11-22-91	TWC	<0.50	*	*	*	*	*	*
8416	2-25-92	TWC	<0.50	*	*	*	*	*	*
8417	12-10-91	TWC	<0.50	*	*	*	*	*	*
8418	2-8-92	TWC	<0.50	*	*	*	*	*	*
8420	12-13-91	TWC	<0.50	*	*	*	*	*	*
8421	1-15-92	TWC	<0.50	*	*	*	*	*	*
8422	11-25-91	TWC	<0.50	*	*	*	*	*	*
8423	12-3-91	TWC	<0.50	*	*	*	*	*	*
8424	12-11-91	TWC	<0.50	*	*	*	*	*	*
8425	12-7-91	TWC	<0.50	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Camden County - Waterford Township - Site 8--Continued									
8426	11-27-91	TWC	<0.50	*	*	*	*	*	*
8427	11-25-91	TWC	<0.50	*	*	*	*	*	*
8428	12-14-91	TWC	1.50	*	*	*	*	*	*
8430	11-29-91	TWC	<0.50	*	*	*	*	*	*
8431	1-18-92	TWC	<0.50	*	*	*	*	*	*
8432	11-29-91	TWC	<0.50	*	*	*	*	*	*
8433	1-9-92	TWC	1.40	*	*	*	*	*	*
8434	3-4-92	TWC	<0.50	*	*	*	*	*	*
8436	12-3-91	TWC	<0.50	*	*	*	*	*	*
8437	2-27-92	TWC	<0.50	*	*	*	*	*	*
8438	11-29-91	TWC	<0.50	*	*	*	*	*	*
8440	12-10-91	TWC	<0.50	*	*	*	*	*	*
8441	12-16-91	TWC	<0.50	*	*	*	*	*	*
8442	12-13-91	TWC	<0.50	*	*	*	*	*	*
8443	1-18-92	TWC	<0.50	*	*	*	*	*	*
8444	12-13-91	P&P	<1.00	*	*	*	*	*	*
8445	12-13-91	P&P	<1.00	*	*	*	*	*	*
8446	12-14-91	TWC	<0.50	*	*	*	*	*	*
8448	12-26-91	TWC	0.70	*	*	*	*	*	*
8450	11-29-91	TWC	1.70	*	*	*	*	*	*
8452	12-4-91	TWC	<0.50	*	*	*	*	*	*
8453	11-25-91	TWC	<0.50	*	*	*	*	*	*
8455	12-24-91	TWC	<0.50	*	*	*	*	*	*
8456	11-20-91	TWC	1.40	*	*	*	*	*	*
8457	12-24-91	TWC	<0.50	*	*	*	*	*	*
8458	1-29-92	TWC	<0.50	*	*	*	*	*	*
8459	12-6-91	TWC	<0.50	*	*	*	*	*	*
8460	12-16-91	TWC	<0.50	*	*	*	*	*	*
8461	1-8-92	TWC	<0.50	*	*	*	*	*	*
8462	11-21-91	TWC	0.90	*	*	*	*	*	*
8463	1-15-92	TWC	<0.50	*	*	*	*	*	*
8464	12-9-91	TWC	<0.50	*	*	*	*	*	*
8465	12-26-91	TWC	2.40	*	*	*	*	*	*
8466	12-16-91	TWC	<0.50	*	*	*	*	*	*
8467	2-10-92	TWC	<0.50	*	*	*	*	*	*
8468	11-26-91	TWC	<0.50	*	*	*	*	*	*
8469	12-13-91	TWC	<0.50	*	*	*	*	*	*
8470	11-26-91	TWC	0.50	*	*	*	*	*	*
8471	11-21-91	TWC	<0.50	*	*	*	*	*	*
8472	12-9-91	TWC	<0.50	*	*	*	*	*	*
8473	12-28-91	TWC	<0.50	*	*	*	*	*	*
8474	12-9-91	TWC	<0.50	*	*	*	*	*	*
8475	12-12-91	TWC	<0.50	*	*	*	*	*	*
8476	12-11-91	TWC	<0.50	*	*	*	*	*	*
8477	11-20-91	TWC	<0.50	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Camden County - Waterford Township - Site 8--Continued									
8478	2-6-92	TWC	<0.50	*	*	*	*	*	*
8479	11-25-91	TWC	<0.50	*	*	*	*	*	*
8481	11-25-91	TWC	<0.50	*	*	*	*	*	*
8482	3-30-92	TWC	<0.50	*	*	*	*	*	*
8483	12-17-91	TWC	<0.70	*	*	*	*	*	*
8484	3-13-92	TWC	<0.50	*	*	*	*	*	*
8486	12-13-91	TWC	<0.50	*	*	*	*	*	*
8487	12-9-91	TWC	<0.50	*	*	*	*	*	*
8488	11-22-91	TWC	<0.50	*	*	*	*	*	*
8489	12-18-91	TWC	0.90	*	*	*	*	*	*
8491	11-27-91	TWC	0.50	*	*	*	*	*	*
8492	12-2-91	TWC	<0.50	*	*	*	*	*	*
8493	12-4-91	TWC	<0.50	*	*	*	*	*	*
8494	11-29-91	TWC	<0.50	*	*	*	*	*	*
8496	12-10-91	TWC	<0.50	*	*	*	*	*	*
8497	2-7-92	TWC	0.60	*	*	*	*	*	*
8498	12-17-91	TWC	<0.50	*	*	*	*	*	*
8499	12-7-91	TWC	<0.50	*	*	*	*	*	*
8500	12-7-91	TWC	0.60	*	*	*	*	*	*
8501	12-12-91	TWC	1.40	*	*	*	*	*	*
8502	2-7-92	TWC	<0.50	*	*	*	*	*	*
8503	12-2-91	TWC	<0.50	*	*	*	*	*	*
8504	1-25-92	TWC	0.90	*	*	*	*	*	*
8505	12-7-91	TWC	3.60	*	*	*	*	*	*
8507	12-18-91	TWC	1.00	*	*	*	*	*	*
8508	11-21-91	PANA	2.00	*	*	*	*	*	*
8510	11-30-91	TWC	<0.50	*	*	*	*	*	*
8511	11-30-91	TWC	<0.50	*	*	*	*	*	*
8513	11-25-91	TWC	<0.50	*	*	*	*	*	*
8514	12-5-91	TWC	<0.50	*	*	*	*	*	*
8515	12-7-91	TWC	<0.50	*	*	*	*	*	*
8516	11-26-91	TWC	<0.50	*	*	*	*	*	*
8517	2-25-92	TWC	<0.50	*	*	*	*	*	*
8518	12-2-91	TWC	<0.50	*	*	*	*	*	*
8521	12-12-91	TWC	<0.50	*	*	*	*	*	*
8522	5-8-91	BSDW	<0.20	*	*	*	*	*	*
8523	1-4-92	TWC	<0.50	*	*	*	*	*	*
8524	11-22-91	TWC	<0.50	*	*	*	*	*	*
8526	12-16-91	TWC	<0.50	*	*	*	*	*	*
8527	11-25-91	TWC	<0.50	*	*	*	*	*	*
8528	12-13-91	TWC	<0.50	*	*	*	*	*	*
8529	11-27-91	TWC	<0.50	*	*	*	*	*	*
8530	12-10-91	TWC	<0.50	*	*	*	*	*	*
8532	1-18-92	TWC	<0.50	*	*	*	*	*	*
8533	11-25-91	TWC	<0.50	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Camden County - Waterford Township - Site 8--Continued									
8534	11-27-91	TWC	<0.50	*	*	*	*	*	*
8535	3-31-92	TWC	<0.50	*	*	*	*	*	*
8536	12-3-91	TWC	<0.50	*	*	*	*	*	*
8337	11-26-91	TWC	<0.50	*	*	*	*	*	*
8538	12-10-91	TWC	0.70	*	*	*	*	*	*
8539	1-2-92	TWC	<0.50	*	*	*	*	*	*
8540	12-6-91	TWC	<0.50	*	*	*	*	*	*
8541	1-14-92	TWC	0.60	*	*	*	*	*	*
8543	12-21-91	TWC	<0.50	*	*	*	*	*	*
8544	2-10-92	TWC	<0.50	*	*	*	*	*	*
8545	11-21-91	TWC	<0.50	*	*	*	*	*	*
8546	12-13-91	TWC	<0.50	*	*	*	*	*	*
8548	11-22-91	TWC	<0.50	*	*	*	*	*	*
8549	1-2-92	TWC	<0.50	*	*	*	*	*	*
8559	12-5-91	TWC	<0.50	*	*	*	*	*	*
8551	1-7-92	TWC	<0.50	*	*	*	*	*	*
8552	12-13-91	TWC	<0.50	*	*	*	*	*	*
8553	12-12-91	TWC	<0.50	*	*	*	*	*	*
8554	12-5-91	TWC	0.70	*	*	*	*	*	*
8556	12-3-91	TWC	<0.50	*	*	*	*	*	*
8557	1-15-92	TWC	0.70	*	*	*	*	*	*
8559	3-16-92	TWC	<0.50	*	*	*	*	*	*
8560	2-21-92	TWC	2.10	*	*	*	*	*	*
8561	1-4-92	TWC	<0.50	*	*	*	*	*	*
8563	12-5-91	TWC	<0.50	*	*	*	*	*	*
8564	1-21-92	TWC	<0.50	*	*	*	*	*	*
8565	12-13-91	TWC	<0.50	*	*	*	*	*	*
8566	11-25-91	TWC	0.60	*	*	*	*	*	*
8567	12-17-91	TWC	<0.50	*	*	*	*	*	*
8568	11-21-91	TWC	<0.50	*	*	*	*	*	*
8569	3-17-92	TWC	<0.50	*	*	*	*	*	*
8570	12-12-91	TWC	<0.50	*	*	*	*	*	*
8571	12-14-91	TWC	<0.50	*	*	*	*	*	*
8572	11-23-91	TWC	0.50	*	*	*	*	*	*
8573	2-12-92	TWC	<0.50	*	*	*	*	*	*
8574	12-5-91	TWC	<0.50	*	*	*	*	*	*
8575	12-14-91	TWC	<0.50	*	*	*	*	*	*
8576	12-19-91	TWC	<0.50	*	*	*	*	*	*
8577	12-9-91	TWC	<0.50	*	*	*	*	*	*
8581	12-5-91	TWC	0.90	*	*	*	*	*	*
8582	12-2-91	TWC	<0.50	*	*	*	*	*	*
8583	1-8-92	TWC	<0.50	*	*	*	*	*	*
8584	2-13-92	TWC	2.00	*	*	*	*	*	*
8586	12-23-91	TWC	1.60	*	*	*	*	*	*
8587	1-28-92	TWC	<0.50	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Camden County - Waterford Township - Site 8--Continued									
8588	1-28-92	TWC	5.00	*	*	*	*	*	*
8589	12-12-91	TWC	1.00	*	*	*	*	*	*
8591	12-3-91	TWC	0.50	*	*	*	*	*	*
8592	12-21-91	TWC	<0.50	*	*	*	*	*	*
8593	11-20-91	TWC	0.50	*	*	*	*	*	*
8594	1-9-92	TWC	<0.50	*	*	*	*	*	*
8595	12-23-91	TWC	<0.50	*	*	*	*	*	*
8597	12-10-91	TWC	<0.50	*	*	*	*	*	*
8598	12-24-91	TWC	<0.50	*	*	*	*	*	*
8600	12-16-91	TWC	1.00	*	*	*	*	*	*
8601	12-2-91	TWC	<0.50	*	*	*	*	*	*
8602	11-25-91	TWC	<0.50	*	*	*	*	*	*
8603	12-16-91	TWC	<0.50	*	*	*	*	*	*
8604	12-6-91	TWC	<0.50	*	*	*	*	*	*
8606	1-18-92	TWC	0.50	*	*	*	*	*	*
8607	12-26-91	TWC	<0.50	*	*	*	*	*	*
8608	12-13-91	TWC	<0.50	*	*	*	*	*	*
Cumberland County - Vineland City - Site 9									
9001	4-19-91	VCHD	<2.00	*	*	*	*	*	*
9002	7-9-91	VCHD	<1.00	*	*	*	*	*	*
9003	5-10-91	VCHD	<2.00	65	10	PVC	sub	9-78	*
9004	7-9-91	VCHD	<1.00	*	*	*	*	*	*
9005	7-9-91	VCHD	<1.00	*	*	*	*	*	*
9006	4-19-91	VCHD	<2.00	*	*	*	*	*	*
9007	7-9-91	VCHD	<1.00	*	*	*	*	*	*
9008	2-13-92	VCHD	0.32	*	*	*	*	*	*
9009	7-9-91	VCHD	<1.00	*	*	*	*	*	*
9010	7-9-91	VCHD	<1.00	*	*	*	*	*	*
9011	7-9-91	VCHD	<1.00	*	*	*	*	*	*
9012	7-9-91	VCHD	<1.00	*	*	*	*	*	*
9013	4-19-91	VCHD	<2.00	*	*	*	*	*	*
9014	5-10-91	VCHD	<2.00	*	*	*	*	*	*
9015	4-19-91	VCHD	<2.00	*	*	*	*	*	*
9016	4-19-91	VCHD	<2.00	80	*	*	*	*	*
9017	7-9-91	VCHD	<1.00	122	*	*	*	*	*
9018	12-28-90	VCHD	<1.00	75	*	*	*	*	*
9019	12-28-90	VCHD	5.00	102	*	*	*	*	*
9020	12-28-90	VCHD	7.00	70	*	*	*	*	*
9021	2-13-92	VCHD	1.13	100	*	*	*	*	*
9022	4-19-91	VCHD	<2.00	*	*	*	*	*	*
9023	7-9-91	VCHD	<1.00	*	*	*	*	*	*
9024	4-19-91	VCHD	<2.00	*	*	*	*	*	*
9025	4-19-91	VCHD	<2.00	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Cumberland County - Vineland City - Site 9--Continued									
9026	4-23-91	VCHD	<0.10	*	*	*	*	*	*
9027	3-10-92	NJDOH	<0.20	68	10	PVC	jet	8-73	34
9028	3-10-92	NJDOH	<0.20	*	*	*	*	*	*
9029	3-10-92	NJDOH	<0.20	*	*	*	*	*	*
9030	3-10-92	NJDOH	<0.20	*	*	*	*	*	*
9031	4-19-91	VCHD	<2.00	*	*	*	*	*	*
9032	4-19-91	VCHD	<2.00	*	*	*	*	*	*
9033	4-19-91	VCHD	<2.00	*	*	*	*	*	*
9034	4-19-91	VCHD	<2.00	117	7	PVC	*	7-83	10
9035	4-19-91	VCHD	<2.00	50	7	PVC	*	12-81	12
9036	4-19-91	VCHD	<2.00	124	4	steel	*	8-82R	13
9037	4-19-91	VCHD	<2.00	*	*	*	*	*	*
9038	5-17-91	VCHD	<2.00	*	*	*	*	*	*
9039	5-10-91	VCHD	<2.00	*	*	*	*	*	*
9040	5-17-91	VCHD	<2.00	*	*	*	*	*	*
9041	4-19-91	VCHD	<2.00	*	*	*	*	*	*
9042	4-19-91	VCHD	<2.00	*	*	*	*	*	*
9043	3-10-92	NJDOH	<0.20	*	*	*	*	*	*
9044	3-10-92	NJDOH	2.90	*	*	*	*	*	*
9045	3-10-92	NJDOH	<0.20	*	*	*	*	*	*
9046	3-10-92	NJDOH	<0.20	*	*	*	*	*	*
9047	3-10-92	NJDOH	<0.20	*	*	*	*	*	*
9048	3-10-92	NJDOH	1.70	*	*	*	*	*	*
9049	3-10-92	NJDOH	<0.20	*	*	*	*	*	*
9050	3-10-92	NJDOH	0.30	*	*	*	*	*	*
9051	3-10-92	NJDOH	0.50	*	*	*	*	*	*
9052	3-10-92	NJDOH	<0.20	*	*	*	*	*	*
Gloucester County - Franklin Township - Site 10									
10001	12-21-92	PGDL	18.64	120	*	*	*	*	*
10002	8-26-92	PGDL	20.63	90	*	*	*	*	*
10003	8-26-92	PGDL	<0.20	29	*	*	*	*	*
10004	8-26-92	PGDL	<0.20	60	*	*	*	*	*
10005	2-26-90	GCHD	5.40	100	*	*	*	*	*
10006	2-26-90	GCHD	6.40	75	*	*	*	*	*
10007	2-26-90	GCHD	1.00	60	*	*	*	*	*
10008	2-26-90	GCHD	<0.20	*	*	*	*	*	*
10009	2-26-90	GCHD	<0.20	*	*	*	*	*	*
10010	2-26-90	GCHD	<0.20	90	*	*	*	*	*
10011	8-19-90	PGDL	<0.20	100	*	*	*	*	*
10012	8-20-92	PGDL	2.50	60	*	*	*	*	*
10013	8-19-92	PGDL	<0.20	*	*	*	*	*	*
10014	8-20-92	PGDL	<0.20	*	*	*	*	*	*
10015	2-26-90	GCHD	<0.20	90	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Gloucester County - Franklin Township - Site 10--Continued									
10016	2-26-90	GCHD	<0.20	*	*	*	*	*	*
10017	2-26-90	GCHD	<0.20	105	*	*	*	*	*
10018	2-26-90	GCHD	<0.20	*	*	*	*	*	*
10019	8-19-92	PGDL	<0.20	*	*	*	*	*	*
10020	2-26-90	GCHD	<0.20	*	*	*	*	*	*
10021	2-26-90	GCHD	<0.20	*	*	*	*	*	*
10022	8-20-92	PGDL	<0.20	*	*	*	*	*	*
10023	8-26-92	PGDL	<0.20	26	*	*	*	*	*
10024	2-26-90	GCHD	<0.20	*	*	*	*	*	*
10025	2-26-90	GCHD	<0.20	73	*	*	*	*	*
10026	2-26-90	GCHD	<0.20	60	*	*	*	*	*
10027	2-26-90	GCHD	<0.20	*	*	*	*	*	*
10028	2-26-90	GCHD	<0.20	100	*	*	*	*	*
10029	8-21-92	PGDL	0.20	*	*	*	*	*	*
10030	8-20-92	PGDL	2.00	86	*	*	*	*	*
10031	8-26-92	PGDL	0.30	*	*	*	*	*	*
Ocean County - Lacey Township - Site 11									
									*
11001	2-2-88	OCH	0.30	100	*	*	*	*	*
11002	8-25-88	BEL	7.20	57	*	*	*	*	*
11003	8-25-88	BEL	3.80	*	*	*	*	*	*
11004	2-14-90	ETL	<0.20	*	*	*	*	*	*
11005	8-25-88	BEL	<0.20	*	*	*	*	*	*
11006	8-25-88	BEL	<0.20	*	*	*	*	*	*
11007	8-25-88	BEL	<0.20	*	*	*	*	*	*
11008	8-25-88	BEL	4.30	*	*	*	*	*	*
11009	2-2-88	BEL	5.00	60	*	*	*	*	*
11010	2-2-88	BEL	3.90	60	*	*	*	*	*
11011	2-2-88	BEL	<0.30	*	*	*	*	*	*
Ocean County - Dover Township - Site 12									
12001	6-13-88	NJDOH	1.80	*	*	*	*	*	*
12002	6-13-88	NJDOH	1.00	*	*	*	*	*	*
12004	6-13-88	NJDOH	0.50	*	*	*	*	*	*
12005	6-13-88	NJDOH	1.30	*	*	*	*	*	*
12006	6-13-88	NJDOH	0.80	*	*	*	*	*	*
12007	6-13-88	NJDOH	1.10	*	*	*	*	*	*
12008	3-15-89	NJDOH	1.80	*	*	*	*	*	*
12009	3-15-89	NJDOH	1.50	*	*	*	*	*	*
12011	3-15-89	NJDOH	4.80	*	*	*	*	*	*
12012	11-20-92	*	3.50	*	*	*	*	*	*
12013	10-10-92	*	8.00	*	*	*	*	*	*
12014	8-3-92	*	8.80	*	*	*	*	*	*
12015	2-2-88	NJDOH	<0.30	*	*	*	*	*	*
12016	2-2-88	NJDOH	<0.30	*	*	*	*	*	*
12017	2-2-88	NJDOH	<0.30	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Ocean County - Dover Township - Site 12--Continued									
12018	5-7-93	HL	17.00	*	*	*	*	*	*
12019	3-1-88	NJDOH	<0.30	60	*	*	*	*	*
12020	3-1-88	NJDOH	<0.30	60	*	*	*	*	*
12021	3-1-88	NJDOH	<0.30	*	*	*	*	*	*
12022	3-1-88	NJDOH	<0.30	60	*	*	*	*	*
12023	3-1-88	NJDOH	0.30	60	*	*	*	*	*
12024	3-1-88	NJDOH	<0.30	*	*	*	*	*	*
12025	3-1-88	NJDOH	0.60	*	*	*	*	*	*
Salem County - Pittsgrove Township - Site 13									
13001	3-7-84	NJDEP	0.50	35	*	*	*	*	*
13002	3-21-84	CL	<0.20	80	*	*	*	*	*
13003	3-26-84	CL	<0.20	*	*	*	*	*	*
13004	2-28-84	CL	<0.20	60	*	*	*	*	*
13005	2-28-84	CL	<0.20	*	*	*	*	*	*
13006	2-28-84	CL	<0.20	93	*	*	*	*	*
13007	3-18-88	USEPA	4.00	*	*	*	*	*	*
13008	1-23-84	NJDEP	2.30	80	*	*	*	*	*
13009	3-18-88	USEPA	0.90	80	*	*	*	*	*
13010	2-18-86	REWAI	<0.20	75	*	*	*	*	*
13011	3-18-88	USEPA	0.63	60	*	*	*	*	*
13012	3-18-88	USEPA	<0.20	80	*	*	*	*	*
13013	3-18-88	USEPA	0.34	90	*	*	*	*	*
13014	3-18-88	USEPA	<0.20	185	*	*	*	*	*
13015	3-15-84	CL	0.20	*	*	*	*	*	*
13016	3-7-84	NJDEP	0.50	101	*	*	*	*	*
13017	3-15-84	CL	<0.20	75	*	*	*	*	*
13018	2-23-84	CL	<0.20	60	*	*	*	*	*
13019	2-23-84	CL	<0.20	80	*	*	*	*	*
13020	3-20-84	CL	<0.20	*	*	*	*	*	*
13021	2-16-84	CL	1.60	30	*	*	*	*	*
13022	3-22-84	CL	0.70	80	*	*	*	*	*
13023	3-7-84	NJDEP	0.50	80	*	*	*	*	*
13024	3-20-84	CL	0.60	50	*	*	*	*	*
13025	3-15-84	CL	<0.20	*	*	*	*	*	*
13026	3-15-84	CL	0.40	55	*	*	*	*	*
13027	3-7-84	NJDEP	0.50	70	*	*	*	*	*
13028	3-7-84	NJDEP	0.50	*	*	*	*	*	*
13029	3-7-84	NJDEP	0.50	*	*	*	*	*	*
13030	2-28-84	NJDEP	0.50	*	*	*	*	*	*
13031	2-28-84	NJDEP	0.50	*	*	*	*	*	*
13032	2-28-84	NJDEP	0.50	*	*	*	*	*	*
13033	2-28-84	NJDEP	0.50	*	*	*	*	*	*
13034	2-28-84	NJDEP	0.50	*	*	*	*	*	*
13035	2-28-84	NJDEP	0.50	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Salem County - Pittsgrove Township - Site - 13--Continued									
13036	12-10-87	NJDOH	0.30	30	*	*	*	*	*
13037	2-18-86	REWAI	29.00	*	*	*	*	*	*
13038	6-8-88	NJDOH	1.20	*	*	*	*	*	*
13039	3-18-88	USEPA	<0.20	*	*	*	*	*	*
13040	3-18-88	USEPA	<0.20	*	*	*	*	*	*
13041	3-18-88	USEPA	6.90	*	*	*	*	*	*
13042	2-28-84	NJDEP	0.50	*	*	*	*	*	*
13043	3-18-88	USEPA	<0.20	*	*	*	*	*	*
13044	3-18-88	USEPA	1.10	*	*	*	*	*	*
13045	3-18-88	USEPA	<0.20	*	*	*	*	*	*
13046	3-18-88	USEPA	<0.20	*	*	*	*	*	*
13047	3-18-88	USEPA	<0.20	*	*	*	*	*	*
13048	3-18-88	USEPA	0.79	*	*	*	*	*	*
13049	2-24-86	REWAI	<0.20	*	*	*	*	*	*
13050	3-18-88	USEPA	42.00	*	*	*	*	*	*
13051	3-18-88	USEPA	6.60	*	*	*	*	*	*
13052	3-18-88	USEPA	<0.20	*	*	*	*	*	*
Atlantic County - Mullica Township- Site 14									
14001	6-12-92	ACHD	0.46	*	*	*	*	*	*
14002	6-23-92	ACHD	0.22	110	*	*	*	*	*
14003	7-16-92	ACHD	0.40	*	*	*	*	*	*
14004	4-28-92	ACHD	6.45	*	*	*	*	*	*
14005	5-28-92	ACHD	0.20	37	*	*	*	*	*
14006	5-28-92	ACHD	0.10	*	*	*	*	*	*
14007	5-28-92	ACHD	0.20	*	*	*	*	*	*
14008	5-28-92	ACHD	0.20	75	*	*	*	*	*
14009	5-28-92	ACHD	0.10	*	*	*	*	*	*
14010	6-30-92	ACHD	0.22	*	*	*	*	*	*
14011	6-16-92	ACHD	0.17	*	*	*	*	*	*
14012	6-16-92	ACHD	0.26	*	*	*	*	*	*
14013	9-3-91	ACHD	0.40	*	*	*	*	*	*
14014	5-28-92	ACHD	0.20	80	*	*	*	*	*
14015	1-29-92	ACHD	<0.10	*	*	*	*	*	*
14016	10-1-92	ACHD	0.10	*	*	*	*	*	*
Atlantic County - Folsom Borough - Site 15									
15001	10-16-91	ACHD	7.08	*	*	*	*	*	*
15002	8-20-91	ACHD	1.39	*	*	*	*	*	*
15003	1-6-92	ACHD	2.73	*	*	*	*	*	*
15004	3-9-92	ACHD	0.33	*	*	*	*	*	*
15005	9-17-91	ACHD	0.22	*	*	*	*	*	*
15006	9-17-91	ACHD	0.32	*	*	*	*	*	*
15007	9-17-91	ACHD	0.11	*	*	*	*	*	*
15008	9-21-91	ACHD	0.39	*	*	*	*	*	*
15009	10-9-91	ACHD	0.39	*	*	*	*	*	*
15010	10-23-91	ACHD	1.93	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - FolsomBorough - Site 15--Continued									
15011	12-5-91	ACHD	<0.20	*	*	*	*	*	*
15012	1-22-92	ACHD	0.54	*	*	*	*	*	*
15013	9-17-91	ACHD	0.22	*	*	*	*	*	*
15014	6-30-92	ACHD	0.12	*	*	*	*	*	*
15015	7-29-91	ACHD	0.26	*	*	*	*	*	*
15016	8-13-91	ACHD	0.19	*	*	*	*	*	*
15017	8-7-91	ACHD	0.57	*	*	*	*	*	*
15018	8-7-91	ACHD	0.46	*	*	*	*	*	*
15019	8-7-91	ACHD	0.34	*	*	*	*	*	*
15020	7-28-92	ACHD	0.28	*	*	*	*	*	*
15021	8-28-91	ACHD	0.42	*	*	*	*	*	*
15022	12-3-91	ACHD	0.29	*	*	*	*	*	*
Atlantic County - Buena Vista Township - Site 16									
16001	10-22-92	ACHD	1.04	25	*	*	*	*	*
16002	3-25-92	ACHD	4.16	*	*	*	*	*	*
16003	3-5-92	ACHD	2.70	150	80	PVC	*	3-88	9
16004	3-5-92	ACHD	0.31	*	*	*	*	*	*
16005	3-5-92	ACHD	0.71	*	*	*	*	*	*
16006	3-5-92	ACHD	1.37	*	*	*	*	*	*
16007	3-5-92	ACHD	0.57	*	*	*	*	*	*
16008	3-18-92	ACHD	0.48	*	*	*	*	*	*
16009	3-18-92	ACHD	0.94	105	10	PVC	jet	9-77	11
16010	3-18-92	ACHD	0.67	90	5	g steel	jet	1-82	9
16011	3-18-92	ACHD	0.85	*	*	*	*	*	*
16012	4-14-92	ACHD	1.06	*	*	*	*	*	*
16013	4-6-92	ACHD	<0.10	*	*	*	*	*	*
16014	4-14-92	ACHD	0.65	*	*	*	*	*	*
16015	6-16-92	ACHD	0.26	*	*	*	*	*	*
16016	6-30-92	ACHD	0.33	*	*	*	*	*	*
16017	6-30-92	ACHD	0.12	*	*	*	*	*	*
16018	7-23-91	ACHD	0.37	*	*	*	*	*	*
16019	8-9-91	ACHD	0.19	*	*	*	*	*	*
16020	8-9-91	ACHD	0.19	*	*	*	*	*	*
16021	8-9-91	ACHD	0.19	160	60	Tuftite	*	4-68	9
16022	9-24-91	ACHD	<0.10	*	*	*	*	*	*
16023	10-8-91	ACHD	0.31	*	*	*	*	*	*
16024	10-8-91	ACHD	0.39	*	*	*	*	*	*
16025	10-9-91	ACHD	0.39	60	10	PVC	jet	11-78	32
16026	10-9-91	ACHD	0.31	*	*	*	*	*	*
16027	12-18-91	ACHD	<0.20	*	*	*	*	*	*
16028	8-22-91	ACHD	0.23	*	*	*	*	*	*
16029	8-22-91	ACHD	<0.10	*	*	*	*	*	*
16030	8-9-91	ACHD	<0.10	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Buena Vista Township - Site 16--Continued									
16031	8-9-91	ACHD	0.91	*	*	*	*	*	*
16032	9-4-91	ACHD	4.16	*	*	*	*	*	*
16033	10-22-91	ACHD	0.19	*	*	*	*	*	*
16034	9-9-91	ACHD	30.99	*	*	*	*	*	*
16035	9-9-91	ACHD	1.11	*	*	*	*	*	*
16036	9-9-91	ACHD	1.59	*	*	*	*	*	*
16037	9-9-91	ACHD	1.11	*	*	*	*	*	*
16038	9-9-91	ACHD	1.35	*	*	*	*	*	*
16039	9-9-91	ACHD	0.41	*	*	*	*	*	*
16040	2-4-92	ACHD	11.28	*	*	*	*	*	*
16041	9-25-91	ACHD	0.19	*	*	*	*	*	*
16042	2-3-92	ACHD	<0.10	*	*	*	*	*	*
16043	9-25-91	ACHD	0.29	*	*	*	*	*	*
16044	9-25-91	ACHD	0.19	*	*	*	*	*	*
16045	9-17-91	ACHD	<0.10	*	*	*	*	*	*
16046	10-8-91	ACHD	0.31	*	*	*	*	*	*
16047	10-22-91	ACHD	1.56	*	*	*	*	*	*
16048	10-22-91	ACHD	0.92	*	*	*	*	*	*
16049	10-23-91	ACHD	0.19	*	*	*	*	*	*
16050	6-25-92	ACHD	0.22	50	*	*	*	*	*
16051	6-25-92	ACHD	1.48	90	*	*	*	*	*
16052	6-25-92	ACHD	0.22	100	10	PVC	sub	5-89	18
16053	6-25-92	ACHD	0.43	80	*	*	*	*	*
16054	6-25-92	ACHD	0.12	*	*	*	*	*	*
16055	9-22-92	ACHD	2.99	109	*	*	*	*	*
16056	7-21-92	ACHD	<0.10	150	*	*	*	*	*
16057	7-21-92	ACHD	0.10	*	*	*	*	*	*
16058	10-20-92	ACHD	0.27	*	*	*	*	*	*
16059	8-12-92	ACHD	3.68	100	10	PVC	*	7-90	14
16060	7-28-92	ACHD	0.18	*	*	*	*	*	*
16061	8-11-92	ACHD	0.17	*	*	*	*	*	*
16062	8-25-92	ACHD	0.37	*	*	*	*	*	*
16063	9-8-92	ACHD	5.73	*	*	*	*	*	*
16064	8-18-92	ACHD	1.53	*	*	*	*	*	*
16065	8-18-92	ACHD	<0.10	55	5	g steel	*	9-89	16
16066	8-18-92	ACHD	0.30	90	*	*	*	*	*
16067	8-19-92	ACHD	1.42	*	*	*	*	*	*
16068	8-11-92	ACHD	0.15	78	*	*	*	*	*
16069	9-1-92	ACHD	1.09	*	*	*	*	*	*
16070	9-22-92	ACHD	0.64	100	*	*	*	*	*
16071	10-20-92	ACHD	5.05	80	*	*	*	*	*
16072	10-20-92	ACHD	1.26	*	*	*	*	*	*
16073	7-18-92	ACHD	0.48	71	5	steel	jet	4-83	6
16074	10-20-92	ACHD	0.47	*	*	*	*	*	*
16075	10-19-83	NJDOH	1.00	*	*	*	*	*	*
16076	10-19-83	NJDOH	2.90	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County- Galloway Township - Site 17									
17001	8-13-91	ACHD	<0.10	*	*	*	*	*	*
17003	8-1-90	ACHD	<0.10	85	10	PVC	*	9-87R	21
17007	6-27-90	ACHD	0.04	*	*	*	*	*	*
17009	5-8-91	ACHD	0.47	*	*	*	*	*	*
17010	6-17-91	ACHD	0.10	*	*	*	*	*	*
17012	9-25-91	ACHD	0.82	*	*	*	*	*	*
17013	11-27-90	ACHD	<0.10	*	*	*	*	*	*
17014	6-17-91	ACHD	0.20	*	*	*	*	*	*
17015	7-17-91	ACHD	<0.10	*	*	*	*	*	*
17016	6-18-91	ACHD	<0.10	*	*	*	*	*	*
17017	6-13-91	ACHD	<0.10	*	*	*	*	*	*
17019	6-17-91	ACHD	0.20	*	*	*	*	*	*
17020	6-17-91	ACHD	0.20	*	*	*	*	*	*
17021	4-16-91	ACHD	0.77	*	*	*	*	*	*
17031	12-3-91	ACHD	0.20	*	*	*	*	*	*
17037	7-2-91	ACHD	<0.10	*	*	*	*	*	*
17038	6-19-91	ACHD	<0.10	*	*	*	*	*	*
17040	5-14-91	ACHD	0.28	*	*	*	*	*	*
17041	8-15-90	ACHD	<0.10	*	*	*	*	*	*
17043	8-1-90	ACHD	<0.10	*	*	*	*	*	*
17044	11-27-90	ACHD	<0.10	*	*	*	*	*	*
17046	5-22-91	ACHD	0.12	*	*	*	*	*	*
17047	4-16-91	ACHD	1.00	*	*	*	*	*	*
17049	4-17-91	ACHD	<0.10	*	*	*	*	*	*
17050	5-16-91	ACHD	0.23	*	*	*	*	*	*
17052	4-16-91	ACHD	<0.10	*	*	*	*	*	*
17056	5-22-91	ACHD	0.12	115	*	*	*	*	*
17060	8-15-91	ACHD	<0.10	*	*	*	*	*	*
17063	5-28-91	ACHD	0.30	*	*	*	*	*	*
17067	4-16-91	ACHD	<0.10	124	*	*	*	*	*
17068	5-16-91	ACHD	0.33	*	*	*	*	*	*
17069	7-31-91	ACHD	0.12	*	*	*	*	*	*
17070	6-4-91	ACHD	0.19	*	*	*	*	*	*
17071	7-1-91	ACHD	<0.10	*	*	*	*	*	*
17072	7-16-91	ACHD	<0.10	*	*	*	*	*	*
17073	7-1-91	ACHD	<0.10	*	*	*	*	*	*
17074	7-18-91	ACHD	<0.10	*	*	*	*	*	*
17075	7-1-91	ACHD	<0.10	*	*	*	*	*	*
17076	7-1-91	ACHD	0.35	*	*	*	*	*	*
17077	7-18-91	ACHD	0.70	*	*	*	*	*	*
17084	4-14-91	ACHD	0.47	*	*	*	*	*	*
17097	10-31-90	ACHD	0.13	*	*	*	*	*	*
17100	5-28-91	ACHD	<0.10	*	*	*	*	*	*
17101	7-30-91	ACHD	0.59	*	*	*	*	*	*
17102	8-7-91	ACHD	0.68	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County- Galloway Township - Site 17--Continued									
17104	7-17-91	ACHD	<0.10	50	*	*	*	*	*
17112	10-30-90	ACHD	<0.10	*	*	*	*	*	*
17114	7-24-91	ACHD	0.48	*	*	*	*	*	*
17116	7-2-91	ACHD	1.40	*	*	*	*	*	*
17119	9-17-91	ACHD	0.22	*	*	*	*	*	*
17121	9-24-91	ACHD	0.39	*	*	*	*	*	*
17125	5-16-91	ACHD	0.12	*	*	*	*	*	*
17126	4-28-92	ACHD	<0.10	*	*	*	*	*	*
17127	11-13-90	ACHD	0.30	*	*	*	*	*	*
17128	5-18-92	ACHD	<0.20	*	*	*	*	*	*
17129	10-22-91	ACHD	<0.10	*	*	*	*	*	*
17130	11-28-90	ACHD	<0.10	*	*	*	*	*	*
17131	10-3-90	ACHD	0.10	105	10	PVC	jet	9-88N	21
17132	*	*	0.30	*	*	*	*	*	*
17134	5-29-90	ACHD	1.50	140	5	PVC	jet	7-85	29
17135	8-8-90	ACHD	<0.10	105	3	g steel	jet	8-80	36
17136	8-14-90	ACHD	0.20	*	*	*	*	*	*
17137	6-27-90	ACHD	0.04	*	*	*	*	*	*
17138	8-16-91	ACHD	0.42	110	5	PVC	sub	4-86	26
17139	8-15-91	ACHD	0.70	*	*	*	*	*	*
17140	8-29-91	ACHD	0.23	*	*	*	*	*	*
17141	8-29-91	ACHD	0.33	125	3	g steel	jet	12-79	29
17142	8-29-91	ACHD	0.42	*	*	*	*	*	*
17143	9-24-91	ACHD	0.39	125	3	steel	jet	*	*
17144	9-24-91	ACHD	0.39	125	3	g steel	jet	12-79	28
17145	8-16-92	ACHD	0.32	*	*	*	*	*	*
17146	8-15-91	ACHD	0.30	*	*	*	*	*	*
17147	9-11-91	ACHD	0.23	*	*	*	*	*	*
17148	8-21-91	ACHD	0.23	123	5	PVC	sub	9-87	23
17149	9-10-91	ACHD	0.41	114	10	PVC	jet	6-86	28
17150	9-11-91	ACHD	0.23	114	10	PVC	jet	7-86	28
17151	8-16-91	ACHD	0.42	114	10	PVC	jet	7-86	28
17152	8-28-91	ACHD	0.64	115	5	PVC	sub	12-85	35
17153	8-16-91	ACHD	0.52	*	*	*	*	*	*
17154	9-4-91	ACHD	0.40	142	10	*	sub	6-90	20
17155	8-16-91	ACHD	0.42	*	*	*	*	*	*
17156	9-3-91	ACHD	0.53	*	*	*	*	*	*
17157	8-16-91	ACHD	0.50	130	10	PVC	sub	8-90	24
Atlantic County - Hamilton Township - Site 18									
18001	9-10-91	ACHD	0.61	*	*	*	*	*	*
18002	8-27-91	ACHD	0.33	*	*	*	*	*	*
18003	7-10-91	ACHD	<0.10	80	10	g steel	jet	1-81	16
18004	11-6-91	ACHD	0.22	*	*	*	*	*	*
18005	9-9-92	ACHD	<0.10	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Hamilton Township - Site 18--Continued									
18006	7-10-91	ACHD	<0.10	*	*	*	*	*	*
18007	8-6-91	ACHD	<0.10	*	*	*	*	*	*
18008	8-27-91	ACHD	0.33	*	*	*	*	*	*
18009	7-22-91	ACHD	0.50	83	10	PVC	sub	5-88N	19
18011	8-20-91	ACHD	0.42	*	*	*	*	*	*
18012	7-17-91	ACHD	<0.10	76	10	PVC	sub	12-87	15
18013	7-16-91	ACHD	<0.10	75	5	steel	jet	2-86	15
18014	6-12-91	ACHD	<0.10	81	5	PVC	jet	11-87	21
18015	7-3-91	ACHD	<0.10	85	5	PVC	sub	8-86	18
18016	8-20-91	ACHD	<0.10	*	*	*	*	*	*
18017	7-3-91	ACHD	<0.10	*	*	*	*	*	*
18018	7-9-91	ACHD	<0.10	81	9	PVC	*	2-85	20
18019	8-28-91	ACHD	<0.10	85	5	PVC	jet	3-89	19
18020	3-4-92	ACHD	<0.20	*	*	*	*	*	*
18021	10-9-91	ACHD	0.27	86	5	PVC	jet	5-88	16
18022	7-23-91	ACHD	0.59	81	5	PVC	jet	11-87	17
18023	7-3-91	ACHD	<0.10	*	*	*	*	*	*
18024	7-31-91	ACHD	0.12	90	10	PVC	jet	6-84	16
18025	7-3-91	ACHD	<0.10	86	5	PVC	jet	3-88	17
18026	3-12-92	P&P	8.52	*	*	*	*	*	*
18027	6-25-91	ACHD	2.75	72	10	PVC	sub	11-88N	17
18028	7-31-91	ACHD	0.12	*	*	*	*	*	*
18029	6-11-91	ACHD	<0.10	81	5	PVC	jet	11-86	11
18030	3-23-92	ACHD	0.71	80	10	PVC	sub	6-88	20
18031	7-10-91	ACHD	<0.10	92	10	PVC	sub	3-90	10
18032	7-9-91	ACHD	0.29	81	5	PVC	jet	8-86	15
18033	7-17-91	ACHD	0.29	81	11	PVC	jet	3-86	11
18034	3-25-92	ACHD	0.16	*	*	*	*	*	*
18035	9-16-91	ACHD	0.27	80	5	PVC	jet	10-84	17
18036	10-8-91	ACHD	<0.10	85	10	PVC	sub	8-89	20
18037	7-8-91	ACHD	0.50	*	*	*	*	*	*
18038	7-9-91	ACHD	<0.10	*	*	*	*	*	*
18039	7-23-91	ACHD	0.15	82	8	g steel	sub	11-86N	4
18040	10-9-91	ACHD	0.27	100	10	PVC	sub	10-87	18
18041	5-19-92	ACHD	0.61	81	5	PVC	sub	5-87	23
18042	7-31-91	ACHD	<0.10	*	*	*	*	*	*
18043	7-9-91	ACHD	<0.10	100	10	PVC	sub	3-88	18
18044	7-9-91	ACHD	0.19	80	5	g steel	jet	5-81	17
18045	2-11-92	ACHD	<0.10	67	10	PVC	sub	8-88	18
18047	6-12-91	ACHD	0.30	*	*	*	*	*	*
18048	8-15-91	ACHD	<0.10	80	5	g steel	jet	11-80	18
18049	8-21-91	ACHD	0.52	80	4	g steel	jet	2-81	17
18050	*	ACHD	<0.10	85	5	g steel	jet	10-82	18
18051	7-3-91	ACHD	0.66	80	10	PVC	sub	6-85	24
18052	7-3-91	ACHD	<0.10	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Hamilton Township - Site 18--Continued									
18053	6-11-91	ACHD	0.20	*	*	*	*	*	*
18054	7-10-91	ACHD	1.97	*	*	*	*	*	*
18055	6-18-91	ACHD	<0.10	*	*	*	*	*	*
18056	9-11-91	ACHD	<0.10	*	*	*	*	*	*
18057	8-22-91	ACHD	0.90	*	*	*	*	*	*
18058	7-8-91	ACHD	<0.10	80	10	PVC	*	5-85	18
18059	6-19-91	ACHD	<0.10	*	*	*	*	*	*
18060	10-22-91	ACHD	<0.10	80	*	g steel	*	1-80	18
18061	7-9-91	ACHD	0.19	*	*	*	*	*	*
18062	7-3-91	ACHD	<0.10	104	10	PVC	sub	10-85	15
18063	2-24-92	ACHD	<0.10	*	*	*	*	*	*
18064	7-8-91	ACHD	<0.10	86	5	PVC	jet	1-90	18
18065	9-4-91	ACHD	0.27	*	*	*	*	*	*
18066	6-18-91	ACHD	<0.10	*	*	*	*	*	*
18067	8-20-91	ACHD	0.22	*	*	*	*	*	*
Atlantic County - Egg Harbor Township - Site 19									
19001	1/22/91	ACHD	<0.10	*	*	*	*	*	*
19002	4/30/91	ACHD	0.43	*	*	*	*	*	*
19003	4/17/91	ACHD	1.00	*	*	*	*	*	*
19004	5/14/91	ACHD	0.46	*	*	*	*	*	*
19005	4/3/91	ACHD	0.45	*	*	*	*	*	*
19006	5/7/91	ACHD	0.57	94	*	*	*	*	*
19007	4/23/91	ACHD	0.14	*	*	*	*	*	*
19008	*	ACHD	0.24	*	*	*	*	*	*
Atlantic County - Egg Harbor Township - Site 20									
20001	9-9-92	ACHD	1.66	*	*	*	*	*	*
20002	9-9-92	ACHD	11.81	*	*	*	*	*	*
20003	9-29-92	ACHD	2.70	*	*	*	*	*	*
20004	9-9-92	ACHD	7.52	*	*	*	*	*	*
20005	9-29-92	ACHD	9.40	*	*	*	*	*	*
20006	9-9-92	ACHD	1.36	*	*	*	*	*	*
20007	9-28-92	ACHD	9.10	118	10	PVC	jet	2-91	25
Atlantic County - Absecon City - Site 21									
21001	10-23-90	*	6.12	*	*	*	*	*	*
21002	11-7-90	*	5.30	*	*	*	*	*	*
21003	11-13-90	*	4.70	*	*	*	*	*	*
Atlantic County - Manchester Township - Site 22									
22001	6-10-91	HL	2.40	*	*	*	*	*	*
Ocean County - Berkeley Township - Site 23									
23001	*	*	4.00	*	*	*	*	*	*
23002	9-1-87	ETL	3.00	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Ocean County - Jackson Township - Site 24									
24001	1-23-91	EPL	5.20	50	3	steel	*	5-91A	*
24002	12-18-78	NJDOH	1.20	*	*	*	*	*	*
24003	12-18-78	NJDOH	<0.20	*	*	*	*	*	*
24004	12-18-78	NJDOH	<0.20	*	*	*	*	*	*
24005	12-18-78	NJDOH	<0.20	*	*	*	*	*	*
24006	12-18-78	NJDOH	0.60	*	*	*	*	*	*
24007	12-18-78	NJDOH	<0.20	*	*	*	*	*	*
24008	12-18-78	NJDOH	<0.20	*	*	*	*	*	*
24009	12-12-92	*	4.30	*	*	*	*	*	*
Cumberland County - Vineland City - Site 25									
25001	2-2-88	NJDOH	13.40	61	*	*	*	*	*
25002	2-2-88	NJDOH	0.50	*	*	*	*	*	*
25003	7-19-89	*	1.00	*	*	*	*	*	*
25004	4-28-89	*	1.00	60	*	*	*	*	*
25005	7-12-88	NJDOH	6.50	*	*	*	*	*	*
25006	2-2-88	NJDOH	<0.30	*	*	*	*	*	*
25007	4-28-89	*	3.80	*	*	*	*	*	*
25008	8-3-89	QC	1.70	75	*	*	*	*	*
25009	3-17-89	*	1.00	*	*	*	*	*	*
25010	4-28-89	*	1.00	*	*	*	*	*	*
25011	3-17-89	QC	4.50	*	*	*	*	*	*
25012	4-28-89	*	1.00	*	*	*	*	*	*
25013	7-19-89	*	8.40	*	*	*	*	*	*
25014	7-19-89	*	1.00	70	*	*	*	*	*
25015	7-25-89	*	1.00	*	*	*	*	*	*
25016	7-25-89	*	1.00	*	*	*	*	*	*
25017	10-4-89	SJTL	14.00	*	*	*	*	*	*
25018	9-20-89	QC	<1.00	*	*	*	*	*	*
25019	8-3-91	QC	<1.00	*	*	*	*	*	*
25020	8-3-89	QC	<1.00	*	*	*	*	*	*
25021	8-3-89	QC	<1.00	*	*	*	*	*	*
25022	8-17-89	QC	<1.00	*	*	*	*	*	*
25023	8-17-89	QC	<1.00	*	*	*	*	*	*
25024	8-3-89	QC	<1.00	*	*	*	*	*	*
25025	8-3-89	QC	1.40	*	*	*	*	*	*
25026	8-3-89	QC	<1.00	*	*	*	*	*	*
25027	8-17-89	QC	<1.00	*	*	*	*	*	*
25028	8-17-89	QC	<1.00	*	*	*	*	*	*
25029	*	*	<1.00	96	*	*	*	*	*
25030	*	*	<1.00	85	*	*	*	*	*
Gloucester County - Elk Township - Site 26									
26001	10-28-92	QC	12.00	64	10	PVC	*	5-86	*
Gloucester County - Monroe Township - Site 27									
27001	12-14-92	SJTL	7.30	60	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township - Site 28									
28001	3-29-89	ACHD	11.73	*	*	*	*	*	*
28002	4-21-89	ACHD	0.09	*	*	*	*	*	*
28003	4-19-89	ACHD	1.76	*	*	*	*	*	*
28004	4-19-89	ACHD	0.83	*	*	*	*	*	*
28005	4-2-91	ACHD	3.25	*	*	*	*	*	*
28006	4-19-89	ACHD	6.18	*	*	*	*	*	*
28007	4-19-89	ACHD	3.55	*	*	*	*	*	*
28008	4-19-89	ACHD	0.37	*	*	*	*	*	*
28009	4-19-89	ACHD	0.19	*	*	*	*	*	*
28010	4-5-88	ACHD	4.87	*	*	*	*	*	*
28011	4-21-89	ACHD	0.13	101	6	g steel	DW jet	3-81	*
28012	1-9-90	ACHD	<0.10	92	5	g steel	jet	12-82	*
28013	3-5-91	ACHD	4.80	*	*	*	*	*	*
28014	4-14-89	ACHD	0.13	*	*	*	*	*	*
28015	4-14-89	ACHD	<0.05	*	*	*	*	*	*
28016	5-10-89	ACHD	0.13	*	*	*	*	*	*
28017	5-8-89	ACHD	0.20	*	*	*	*	*	*
28018	5-8-89	ACHD	0.14	*	*	*	*	*	*
28019	5-8-89	ACHD	0.15	*	*	*	*	*	*
28020	5-8-89	ACHD	<0.10	*	*	*	*	*	*
28021	6-6-90	ACHD	<0.10	*	*	*	*	*	*
28022	4-19-89	ACHD	<0.50	*	*	*	*	*	*
28023	4-19-89	ACHD	0.51	*	*	*	*	*	*
28024	4-15-92	ACHD	0.34	*	*	*	*	*	*
28025	4-5-89	ACHD	0.24	106	13	PVC	sub	8-85R	*
28026	4-20-89	ACHD	0.67	105	6	g steel	SW jet	8-80	*
28027	4-19-89	ACHD	0.67	*	*	*	*	*	*
28028	4-14-89	ACHD	0.29	*	*	*	*	*	*
28029	4-10-91	ACHD	0.12	105	5	PVC	DW jet	12-84N	*
28030	1-16-89	ACHD	<0.10	*	*	*	*	*	*
28031	4-5-89	ACHD	0.15	*	*	*	*	*	*
28032	4-19-89	ACHD	0.30	*	*	*	*	*	*
28033	4-5-89	ACHD	0.09	*	*	*	*	*	*
28034	4-26-89	ACHD	0.14	*	*	*	*	*	*
28035	4-21-89	ACHD	0.08	*	*	*	*	*	*
28036	4-19-89	ACHD	0.42	*	*	*	*	*	*
28037	4-18-89	ACHD	<0.05	*	*	*	*	*	*
28038	5-10-89	ACHD	0.11	*	*	*	*	*	*
28039	3-23-89	ACHD	0.13	*	*	*	*	*	*
28040	5-8-89	ACHD	0.13	*	*	*	*	*	*
28041	5-8-89	ACHD	0.15	*	*	*	*	*	*
28042	5-8-89	ACHD	0.15	*	*	*	*	*	*
28043	5-15-89	ACHD	0.14	*	*	*	*	*	*
28044	5-4-89	ACHD	0.13	*	*	*	*	*	*
28045	5-10-89	ACHD	0.13	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Egg Harbor Township - Site 28--Continued									
28046	9-14-87	ACHD	1.00	*	*	*	*	*	*
28047	5-10-89	ACHD	0.86	*	*	*	*	*	*
28048	5-8-89	ACHD	0.13	*	*	*	*	*	*
28049	5-10-89	ACHD	0.21	*	*	*	*	*	*
28050	5-8-89	ACHD	0.20	*	*	*	*	*	*
28051	5-8-89	ACHD	<0.10	*	*	*	*	*	*
28052	5-8-89	ACHD	0.14	*	*	*	*	*	*
28053	4-14-89	ACHD	<0.50	*	*	*	*	*	*
28054	4-17-89	ACHD	0.11	*	*	*	*	*	*
28055	6-19-89	ACHD	0.19	*	*	*	*	*	*
28056	6-19-89	ACHD	0.19	*	*	*	*	*	*
28057	4-19-89	ACHD	0.16	*	*	*	*	*	*
28058	5-8-89	ACHD	0.09	*	*	*	*	*	*
28059	5-8-89	ACHD	0.08	*	*	*	*	*	*
28060	5-15-89	ACHD	0.16	*	*	*	*	*	*
28061	5-8-89	ACHD	0.11	*	*	*	*	*	*
28062	5-8-89	ACHD	0.11	*	*	*	*	*	*
28063	5-10-89	ACHD	0.11	*	*	*	*	*	*
28064	9-2-87	ACHD	1.80	*	*	*	*	*	*
28065	4-19-89	ACHD	8.20	*	*	*	*	*	*
28066	5-8-89	ACHD	0.11	*	*	*	*	*	*
28067	5-8-89	ACHD	0.08	*	*	*	*	*	*
28068	5-8-89	ACHD	0.13	*	*	*	*	*	*
28069	5-8-89	ACHD	0.14	*	*	*	*	*	*
28070	5-12-89	ACHD	0.12	*	*	*	*	*	*
28071	5-10-89	ACHD	<0.10	*	*	*	*	*	*
28072	5-10-89	ACHD	0.09	*	*	*	*	*	*
28073	5-10-89	ACHD	0.35	*	*	*	*	*	*
28074	5-10-89	ACHD	<0.10	*	*	*	*	*	*
28075	5-10-89	ACHD	0.26	*	*	*	*	*	*
28076	4-12-88	*	2.00	*	*	*	*	*	*
28077	4-12-88	*	5.00	*	*	*	*	*	*
28078	4-12-88	*	4.00	*	*	*	*	*	*
28079	*	*	<0.10	*	*	*	*	*	*
28080	4-12-88	*	2.00	*	*	*	*	*	*
28082	1-9-87	*	2.20	*	*	*	*	*	*
Atlantic County - Buena Vista Township - Site 29									
29001	11-7-91	ACHD	<0.20	*	*	*	*	*	*
29002	11-7-91	ACHD	<0.20	*	*	*	*	*	*
29003	11-7-91	ACHD	<0.20	*	*	*	*	*	*
29004	11-7-91	ACHD	0.41	*	*	*	*	*	*
29005	12-3-91	ACHD	0.21	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Buena Vista Township - Site 29--Continued									
29006	12-11-91	ACHD	<0.20	*	*	*	*	*	*
29007	1-7-91	ACHD	2.15	*	*	*	*	*	*
29008	11-20-91	ACHD	<0.20	*	*	*	*	*	*
29009	1-7-92	ACHD	0.38	*	*	*	*	*	*
29010	11-19-91	ACHD	<0.20	*	*	*	*	*	*
29011	11-7-91	ACHD	<0.20	80	10	PVC	sub	7-86	9
29012	11-7-91	ACHD	<0.20	*	*	*	*	*	*
29013	3-30-92	ACHD	2.88	*	*	*	*	*	*
29014	2-25-92	ACHD	<0.10	82	6	g steel	*	3-66	*
29015	2-25-92	ACHD	0.38	*	*	*	*	*	*
29016	2-25-92	ACHD	<0.10	*	*	*	*	*	*
29017	5-21-91	ACHD	0.12	*	*	*	*	*	*
29018	2-25-92	ACHD	<0.10	*	*	*	*	*	*
29019	2-25-92	ACHD	<0.10	*	*	*	*	*	*
29020	1-13-92	ACHD	<0.20	*	*	*	*	*	*
29021	1-15-92	ACHD	<0.10	*	*	*	*	*	*
29022	1-14-92	ACHD	0.25	*	*	*	*	*	*
29023	1-6-92	ACHD	0.50	*	*	*	*	*	*
29024	1-15-92	ACHD	<0.10	*	*	*	*	*	*
29025	11-6-91	ACHD	0.22	*	*	*	*	*	*
29026	1-15-92	ACHD	0.65	*	*	*	*	*	*
29027	1-15-92	ACHD	0.54	*	*	*	*	*	*
29029	1-6-92	ACHD	0.28	*	*	*	*	*	*
29030	12-10-91	ACHD	<0.20	*	*	*	*	*	*
29031	12-10-91	ACHD	<0.20	*	*	*	*	*	*
29032	1-7-92	ACHD	0.26	*	*	*	*	*	*
29033	12-10-91	ACHD	<0.20	*	*	*	*	*	*
29034	12-10-91	ACHD	<0.20	*	*	*	*	*	*
29035	1-13-92	ACHD	<0.20	*	*	*	*	*	*
29036	11-7-91	ACHD	<0.20	*	*	*	*	*	*
29037	12-10-91	ACHD	<0.20	*	*	*	*	*	*
29038	12-10-91	ACHD	<0.20	*	*	*	*	*	*
29039	2-4-92	ACHD	0.27	*	*	*	*	*	*
29040	9-24-91	ACHD	<0.10	*	*	*	*	*	*
29041	11-21-91	ACHD	<0.20	*	*	*	*	*	*
29042	1-15-92	ACHD	0.19	*	*	*	*	*	*
29043	1-15-92	ACHD	<0.10	*	*	*	*	*	*
29044	8-5-92	ACHD	<0.10	*	*	*	*	*	*
29045	12-23-91	ACHD	<0.20	*	*	*	*	*	*
29046	9-25-91	ACHD	0.29	*	*	*	*	*	*
29047	12-11-91	ACHD	<0.10	*	*	*	*	*	*
29048	2-25-92	ACHD	<0.10	*	*	*	*	*	*
29049	3-10-92	ACHD	0.16	*	*	*	*	*	*
29050	3-17-92	ACHD	0.76	*	*	*	*	*	*
29051	3-17-92	ACHD	1.85	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Buena Vista Township - Site 29--Continued									
29052	3-17-92	ACHD	0.12	*	*	*	*	*	*
29053	3-16-92	ACHD	0.12	*	*	*	*	*	*
29054	3-18-92	ACHD	<0.10	*	*	*	*	*	*
29055	3-17-92	ACHD	<0.10	*	*	*	*	*	*
Burlington County - Evesham Township - Site 30									
30045	3-24-92	SIO	<0.01	75	10	PVC	sub	7-87	12
30046	3-24-92	SIO	<0.01	65	10	PVC	jet	6-86	*
30047	3-24-92	SIO	<0.01	60	10	PVC	jet	12-87	10
30048	3-24-92	SIO	<0.01	60	10	PVC	sub	7-87	*
30049	3-24-92	SIO	<0.01	69	10	PVC	jet	4-83	*
30050	3-24-92	SIO	3.53	64	10	PVC	jet	7-84	11
Atlantic County - Galloway Township - Site 31									
31001	7-14-92	ACHD	0.82	110	*	*	*	*	*
31002	10-28-91	ACHD	0.13	120	*	*	*	*	*
31003	10-30-91	ACHD	0.48	120	10	PVC	sub	1-85	16
31004	12-16-91	ACHD	<0.20	110	5	PVC	sub	10-89	45
31005	10-4-91	ACHD	0.26	*	*	*	*	*	*
31006	3-13-92	ACHD	0.44	90	10	PVC	sub	9-87	12
31007	10-17-91	ACHD	0.37	110	*	*	*	*	*
31008	10-17-91	ACHD	0.19	105	10	PVC	*	2-90	15
31009	10-17-91	ACHD	0.17	80	10	PVC	sub	6-90	31
31010	10-28-91	ACHD	0.13	*	*	*	*	*	*
31011	7-14-92	ACHD	<0.10	*	*	*	*	*	*
31012	9-24-92	ACHD	1.10	*	*	*	*	*	*
31013	7-10-92	ACHD	0.17	*	*	*	*	*	*
31014	8-5-92	ACHD	<0.10	100	*	*	*	*	*
31015	7-10-92	ACHD	<0.10	80	10	PVC	sub	4-86	20
31016	7-10-92	ACHD	0.27	90	10	PVC	sub	2-88	32
31017	7-14-92	ACHD	<0.10	*	*	*	*	*	*
31018	8-5-92	ACHD	<0.10	*	*	*	*	*	*
31019	10-16-91	ACHD	2.96	109	10	PVC	sub	5-89	*
31020	10-4-91	ACHD	0.17	119	10	PVC	sub	8-88	*
31021	10-4-91	ACHD	0.17	*	*	*	*	*	*
31022	8-15-92	ACHD	<0.10	*	*	*	*	*	*
31023	10-23-91	ACHD	0.19	104	*	*	*	*	*
31024	10-4-91	ACHD	0.26	*	*	*	*	*	*
31025	10-4-91	ACHD	0.36	90	5	PVC	*	10-85	20
31026	10-23-91	ACHD	1.00	120	*	*	*	*	*
31027	6-16-92	ACHD	0.36	*	*	*	*	*	*
31028	7-8-92	ACHD	0.27	32	*	*	*	*	*
31029	6-16-92	ACHD	0.46	105	*	*	*	*	*
31030	8-18-92	ACHD	<0.10	100	10	PVC	sub	10-85	40

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

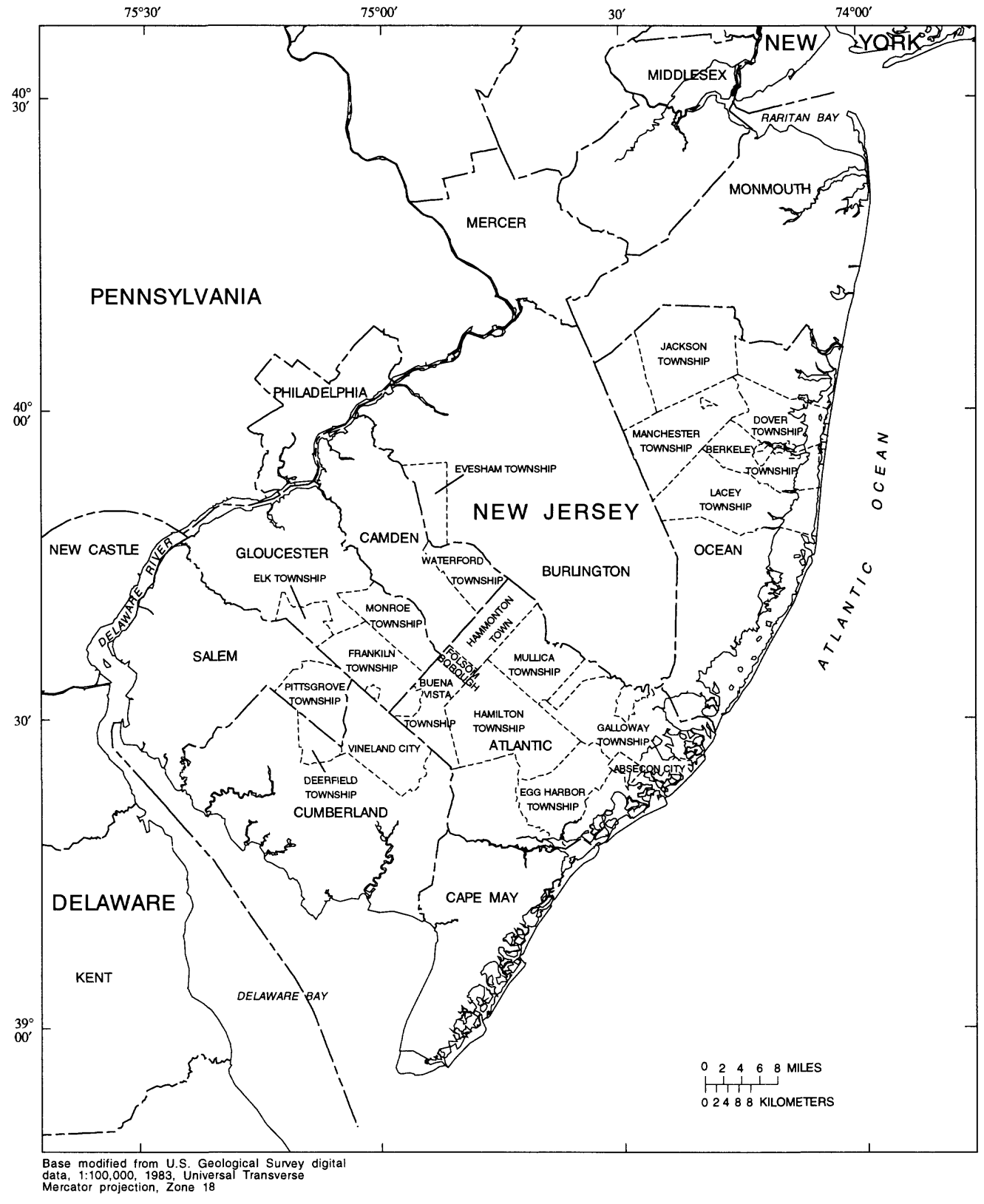
Well-identification number[1]	Sampling date	Laboratory[2,3]	Hg concentration (µg/L)	Well depth (ft)	Screened interval (ft)	Casing material	Pump type	Installation date	Water level (ft below land surface)
Atlantic County - Galloway Township - Site 31--Continued									
31031	7-14-92	ACHD	<0.10	*	*	*	*	*	*
31032	10-23-91	ACHD	0.19	102	*	*	*	*	*
31033	7-8-92	ACHD	0.17	*	*	*	*	*	*
31034	7-8-92	ACHD	0.17	*	*	*	*	*	*
31035	7-9-92	ACHD	0.98	50	10	PVC	*	5-84	*
31036	6-16-92	ACHD	0.17	90	10	PVC	sub	3-86	25
31037	7-14-92	ACHD	<0.10	97	13	PVC	sub	4-87	24
31038	10-4-91	ACHD	<0.10	101	5	g steel	*	5-81	7
31039	6-14-92	ACHD	0.17	100	*	*	*	*	*
31040	6-16-92	ACHD	0.17	101	5	PVC	sub	6-85R	30
31041	7-7-92	ACHD	0.27	80	10	PVC	sub	7-91	27
31042	7-14-92	ACHD	<0.10	*	*	*	*	*	*
31043	5-27-92	ACHD	<0.10	105	*	*	*	*	*
31044	7-10-92	ACHD	0.27	*	*	*	*	*	*
31045	6-16-92	ACHD	0.56	109	*	*	*	*	*
Atlantic County - Galloway Township - Site 32									
32001	8-29-91	ACHD	0.23	*	*	*	*	*	*
32002	10-9-91	ACHD	0.39	112	5	PVC	DW jet	10-86	42
32003	8-12-91	ACHD	0.11	105	3	g steel	DW jet	12-81	40
32004	8-28-91	ACHD	0.23	*	*	*	*	*	*
32005	8-29-91	ACHD	0.13	105	5	PVC	DW jet	8-88	40
32006	9-2-91	ACHD	0.40	112	4	PVC	DW jet	6-88	40
32007	9-4-91	ACHD	0.13	111	5	PVC	DW jet	6-88	40
32008	9-4-91	ACHD	0.40	*	*	*	*	*	*
32009	8-19-91	ACHD	<0.20	112	5	PVC	DW jet	8-87	40
32010	8-14-91	ACHD	0.13	*	*	*	*	*	*
32011	9-3-91	ACHD	0.27	*	*	*	*	*	*
32012	9-10-91	ACHD	0.64	120	10	PVC	sub	4-88	*
32013	8-12-91	ACHD	<0.10	112	5	PVC	SW jet	9-88	36
32014	8-12-91	ACHD	1.11	*	*	*	*	*	*
32015	9-4-91	ACHD	0.27	55	10	PVC	sub	6-88	29
32016	9-4-91	ACHD	0.40	110	10	PVC	sub	2-89	41
32017	9-4-91	ACHD	0.27	*	*	*	*	*	*
32018	9-3-91	ACHD	0.27	*	*	*	*	*	*
32019	9-3-91	ACHD	0.27	*	*	*	*	*	*
32020	9-11-91	ACHD	0.20	106	5	PVC	DW jet	11-88	31
Ocean County - Lacey Township - Site 33									
33001	*	OCHD	3.8	*	*	*	*	*	*
33002	3-17-88	OCHD	3.9	*	*	*	*	*	*
Ocean County - Dover Township - Site 34									
*34001	*	OCHD	4.2	*	*	*	*	*	*
*34002	*	OCHD	5.6	*	*	*	*	*	*
*34003	*	OCHD	2.0	*	*	*	*	*	*

Table 1a. Mercury concentrations in water samples from, and well-construction data for, 2,239 wells screened in the Kirkwood-Cohansey aquifer system at 34 sites of elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

[2]Abbreviations for laboratories:

AA	AA Laboratories
ACHD	Atlantic County Division of Public Health Laboratory
BE	Bridgeport Environmental
BEL	Bureau of Environmental Laboratories, New Jersey Department of Environmental Protection
BSDW	Bureau of Safe Drinking Water, New Jersey Department of Environmental Protection
CCJM	C.C. Johnson and Malhotra
CL	Century Laboratories
EMA	Environmental Measurements and Analysis, Inc.
EPL	Environmental Profile Laboratories
ETL	Environmental Testing Laboratory
GCHD	Gloucester County Health Department
HL	Henderson Laboratories
NJDEP	New Jersey Department of Environmental Protection
NJDOH	New Jersey Department of Health
OCH	Ocean County Health Department
PANA	Panacore Laboratories
P&P	P&P Laboratories
PGDL	Princeton University Geology Department Laboratory
QC	Quality Control Laboratories
REWAI	R.E. Wright and Associates, Inc.
SIO	Skidaway Institute of Oceanography
SJTL	South Jersey Testing Laboratory
TWC	Testwell Craig Laboratory
USEPA	U.S. Environmental Protection Agency
VCHD	Vineland City Health Department

In some cases, the name given for the laboratory is the name of the sampling agency, and the analysis was done by a contract laboratory or related agency laboratory. The laboratory name that is given is that listed in the various data bases compiled by the U.S. Geological Survey in the course of this study.



Base modified from U.S. Geological Survey digital data, 1:100,000, 1983, Universal Transverse Mercator projection, Zone 18

Figure 1a. Municipalities in which 34 sites of elevated mercury concentrations in ground water are located, New Jersey Coastal Plain.

Table 1b. Mercury concentrations in water samples from 168 wells screened in the Kirkwood-Cohansey aquifer system, New Jersey Coastal Plain

[Hg, mercury; µg/L, micrograms per liter; <, less than; all data from U.S. Geological Survey ground-water quality data base (QWDATA)]

Well-identification number	Date sampled	Local identifier	Dissolved[1] Hg concentration (µg/L)
391820074462201	08-31-87	AC REGIONAL DAY SCHOOL	<0.1
	12-05-88		<.1
391824075132901	08-11-87	COOK FARM 1	<.1
391830075120801	09-22-86	JONES ISLAND 1 OBS	<.1
391842075133701	08-11-87	HOWELL FARM 1	.1
391949074385401	12-01-88	MARTINELLI 1	<.1
392026075150701	07-06-87	FARM 2	<.1
392235075043201	09-15-93	MUNICIPAL AIRPORT TW 4	<.1
392241074493301	12-02-88	ESTELL MANOR SCHOOL	.3
392430075131301	08-14-87	BWD 2 REP	<.1
392437075130501	09-29-93	BWD 6	<.1
392450075153901	09-01-87	CUMBERLAND MEDICAL CTR 1	<.1
392508075184601	07-29-86	SHEPPARDS 2 OBS	<.1
392523075151901	09-28-93	BWD 13	<.1
392527075064201	06-26-84	FAIR GROUNDS 1	<.1
392547075140901	09-28-93	BWD 16	<.1
392552075145001	09-28-93	BWD 11	<.1
392641075132901	09-27-93	BWD 3	<.1
392722074384301	12-06-88	HTMUA 1(WOOD)	<.1
	09-17-93		<.1
392724075123603	08-14-87	BWD 14	<.1
	09-27-93		<.1
392731075092401	05-13-86	VOCATIONAL SCHOOL 2 OBS	<.1
392732075092401	05-12-86	VOCATIONAL SCHOOL 1 OBS	<.1
392757074552801	08-10-87	BERTONAZZI 3	.3

[1]Concentrations marked with an asterisk are total- (unfiltered) mercury values. Samples were collected from several observation wells and from a series of shallow wells (local identifiers begin with WM and CM) installed at two sites where liquid sludge was applied to experimental plots over the course of 3 years. (See Ocean County Sewerage Authority and Cook College, 1980; also Kam, 1978.)

Table 1b. Mercury concentrations in water samples from 168 wells screened in the Kirkwood-Cohansey aquifer system, New Jersey Coastal Plain--Continued

Well-identification number	Date sampled	Local identifier	Dissolved[1] Hg concentration (µg/L)
392758074473101	12-05-88	FARNSWORTH 1	<.1
392813074563601	06-29-87	IRR-1979	.1
	06-29-87		<.1
392840074535401	08-12-87	1	<.1
392850075010301	09-24-93	VWSU 7	<.1
392920074570001	11-15-84	NATURAL AREA 1 OBS	<.1
392959074410701	12-06-88	LAURELDALE FIRE DEPT	<.1
392959075072901	08-26-87	CUMBERLAND REG SCHOOL	<.1
393027074574401	07-06-87	ANDALORO 1	.1
393047075054202	04-26-91	REINMAN DOM	.2
393051074412101	12-07-88	EGG HARBOR PL	<.1
393053074365402	07-28-87	STADTMUELLER 2	<.1
393057075083901	09-01-87	PARVIN PARK DOMESTIC	<.1
393104075122201	05-01-91	RUTGERS R&D1 SHALLOW OBS	<.1
	05-01-91		<.1
	12-20-91		<.1
	07-14-94		<.1
393104075122202	05-01-91	RUTGERS R&D2 MED OBS	<.1
	12-20-91		3.4
	07-13-94		<.1
393104075122203	05-02-91	RUTGERS R&D3 DEEP OBS	<.1
	12-23-91		<.1
393112074351301	07-01-87	1	<.1
393124074324001	07-01-87		<.1
393149074555401	08-26-87	SCOTT PAPER DOMESTIC	.6
	12-13-88		1.0
393149074575201	07-30-87	SCAPELLATO 1	.3
393149074575202	07-21-87	SCAPELLATO 2	.3
393208075024501	09-24-93	VWSU 10	.1
393319075081301	06-29-87	7-1959	.4
393322074595001	09-20-88	MAIN RD SCHOOL #1	<.1

Table 1b. Mercury concentrations in water samples from 168 wells screened in the Kirkwood-Cohansey aquifer system, New Jersey Coastal Plain--Continued

Well-identification number	Date sampled	Local identifier	Dissolved[1] Hg concentration (µg/L)
393411075002201	09-26-88	LAKE SCHOOL 1	<.1
	02-16-89		<.1
393419074562601	08-12-87	FERRUCCI IRR-76	.3
393428075024401	09-09-88	MALAGA 1	<.1
393448074560601	09-09-88	FERRUCCI 10	<.1
393449075052801	04-24-91	WALKER FARM	.2
393457074583901	12-10-86	WROBEL.H1	<.1
	09-29-88		<.1
393517074553901	12-11-86	BIAGI H1	<.1
393523074591201	12-10-86	DASE 1	<.1
	08-26-88		<.1
393539075034801	01-28-86	FRANKLIN ADMIN BLD	.5
	09-14-88		.3
393557074411401	06-21-84	AMATOL 6 OBS	<.1
393625074484601	07-08-87	IRR-1979	<.1
393629074484101	07-10-87	5	<.1
393634075041501	09-15-88	CLR 1	<.1
393701074510401	12-01-88	FOLSOM BORO	<.1
393708075014301	09-27-88	SCAFONIS D	<.1
393727074490101	07-23-87	CLARK 5A	.2
393748074381701	04-27-78	MULLICA 41S	<.5
393805074555401	12-10-86	CORONA 1	<.1
	08-24-88		.1
393809074334901	03-02-78	MULLICA 43S	<.5
393809074484602	11-22-88	EASTERN 4	<.1
393819074445201	07-02-87	VARIETY FARM 1	<.1
393822074400201	07-02-87	VARIETY FARM 4	<.1
393828074565501	09-15-88	HOSPITALITY CAMPGROUND 1	<.1
393832074360801	04-14-78	MULLICA 12D	<.5
393832074360802	04-14-78	MULLICA 42S	<.5

Table 1b. Mercury concentrations in water samples from 168 wells screened in the Kirkwood-Cohansey aquifer system, New Jersey Coastal Plain--Continued

Well-identification number	Date sampled	Local identifier	Dissolved[1] Hg concentration (µg/L)
393842074565501	09-26-88	CECIL 1	<.1
393855074200801	06-02-83	BASS R SF 1	<.5
393907074440201	07-06-87	COLUMBIA 1A	<.1
393917075014901	09-19-88	BEHL RD WELL	.2
393931074482101	11-22-88	OW53	.2
393940074574601	12-10-86	DEMATTO 1	.2
	09-23-88		<.1
393944074371401	03-09-78	MULLICA 40S	<.5
393945074384801	03-09-78	MULLICA 39S	<.5
394009074325101	02-22-78	MULLICA 6D	<.5
394009074325202	02-22-78	MULLICA 56S	<.5
394020074561102	09-28-88	WILLIAMS GARDEN	.2
394026075050401	09-28-88	MT MUA 7 1979	<.1
	09-01-93		<.1
394036074400101	06-21-84	WHARTON 2G	<.1
394041074460401	02-16-78	MULLICA 2D	<.5
394050074303701	03-02-78	MULLICA 47S	<.5
394054074570001	09-29-88	DECORA 1	<.1
394104074344001	04-12-78	MULLICA 44S	<.5
394106074362501	04-12-78	MOUNT OBS	<.5
	06-27-84		<.1
394108074431901	03-31-78	MULLICA 23S	<.5
394111074214101	09-11-84	STFFRD FORGE 1	<.1
394138074411901	04-28-78	MULLICA 57S	<.5
394143074282801	03-29-78	MULLICA 48S	<.5
394148074481001	03-31-78	MULLICA 17S	<.5
394156074450801	02-15-78	MULLICA 19S	<.5
394204074492101	03-10-78	MULLICA 7D	<.5
394204074492102	03-10-78	MULLICA 16S	<.5

Table 1b. Mercury concentrations in water samples from 168 wells screened in the Kirkwood-Cohansey aquifer system, New Jersey Coastal Plain--Continued

Well-identification number	Date sampled	Local identifier	Dissolved[1] Hg concentration (µg/L)
394208074264501	12-12-77	OSWEGO LAKE 1	<.5*
	09-07-84		<.1
394208074403101	03-08-78	MULLICA 26S	<.5
394215074561704	06-08-83	NEW BROOKLYN 4	<.1
394223074415301	04-28-78	MULLICA 11D	<.5
394223074415302	04-28-78	MULLICA 25S	<.5
394224074471301	02-23-78	MULLICA 18S	<.5
394226074394801	03-08-78	MULLICA 37S	<.5
394235074572801	08-20-74	OBS 2-1971	.5*
	04-20-78		<.5
394248074571001	08-19-74	PROD 1	<.5*
	12-16-88		<.1
	09-08-93		<.1
394300074383001	04-07-78	MULLICA 4D OBS	<.5
394300074383002	04-07-78	MULLICA 54S OBS	<.5
394305074335701	04-05-78	MULLICA 13D	<.5
394305074335702	04-05-78	MULLICA 45S	<.5
394308074571101	08-20-74	OBS 3-1971	<.5*
	04-20-78		<.5
394312074282101	03-29-78	MULLICA 49S	<.5
394316074441501	02-15-78	MULLICA 22S	<.5
394329074371801	04-06-78	MULLICA 36S	<.5
394332074574001	12-16-88	PROD 2	<.1
	09-08-93		<.1
394405074395801	04-06-78	MULLICA 35S	<.5
394406074412701	04-25-78	MULLICA 27S	<.5
394417074553801	12-09-88	CERTAINTEED 1	<.1
394422074430902	06-01-83	ATSION 2 OBS	.1
	09-06-84		<.1
394422074430903	06-01-83	ATSION 3 OBS	.1
	09-06-84		<.1

Table 1b. Mercury concentrations in water samples from 168 wells screened in the Kirkwood-Cohansey aquifer system, New Jersey Coastal Plain--Continued

Well-identification number	Date sampled	Local identifier	Dissolved[1] Hg concentration (µg/L)
394431074494101	02-23-78	MULLICA 15S	< .5
394438074483801	04-25-78	MULLICA 14S	< .5
394452074281901	06-13-84	PENN SF SHALLOW OBS	< .1
394455074504301	03-15-78	MULLICA 13S	< .5
394520074451101	02-17-78	MULLICA 21S	< .5
394531074435601	02-16-78	MULLICA 52S	< .5
394536074354201	04-26-78	MULLICA 5D	< .5
394536074354202	04-26-78	MULLICA 55S	< .5
394553074473901	03-15-78	MULLICA 12S	< .5
394608074405401	04-29-78 09-03-81	MULLICA 10D	< .5 < .1
394608074405402	03-30-78 09-03-81	MULLICA 29S	< .5 < .1
394636074373901	04-21-78	MULLICA 31S	< .5
394742074142001	05-24-83 09-20-84	GARDEN ST PKY 1 OBS	.1 < .1
394742074142002	05-24-83	GARDEN ST PKY 2 OBS	.1
394812074403101	03-01-78	MULLICA 3D OBS	< .5
394812074403102	03-01-78	MULLICA 53S OBS	< .5
394834074471501	02-17-78	MULLICA 10S	< .5
394848074365601	04-21-78	MULLICA 32S	< .5
394940074314301	03-03-78	MULLICA 8S	< .5
394949074202901	06-14-84	CEDAR BRG TWR1	.1
395107074225501	06-14-84	GREENWOOD FOR1	< .1
395122074301702	06-19-84	BUTLER PLACE 2 OBS	< .1
395150074284201	06-27-84	LEBANON SF 23-D OBS	.2
395317074233501	03-08-74	WM24B	< .5*
395318074225801	05-19-75	WM12E	< .5*
395318074225901	05-19-75	WM12D	< .5*

Table 1b. Mercury concentrations in water samples from 168 wells screened in the Kirkwood-Cohansey aquifer system, New Jersey Coastal Plain--Continued

Well-identification number	Date sampled	Local identifier	Dissolved[1] Hg concentration (µg/L)
395318074230001	05-19-75	WM12C	.9*
395318074230301	03-08-74	WM13B	.6*
395319074230101	03-08-74	WM12B	< .5*
395319074233401	03-08-74	WM23B	< .5*
395320074233201	03-08-74	WM22B	< .5*
395322074230601	03-08-74	WM15B	< .5*
395451074270201	06-29-83 09-11-84	LSF GOOSE PD 1	< .1 < .1
395714074211201	09-02-93	CRESTWOD VIL 5	.2
395714074223401	06-07-83	CRAMMER OBS	< .1
395722074231901	09-03-93	1	< .1
395741074212701	09-02-93	CRESTWOD VIL 7	< .1
400039074193001	09-09-93 09-09-93	1R	1.1 1.0
400416074270104	07-10-84	COLLIERS MILLS 4 OBS	< .1
400438074270801	03-08-74	CM15B	< .5*
400439074270501	05-19-75	CM12E	< .5*
400439074270601	05-19-75	CM12D	< .5*
400439074270701	05-19-75	CM12C	< .5*
400439074270901	03-08-74	CM14B	< .5*
400440074270701	05-19-75	CM13E	< .5*
400440074270801	05-19-75	CM13D	< .5*
400440074270901	05-19-75	CM13C	.6*
400441074270701	03-08-74	CM14D	< .5*
400442074270801	03-08-74	CM11B	< .5*

Table 1c. Mercury concentrations in water samples from, and well-construction data for, 31 wells sampled during State and county investigations; mercury concentrations less than 1 microgram per liter for all wells in a given area

[Hg, mercury; µg/L, micrograms per liter; <, less than; ft, feet; *, no available data]

Well-identification number[1]	Date of sampling	Laboratory[2]	Total Hg concentration (µg/L)	Depth from land surface (ft)	Screened interval (ft)	Casing material	Pump type	Date of installation	Water level (ft below land surface)
Atlantic County - Hammonton Town - Area 35									
35001	10-22-91	ACHD	<0.10	*	*	*	*	*	*
35002	12- 9-91	ACHD	<0.20	*	*	*	*	*	*
35003	12- 9-91	ACHD	<0.20	*	*	*	*	*	*
35004	11-12-91	ACHD	0.59	*	*	*	*	*	*
35005	11-12-91	ACHD	0.46	*	*	*	*	*	*
35006	11-12-91	ACHD	0.46	*	*	*	*	*	*
35007	11- 4-91	ACHD	0.23	*	*	*	*	*	*
35008	11- 4-91	ACHD	0.42	*	*	*	*	*	*
35009	11-19-91	ACHD	<0.20	*	*	*	*	*	*
35010	11-19-91	ACHD	<0.20	*	*	*	*	*	*
35011	10-22-91	ACHD	0.37	*	*	*	*	*	*
35012	12- 9-91	ACHD	<0.20	*	*	*	*	*	*
35013	3-10-92	ACHD	0.68	*	*	*	*	*	*
Atlantic County - Hammonton Town - Area 36									
36001	12- 2-91	ACHD	<0.20	*	*	*	*	*	*
36002	12-18-91	ACHD	<0.20	*	*	*	*	*	*
Atlantic County - Somers Point City - Area 37									
37001	9-24-91	ACHD	0.39	*	*	*	*	*	*
37002	7-30-91	ACHD	0.68	*	*	*	*	*	*
37003	7-20-92	SJTL	<0.50		*	*	*	*	*
37004	8-20-91	ACHD	0.42	*	*	*	*	*	*
37005	8-20-91	ACHD	0.42	*	*	*	*	*	*
37006	8-20-91	ACHD	0.22	*	*	*	*	*	*
37007	8-20-91	ACHD	0.11	*	*	*	*	*	*
37008	8-20-91	ACHD	0.32	*	*	*	*	*	*
37009	10-22-91	ACHD	<0.10	*	*	*	*	*	*
37010	10-22-91	ACHD	0.55	*	*	*	*	*	*
37011	12- 2-91	ACHD	<0.20	*	*	*	*	*	*
37012	11- 4-91	ACHD	0.32	111	5	PVC	DW jet	5-85	28

[1]First digits in well-identification number correspond to area number (see figure 1c of appendix 1c); following digits correspond to well number assigned by U.S. Geological Survey.
[2]Laboratory abbreviations listed at end of table 1a of appendix 1a.

Table 1c. Mercury concentrations in water samples from, and well-construction data for, 31 wells sampled during State and county investigations; mercury concentrations less than 1 microgram per liter for all wells in a given area--Continued

Well-identification number[1]	Date of sampling	Laboratory[2]	Total Hg concentration (µg/L)	Depth from land surface (ft)	Screened interval (ft)	Casing material	Pump type	Date of installation	Water level (ft below land surface)
Atlantic County - Absecon City - Area 38									
38001	*	*	0.38	*	*	*	*	*	*
Atlantic County - Egg Harbor Township - Area 39									
39001	2- 8-83	CL	<0.20	*	*	*	*	*	*
Atlantic County - Brigantine City - Area 40									
40001	9-4-84	QC	<2.00	*	*	*	*	*	*
Ocean County - Jackson Township - Area 41									
41001	12-17-85	ETC	<0.20	*	*	*	*	*	*

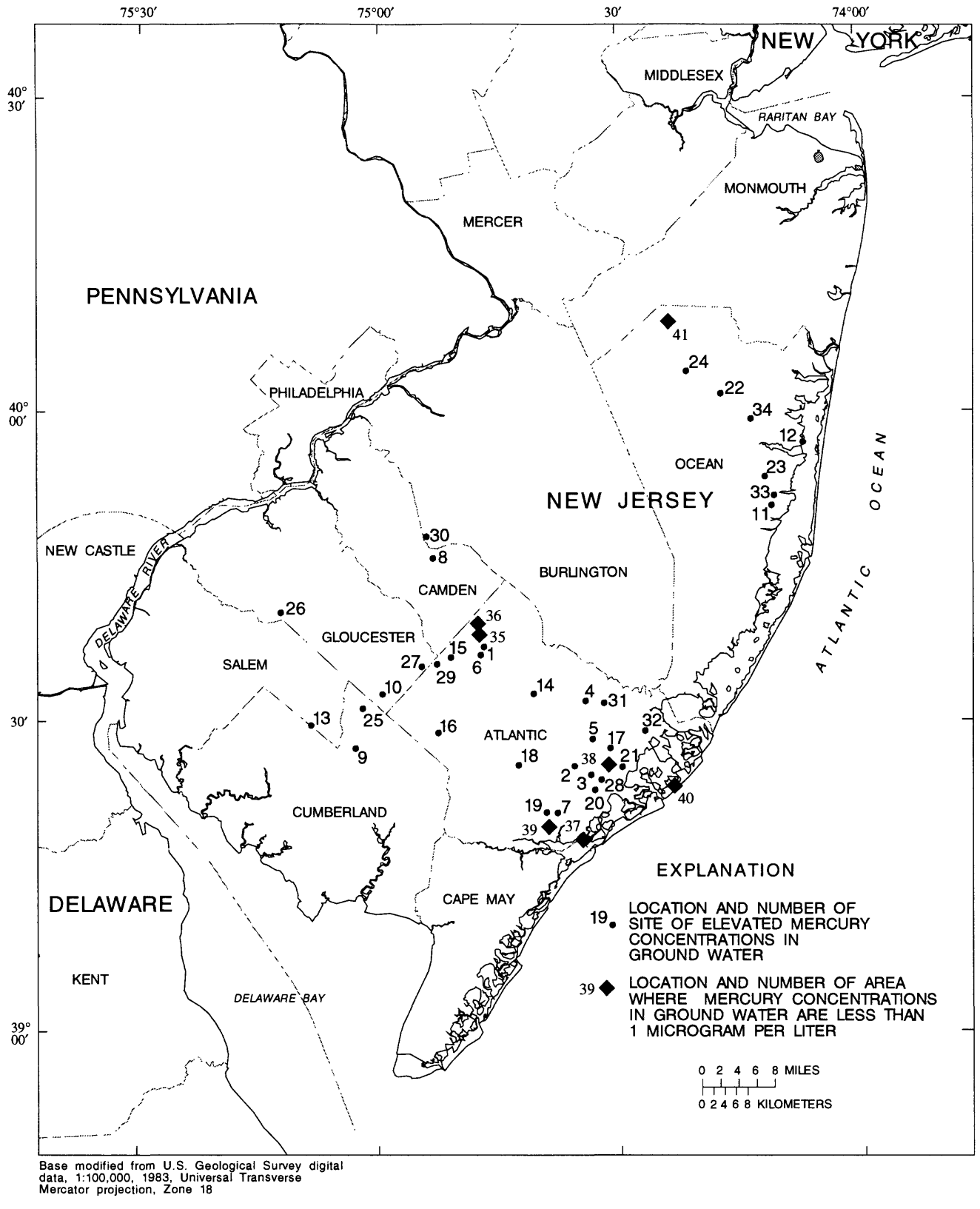


Figure 1c. Locations of areas not included in sites of elevated mercury concentrations in ground water for which mercury concentrations in ground water are less than 1 microgram per liter, and locations of 34 sites of elevated mercury concentration in ground water, New Jersey Coastal Plain.

Table 1d. Total-mercury concentrations in water from wells sampled during study of background mercury concentrations by Skidaway Institute of Oceanography and New Jersey Department of Environmental Protection, 1991

[All analyses by inductively coupled plasma/mass spectrometry (Windom and Smith, 1992); Hg- (mercury) concentration data are reported in this table in μg/L (micrograms per liter)]

Well number[1]	Total Hg concentration	Well number	Total Hg concentration	Well number	Total Hg concentration
20	0.011	38	0.003	67	0.002
21	.012	39	.002	68	.005
22	.012	40	.002	69	.002
23	.019	41	.006	71	.005
28	.027	42	.003	72	.003
29	.042	43	.004	74	.001
30	.023	44	.003	75	.002
32	.008	61	.005	76	.680
33	.009	62	.003		
34	.003	63	.006		
35	.002	64	.002		
36	.015	65	.006		
37	.008	66	.004		

[1]No wells listed in appendix 1d are listed in appendix 1a, which contains the wells associated with the 34 sites of elevated mercury concentrations in ground water.

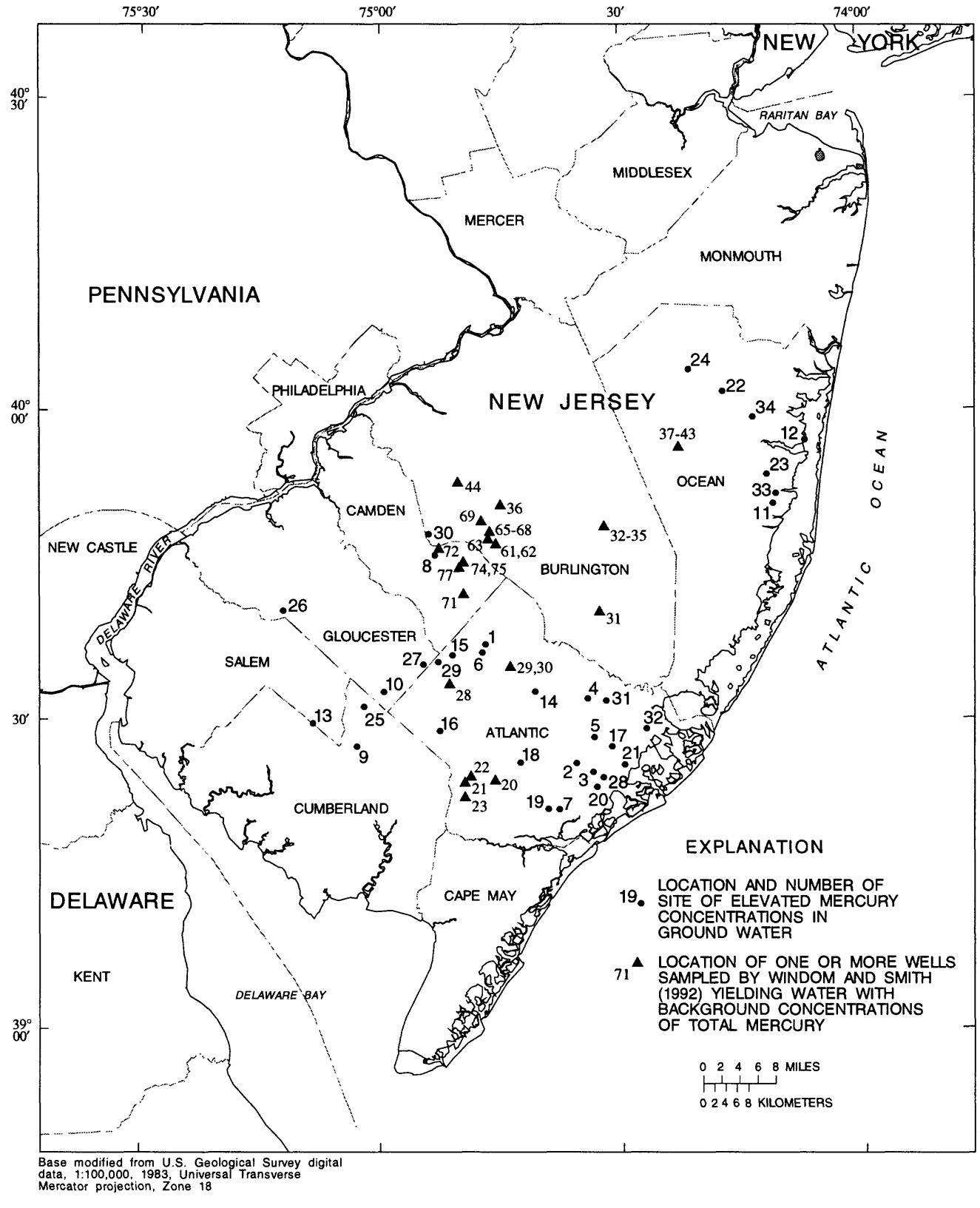


Figure 1d. Locations of wells yielding water with background concentrations of total mercury, and location of 34 sites of elevated mercury concentrations in ground water.

Appendix 2. Soil and water-quality sampling and analysis methods, quality-assurance and quality-control measures, raw data, and calculations

2a. Soil and water-quality sampling and analysis methods.

2b. Experiment in sampling protocol for analysis of mercury in ground water.
Figure 2b. Map showing locations of wells sampled for experiment in sampling protocol, New Jersey Coastal Plain.

2c. Published values and analytical values for National Institute of Standards and Technology Reference Materials 8406 and 8407, mercury in Tennessee River sediments.

2d. Raw data, calculations, and statistical summary for mercury concentrations in a soil core and soil samples collected from Wharton State Forest, New Jersey.

2e. Raw data, calculations, and statistical summary for mercury concentrations in soil and aquifer sediment cores from Hammonton and Franklin Townships, New Jersey.

2f. Raw data, calculations, and statistical summary of mercury concentrations in soil samples collected at sites associated with elevated mercury concentrations in ground water, New Jersey Coastal Plain.

2g. Raw data for mercury concentrations in ground-water samples from sites 1 and 4.

2h. Raw data for mercury concentrations in ground-water samples from site 10.

2i. Table 2i. Raw data for mercury concentrations in ground-water samples from Atlantic City Municipal Utilities Authority public supply wells and U.S. Geological Survey and State of New Jersey observation wells.
Figure 2i. Map showing locations of Atlantic City Municipal Authority public supply wells and U.S. Geological Survey and State of New Jersey observation wells.

2j. Raw data for percent moisture, loss on ignition, and organic matter for soil samples collected at sites associated with elevated concentrations of mercury in ground water.

2k. Figure 2k. Representative raw data from mercury analyses performed by a New Jersey laboratory.

Appendix 2a. Soil and water-quality sampling and analysis methods

Collection of Samples by the U.S. Geological Survey

Ground Water

In addition to ground-water samples collected from 21 wells at sites 1, 4, and 10 (mercury-concentration data in table 3 and app. 1a), water samples also were collected from 4 deep public-supply wells finished in the Kirkwood-Cohansey aquifer system that are within 2 mi of several areas of ground-water mercury contamination. Water samples also were collected from three deep observation wells, two in Wharton State Forest and one along the Garden State Parkway in Ocean County. Eight shallow monitoring wells also were sampled, five of which tap the surficial aquifer overlying the Kirkwood-Cohansey aquifer system in Cape May County. Three shallow observation wells that are finished in the Kirkwood-Cohansey aquifer system, of which two are located in Wharton State Forest and one is located near the Garden State Parkway in Ocean County, also were sampled. Mercury-concentration data and maps showing locations of public-supply, observation, and monitoring wells are presented in appendix 2a and 2h.

Water samples were collected from wells according to USGS standard techniques (Wayne Lapham, Francesca Wilde, and Michael Koterba, U.S. Geological Survey, written commun., 1992). Because of recent concern regarding contamination of samples during sampling, however, additional precautions were taken. The standard glass acid-washed bottles used for mercury samples were cleaned further by immersion soaking in a solution of 1:7 nitric acid for a minimum of 3 hours. Bottles were then rinsed with doubly distilled water and placed inverted onto paper-lined baskets to dry. When dry, the bottles were sealed and placed inside a polyethylene zipper bag. This bag was then placed inside a second polyethylene zipper bag containing a pair of disposable gloves for use during sampling, a zipper bag for the collected sample, and a nitric acid ampoule for sample preservation. The second zipper bag was sealed, folded over, and taped, and was then placed in a clean cooler for transport to the field.

For sample filtration, four filter tripods were used daily. The tripods were pre-cleaned in the laboratory by washing with soap and water followed by soaking in a nitric acid bath overnight. They were then rinsed in distilled water and allowed to dry. When dry, each apparatus was reassembled and placed in a polyethylene bag which was then sealed. Acid-washed 0.45-micrometer filters were used to filter the water samples. After collection, the samples were preserved with nitric acid/dichromate, and the sample bottles were placed in clean zipper bags and sealed, and were then placed in a cooler on ice, transported to the USGS New Jersey District office, and sent by overnight mail to the USGS National Water Quality Laboratory (NWQL) in Arvada, Colorado, or transported to the Princeton University Geology Department Laboratory (PGDL) for analysis. In order to assess the potential for sample contamination as well as the effectiveness of several sample preservatives, water samples from monitoring wells in Cape May County were collected and prepared by using several different treatments. A discussion of the treatments and the analytical results is presented in appendix 2b.

Soils and Aquifer Sediments

Fifty-one soil samples were collected from 17 locations at 6 sites of contaminated ground water and 1 undisturbed forest site in southern New Jersey to determine the distribution profile of mercury in New Jersey soils (see table below). Soils were collected by using a trenching method and samples were separated by natural horizons or by changes in color, texture, and grain size. An early experiment in which a core of soils was collected from Wharton State Forest (sample WF-C1) resulted in blending the horizons, thus obscuring the characteristics of each horizon. The trenching method permitted collection of representative samples of each horizon or section of soil where changes in color, texture, and grain size indicated a change in characteristics of recently disturbed soils.

The locations for sampling were chosen so that a broad spectrum of specific land uses could be represented. Soils were collected with a stainless-steel shovel and stainless-steel hand trowels, which were cleaned thoroughly with soap and water and rinsed with distilled water between uses. Although metal instruments may be a minor source of contamination for some trace metals, they are preferable to plastic implements when digging in hard ground. The shovel and trowels were stored in plastic bags. Samples were stored in tightly sealed glass jars and refrigerated at 4 °C until analysis.

The soil core at Wharton State Forest, which sampled only the shallow soils, was collected by pounding a core barrel into the soil with a sledge hammer. The deeper core collected by the USGS at site 10 was collected by using a split-spoon coring device, pounded into the soil and aquifer sediments with a 240-lb safety hammer. Two-ft plastic tube liners were enclosed in the split spoon; the ends of the plastic tubes were capped once each core was collected. Coring continued to 20 ft, with the core collected in 2-ft increments. The capped plastic tubes of sediment were marked with depth of sampling and refrigerated at 4 °C until analysis.

Analysis of Samples by the U.S. Geological Survey

Concentrations of mercury in soils and in ground-water samples were determined at the Princeton Geology Department Laboratory (PGDL) by using an atomic absorption spectrophotometer in the cold vapor flameless mode. For the water samples, the USEPA method 7011 for analysis of mercury in hazardous waste was used because this method employs a more vigorous digestion treatment of soluble organic matter than the method (EPA 245.1) for ground water. Similarly, soil samples were analyzed for mercury at PGDL by using a modification of USEPA method 7012 for mercury in soils and hazardous wastes. Although method 7012, like most methods for soil analysis, calls for drying the samples in an oven at 110 °C, this was not done in order to prevent mercury losses. Splits of the samples were later dried and the percent solids or moisture content determined. The soils also were analyzed for pH, and organic matter by loss on ignition. Standard curves were prepared daily by using the Atomic Absorption Standard for mercury from Baker Chemical[1]. A stock solution of 1,000 ppm (parts per million, equivalent to mg/L) was diluted to 1 ppm, and thereafter,

[1]Use of brand or trade names is for identification purposes only, and does not imply endorsement by the U.S. Geological Survey.

serially diluted to working range. A secondary standard of 1,000 ppm mercury in 1 percent nitric acid from Aldrich Chemical Company was used for curve validation. Water samples were analyzed with one duplicate and one spike per batch of 10 samples. Soil samples were analyzed in triplicate, with duplicate sets run every 10 sets. Additionally, a National Institute of Standards and Technology (NIST) standard reference material (SRM) 8406 for Mercury in Tennessee River Sediments was analyzed with each set. A NIST SRM 8407 also was analyzed once, but contained a higher concentration of mercury than those encountered in the samples. Details of quality-assurance and quality-control measures can be found in appendix 2b.

Appendix 2b. Experiment in sampling protocol for analysis of mercury in ground water

Because of the recent concern regarding the reliability of low-level mercury-concentration data, a sampling protocol was tested to determine whether it was necessary to adjust the protocol currently used by the U.S. Geological Survey (USGS), New Jersey District, when sampling ground water for mercury.

Prior to sampling, all glassware and sampling apparatus were cleaned with 10 percent nitric acid. Acid-washed glass bottles were further soaked in 10-percent nitric acid for 24 hours and rinsed with doubly distilled water six times.

The experimental design consisted of five steps:

1. Nitric acid preservation (HNO_3 FA (filtered, acidified) and total) - in the laboratory prior to departure for the field 1 mL (milliliter) of ultrapure nitric acid was added to each extra-acid-washed sample bottle. Two samples were collected by using a portable Grundfos[1] submersible pump. One sample was filtered in the field. The two bottles were placed in ziploc bags and sealed. The sealed bags were placed in a cooler with ice for transport to the laboratory at Princeton University. When collecting this sample, the field hydrologist was wearing the disposable gloves that were placed in the original bag with the sample bottles. The hydrologist pointed the bottle away from him/her when filling it with water, making sure not to breathe on the sample.

2. Hydrochloric acid preservation (HCl FA and total) - in the laboratory prior to departure for the field the 1 ml of ultrapure hydrochloric acid was added to two extra-acid-washed bottles and the bottles were sealed in a ziploc bag for transport to the field. As in step 1, two samples were collected by using a submersible pump. One sample was filtered in the field. The sample bottles were placed in ziploc bags, which were sealed and then placed in a cooler with ice. The hydrologist wore fresh disposable gloves while sampling and took care not to breathe on the sample.

3. Dichromate preservation (USGS FA and total) - in the laboratory prior to departure for the field the standard nitric acid/dichromate preservation solution was added to two extra-acid-washed bottles and the bottles were sealed in a ziploc bag for transport to the field. As in step 1, two samples were collected by using the submersible pump. One sample was filtered in the field. The sample bottles were placed in ziploc bags, which were sealed and then placed in a cooler with ice. The hydrologist wore fresh disposable gloves while sampling and took care not to breathe on the sample.

4. Step 4 (HNO_3 bailer) was essentially the same as step 1 except acid-washed bailers were used to collect the samples, one bailer per well. The bailers were transported to the field in double plastic bags with clean disposable gloves in the outer bag. Extra-acid-washed bottles with 1 ml each of ultrapure nitric acid were placed in ziploc bags prior to departure for the field. An acid-washed teflon bailer was used to collect the samples in the field. Samples were filtered in the field. The sample bottles were sealed in a ziploc bag and placed in a cooler of ice. The hydrologist wore fresh disposable gloves while sampling and took care not to breathe on the sample.

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[1] The use of brand names is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

5. Standard sampling and preservation method (Regular FA) - the sample was collected by using the stainless steel pump. The sample was filtered in the field and nitric acid/dichromate preservative was added in the field. No extra precautions, such as acid-washing equipment and using gloves, were taken.

Water samples were collected from shallow monitoring wells in Cape May County that tap an unconfined aquifer, the Holly Beach water-bearing zone, which overlies the Kirkwood-Cohansey aquifer system in most of the Cape May Peninsula. These wells were chosen because (1) they are completed in an aquifer similar to the Kirkwood-Cohansey aquifer system, but one in which no mercury had been detected, and (2) on the basis of prior information, the wells could be expected to yield water with undetectable mercury concentrations. MW-1 is located at exit 6 of the Garden State Parkway at a waste-transfer station. MW-3 is located at a county solid-waste facility in Upper Township; MW-10 is a monitoring well at the Woodbine State School, in Woodbine Borough; MW-14 is a monitoring well at a county solid-waste facility in Woodbine Borough; and MW-North is a well at the Swainton office of the Cape May County Municipal Utilities Authority. Locations of the wells are shown in figure 2b, and well-construction data are given below.

Local well name	Well-identification number	Well depth (feet below land surface)	Top of screen (feet below land surface)	Bottom of screen (feet below land surface)
MW-1	090334	19.0	14.0	19.0
MW-3	090340	22.0	2.0	22.0
MW-10	090345	23.0	3.0	23.0
MW-14	090347	90.0	70.0	90.0
MW-North	090336	25.0	no data	no data

Water samples were analyzed by using USEPA method 7510 for analysis of mercury in wastewater. This protocol requires a 2-hour sample digestion step with 5-percent potassium permanganate ($KMnO_4$), concentrated sulfuric acid (H_2SO_4), nitric acid (HNO_3), and potassium persulfate ($K_2S_2O_8$). After the samples cool, hydroxylamine hydrochloride is added, followed by stannous chloride ($SnCl_2$), and the samples are aspirated on the atomic absorption spectrophotometer. A wavelength of 253.7 nm (nanometers) and slit 4 are used.

The reaction that occurs in samples preserved with hydrochloric acid (HCl) militates against that preservative being used in samples analyzed for mercury. Chlorine gas is evolved when the hydroxylamine hydrochloride is added, which is dangerous for the analyst, and which can produce false positive results if the sample is not aerated prior to the addition of the stannous chloride. The hazardous conditions created, as well as the matrix effects, make hydrochloric acid a poor choice for use in the analysis of water samples for mercury.

Appendix 2b. Experiment in sampling protocol for analysis of mercury in ground water--Continued

The mercury concentrations in µg/L (micrograms per liter) in water samples from the Cape May wells prepared by using different treatments are given below. Concentrations in most of the samples were determined to be less than (<) the method detection limit of 0.2 µg/L.

Local well name	USGS FA*	USGS total**	Treatment		HNO_3 bailer	HNO_3 FA*	HNO_3 total**	Regular FA*
			HCl FA*	HCl total**				
MW-1	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2
MW-3	<.2	<.2	<.2	<.2	<.2	.3	<.2	<.2
MW-10	<.2	.4	<.2	<.2	<.2	<.2	<.2	<.2
MW-14	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2
MW-North	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2

* Filtered and acidified.

** Total unfiltered.

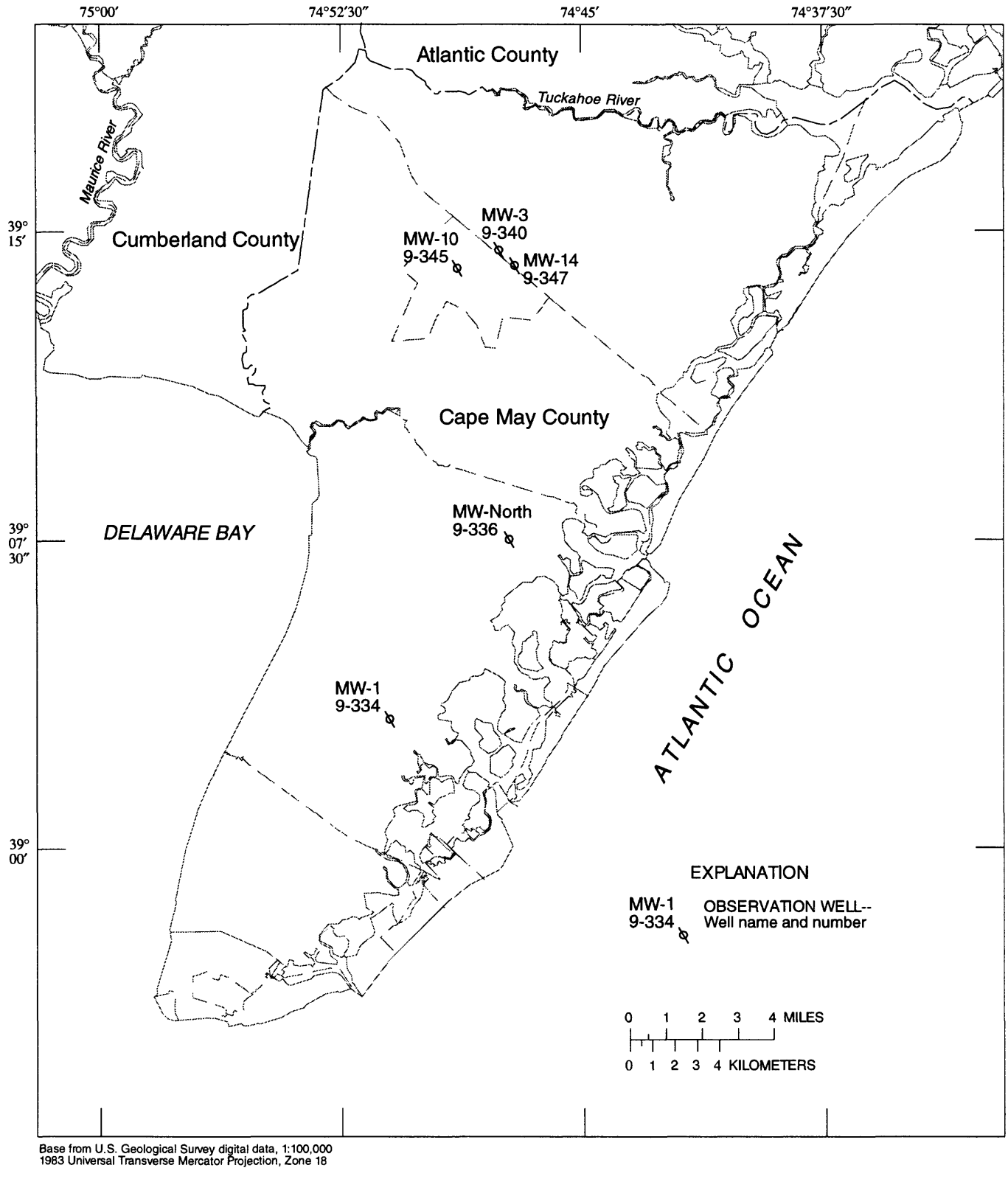


Figure 2b. Locations of wells sampled for experiment in sampling protocol, New Jersey Coastal Plain.

Appendix 2c. Published values and analytical values for National Institute of Standards and Technology Reference Materials 8406 and 8407, mercury in Tennessee River sediments

[Hg, mercury; μg/g, micrograms per gram (equivalent to parts per million); std. dev., standard deviation; PGDL, Princeton University Geology Department Laboratory]

	Date	Reference material number	Hg (μg/g)	std. dev. (μg/g)
Published value		8406	0.06	
PGDL analyzed	8/30/92	8406	.068	0.0036
PGDL analyzed	10/29/92	8406	.063	.004
PGDL analyzed	9/12/92	8406	.057	.0043
PGDL analyzed	1/21/93	8406	.066	.0025
PGDL analyzed	1/22/93	8406	.061	.0078
PGDL analyzed	1/23/93	8406	.061	.0024
PGDL analyzed	2/13/93	8406	.058	.0026
Mean of analyses			.062	
Published value		8407	50	2
PGDL analyzed	1/21/93	8407	46.45	2.3

Appendix 2d. Raw data, calculations, and statistical summary for mercury concentrations in a soil core and soil samples collected from Wharton State Forest, New Jersey

[ft, feet; std., standard; g, grams; µg/L, micrograms per liter; Hg, mercury; L, liter; µg/g, micrograms per gram (equivalent to parts per million); µg/kg, micrograms per kilogram (equivalent to parts per billion); C*V/m = concentration (µg/L)*volume(L)/mass(g), where V = 0.2L for analyses of WF-C1 samples, 0.1L for WF-2 samples; dashed lines separate calibration samples from soil samples]

Sample number/solution description	Soil-sample depth (ft)	Absor-bance	Raw concen-tration (µg/L)	Sediment mass (g)	C*V/m (µg/g)	Mean concen-tration (µg/g)	Concen-tration (µg/kg)	Percent recovery
Distilled water blank		0.003	0.00					
Std. solution containing 0.2 µg/L Hg		.007	.17					85.0
Std. solution containing 0.5 µg/L Hg		.009	.26					52.0
Std. solution containing 1.0 µg/L Hg		.034	1.32					132
Std. solution containing 2.0 µg/L Hg		.05	2					100
WF-C1a	0-0.5	.0075	.19	.472	.082	.097	97.2	
		.007	.17	.293	.118			
		.011	.34	.754	.091			
WF-C1b	0.5-0.9	.007	.17	.56	.062	.146	145.81	
		.016	.56	.398	.279			
		.007	.17	.36	.096			
WF-C1c	0.9-1.1	.0115	.36	.69	.106	.133	133.24	
		.014	.47	1.038	.091			
		.009	.26	.254	.203			
WF-C1d	1.1-1.5	.013	.43	.968	.089	.101	101.12	
		.0085	.24	.418	.113			
		.008	.22	.425	.101			
WF-C1e	1.5-1.9	.0085	.24	.54	.088	.098	98.05	
		.0115	.36	.673	.108			
Distilled water blank		.004	.05					
Std. solution containing 0.2 µg/L Hg		.007	.17					85.0
Std. solution containing 0.5 µg/L Hg		.014	.47					94.0
Std. solution containing 1.0 µg/L Hg		.023	.85					85.0
Std. solution containing 2.0 µg/L Hg		.05	2					100

Standard curve:

$y = (x - 0.002931319)/0.02350275$

where y = concentration of Hg, x = absorbance

$r^2 = 0.996$

Appendix 2d. Raw data, calculations, and statistical summary for mercury concentrations in a soil core and soil samples collected from Wharton State Forest, New Jersey--Continued

Sample number/solution description	Soil-sample depth (ft)	Absor-bance	Raw concen-tration (µg/L)	Sediment mass (g)	C*V/m (µg/g)	Mean concen-tration (µg/g)	Concen-tration (µg/kg)	Percent recovery
Std. solution containing 0.2 µg/L Hg		.005	.19					95.90
Std. solution containing 0.5 µg/L Hg		.013	.48					96.07
Std. solution containing 1.0 µg/L Hg		.027	.99					98.52
Std. solution containing 2.0 µg/L Hg		.055	2.01					100.66
Distilled water blank		0	.03					
WF-2d	.75-1.0	.013	.48	.443	.108	.118	118.06	
WF-2d	.75-1.0	.014	.52	.4045	.128			
WF-2b	.08-.25	.01	.39	.910	.043	.050	50.20	
WF-2b	.08-.25	.013	.48	.835	.058			
WF-2a	0-.08	.012	.44	.8234	.054	.127	127.07	
WF-2a	0-.08	.033	1.2	.6096	.197			
WF-2a	0-.08	.008	.32	.2444	.130			
WF-2c	.25-.75	.006	.25	.5415	.045	.064	63.78	
WF-2c	.25-.75	.008	.30	.5253	.057			
WF-2c	.25-.75	.01	.39	.4393	.089			
Std. solution containing 0.5 µg/L Hg		.014	.53					106.89
Std. solution containing 2.0 µg/L Hg		.058	2.12					106.07

Standard curve:

$y = (x + 0.0008181818)/0.02772727$

where y = concentration of Hg, x = absorbence

$r^2 = 0.9993$

Appendix 2e. Raw data, calculations, and statistical summary for mercury concentrations in soil and aquifer sediment cores from Hammonton and Franklin Townships, New Jersey

[Abs., absorbance; conc., concentration; g, grams; C*V/m, concentration (µg/L)* volume (L) mass (g), where V = 0.1L for all analyses; µg/g, micrograms per gram; µg/kg, micrograms per kilogram; std. dev., standard deviation]

Sample number	Abs.	Raw conc. (µg/L)	Sediment mass (g)	C*V/m (µg/g)	Mean conc. µg/g	Conc. µg/kg	Std. dev.
MW5-1	0.011	0.39	3.039	0.013			
	.019	.68	4.559	.015			
	.008	.28	1.146	.025	0.017	17.38	0.006
MW5-2	.007	.24	3.285	.007			
	.007	.24	3.15	.008			
	.006	.21	1.92	.011	.009	8.71	.002
MW5-3	.01	.35	1.72	.021			
	.009	.32	1.744	.018			
	.009	.32	3.15	.010	.016	16.25	.005
MW5-4	.053	1.90	1.792	.106			
	.048	1.72	1.521	.113			
	.057	2.04	1.933	.106	.108	108.19	.004
MW5-5	.016	.57	2.776	.020			
	.013	.46	1.771	.026			
	.01	.35	1.389	.025	.024	23.96	.003
MW5-6	.011	.39	3.334	.012			
	.0065	.23	1.824	.012			
	.007	.24	1.58	.016	.013	13.20	.002
MW5-7	.012	.42	4.606	.009			
	.012	.42	1.446	.029			
	.0075	.26	1.88	.014	.018	17.53	.011
MW5-8	.009	.32	1.668	.019			
	.009	.32	1.979	.016			
	.008	.28	1.314	.021	.019	18.80	.003
MW5-9	.008	.28	2.253	.012			
	.007	.24	2.331	.011			
	.044	1.57	2.705	.058	.027	27.07	.027
MW5-10(clay)	.127	4.56	4.272	.107			
	.017	0.60	2.795	.022			
	.02	.71	2.885	.025	.051	51.00	.048
Franklin							
1	.036	1.29	2.756	.047			
	.023	.82	1.482	.055	.031	31.08	.022
2	.038	1.36	3.623	.038			
	.021	.75	1.556	.048	.032	32.17	.008
3	.012	.42	1.282	.033			
	.013	.46	1.146	.040	.038	37.89	.007
4	.012	.42	2.085	.020			
	.013	.46	1.717	.027	.019	19.02	.002
5	.014	.50	3.699	.013			
	.008	.28	1.59	.018	.034	34.38	.030
6	.023	.82	1.994	.041			
	.023	.82	1.923	.043	.039	38.81	.003
6A	.014	.50	1.961	.025			
	.011	.39	1.566	.025	.025	25.01	0
7	.007	.24	1.522	.016			
	.008	.28	1.457	.019	.020	20.46	.006
8	.01	.35	2.1	.017			
	.008	.28	2.112	.013	.018	18.04	.002
9	.012	.42	1.787	.024			
	.013	.46	1.262	.037	.036	35.92	.017
10	.007	.24	2.282	.011			
	.007	.24	1.585	.015	.012	12.02	.002

Appendix 2f. Raw data, calculations, and statistical summary of mercury concentrations in soil samples collected at sites associated with elevated mercury concentrations in ground water, New Jersey Coastal Plain

[µg/L, micrograms per liter; Hg, mercury; g, grams; µg/g, micrograms per gram (equivalent to parts per million); µg/kg, micrograms per kilogram (equivalent to parts per billion); L, liters; NIST SRM, National Institute of Standards and Technology reference material; ft, feet; C*V/m = concentration (µg/L)*volume(L)/mass(g), where V = 0.1L for all analyses; std., standard; dashed line separates calibration and quality-control samples from soil samples]

Sample number/description	Soil-sample depth (ft)	Absorbance	Raw concentration (µg/L)	Sediment mass (g)	C*V/m (µg/g)	Mean concentration (µg/g)	Concentration (µg/kg)	Percent recovery
Distilled water blank		0.002	0.00					
Std. solution containing 0.1 µg/L Hg		.005	.09					93.83
Std. solution containing 0.5 µg/L Hg		.017	.55					110.62
Std. solution containing 1.0 µg/L Hg		.028	.97					97.41
Std. solution containing 5.0 µg/L Hg		.131	4.99					99.89
Standard a 5.0 µg/L Hg		.126	4.80					97.60
Standard b 5.0 µg/L Hg		.131	5.07					101.40
3-4b	0.1-0.2	.005	.09	2.798	.003	.002	2.16	
3-4b	0.1-0.3	.003	.02	1.8	.001			
3-4c	0.2-0.45	.016	.51	1.726	.030	.030	29.71	
3-4c	0.2-0.46	.012	.36	1.222	.030			
3-4a	0-0.1	.007	.17	1.055	.016	.009	8.81	
3-4a	0-0.1	.003	.02	1.182	.001			
3-4d	0.45-.6	.003	.02	1.898	.001	.003	3.23	
3-4d	0.45-.6	.004	.06	1.001	.006			
3-4e	0.6-1.0	.007	.17	1.21	.014	.022	22	
4-1a	0-1.0	.011	.32	1.34	.024			
4-1b	1.0-1.5	.014	.44	1.9	.023	.025	25.22	
4-1b	1.0-1.5	.017	.55	2.021	.027			
2-3a	0-0.9	.006	.13	1.192	.011	.012	11.72	
2-3a	0-0.9	.007	.17	1.379	.012			
4-6a	0-1.0	.004	.06	1.077	.005	.005	5.19	
4-6a	0-1.0	.004	.06	.066	.005			
Std. solution containing 0.1 µg/L Hg		.006	.11					110.0
Std. solution containing 0.5 µg/L Hg		.016	.51					102.0
Std. solution containing 1.0 µg/L Hg		.027	.94					94.0
2-11a	0-0.1	.01	.29	2.625	.011	.010	9.85	
2-11a	0-0.1	.007	.17	1.927	.009			
2-1c	.35-.45	.004	.06	1.155	.005	.012	12.36	
2-1c	.35-.45	.013	.40	2.009	.020			
1-3a	0-0.2	.065	2.44	2.413	.101	.099	99.42	
1-3a	0-0.2	.078	2.94	3.007	.098			
1-4a	0-0.2	.01	.29	3.659	.008	.008	8.29	
1-4a	0-0.2	.011	.32	3.682	.009			
1-5b	1.5-2.5	.004	.06	1.56	.004	.004	4.48	
1-5b	1.5-2.5	.005	.09	1.737	.005			
1-5a	0-1.5	.005	.09	1.816	.005	.006	5.83	
1-5a	0-1.5	.007	.17	2.622	.006			
2-12a	0-0.3	.031	1.12	1.049	.107	.106	105.76	
2-12a	0-0.3	.03	1.08	1.033	.105			
2-12b	0.3-0.7	.004	.06	1.549	.004	.004	4.01	
2-12b	0.3-0.7	.004	.06	1.255	.004			
1-2a	0-0.4	.006	.13	1.359	.010	.009	9.28	
1-2a	0-0.4	.006	.13	1.493	.009			
1-2b	0.4-1.5	.005	.09	1.464	.006	.008	7.97	
1-2b	0.4-1.5	.009	.25	2.589	.010			
NIST SRM 8406		.017	.55	.82	.067	.066	65.85	
NIST SRM 8406		.025	.86	1.351	.064			
NIST SRM 8406		.021	.71	1.062	.066			
Distilled water blank		.002	0					
Std. solution containing 0.1 µg/L Hg		.005	.07					70.0
Std. solution containing 0.5 µg/L Hg		.017	.55					110.0
Std. solution containing 1.0 µg/L Hg		.029	1.04					104.0
Std. solution containing 5.0 µg/L Hg		.133	5.07					101.4

Standard curve: $y = (x - 0.00254838)/0.02612903$ for 0.1 - 1.0 µg/kg
where y = concentration of Hg, x = absorbance

Appendix 2f. Raw data, calculations, and statistical summary of mercury concentrations in soil samples collected at sites associated with elevated mercury concentrations in ground water, New Jersey Coastal Plain—Continued

Sample number/description	Soil-sample depth (ft)	Absorbance	Raw concentration (µg/L)	Sediment mass (g)	C*V/m (µg/g)	Mean concentration (µg/g)	Concentration (µg/kg)	Percent recovery
Std. solution containing 0.1 µg/L Hg		0.003	0.09					90.0
Std. solution containing 0.2 µg/L Hg		.006	.21					105.0
Std. solution containing 0.5 µg/L Hg		.014	.50					100.0
Std. solution containing 1 µg/L Hg		.028	1.02					102.0
Std. solution containing 2 µg/L Hg		.048	1.78					89.0
Std. solution containing 5 µg/L Hg		.132	4.90					98.0
Std. solution containing 10 µg/L Hg		.246	9.13					91.3
Distilled blank		0	0					
NIST STM 8406		.014	.50	.818	.061	.061	60.64	
NIST STM 8406		.015	.57	.909	.062			
NIST STM 8406		.013	.49	.835	.058			
NIST STM 8407		.033	1.23	.296	45.564	46.488	46487.78	
NIST STM 8407		.048	1.78	.438	44.778			
NIST STM 8407		.028	1.04	.233	49.121			
4-6b	1-1.5	.007	.26	1.283	.020	.021	20.71	
4-6b	1-1.5	.012	.45	2.035	.022			
4-6b	1-1.5	.006	.22	1.126	.020			
2-11c	0.35-0.7	.008	.30	1.115	.027	.025	25.10	
2-11c	0.35-0.7	.008	.30	1.185	.025			
2-11c	0.35-0.7	.008	.30	1.271	.023			
2-11d	0.7-1	.016	.59	1.115	.053	.034	34.37	
2-11d	0.7-1	.008	.30	1.075	.028			
2-11d	0.7-1	.007	.26	1.184	.022			
Std. solution containing 0.5 µg/L Hg		.014	.52					104.0
Std. solution containing 1 µg/L Hg		.029	1.08					108.0
Std. solution containing 10 µg/L Hg		.253	9.39					93.9
2-11b	0.1-0.35	.004	.15	1.252	.012	.013	12.70	
2-11b	0.1-0.35	.004	.15	1.18	.013			
2-11b	0.1-0.35	.004	.15	1.106	.014			
2-3b	0.9-1.5	.012	.45	1.239	.036	.035	35.29	
2-3b	0.9-1.5	.01	.37	1.089	.034			
2-3b	0.9-1.5	.014	.50	1.408	.036			
2-12c	0.7-2	.024	.87	1.348	.065	.070	70.22	
2-12c	0.7-2	.019	.71	1.092	.065			
2-12c	0.7-2	.023	.84	1.03	.081			
2-1b	.25-.35	.005	.19	1.66	.011	.012	12.01	
2-1b	.25-.35	.005	.19	1.494	.012			
2-1b	.25-.35	.005	.19	1.518	.012		20.79	
2-1a	0-.25	.011	.41	1.979	.021	.021		
2-1a	0-.25	.007	.26	1.37	.019			
2-1a	0-.25	.007	.26	1.152	.023			
Std. solution containing 0.2 µg/L Hg		.006	.22					110.0
Std. solution containing 0.5 µg/L Hg		.015	.54					108.0
Std. solution containing 5 µg/L Hg		.139	5.16					103.2

Standard curve: $y = (x + 2.542963 \times 10^{-5})/0.02426614)$
where y = concentration of Hg, x = absorbance

Appendix 2f. Raw data, calculations, and statistical summary of mercury concentrations in soil samples collected at sites associated with elevated mercury concentrations in ground water, New Jersey Coastal Plain--Continued

Sample number/description	Soil-sample depth (ft)	Absor-bance	Raw concen-tration (µg/L)	Sediment mass (g)	C*V/m (µg/g)	Mean concen-tration (µg/g)	Concen-tration (µg/kg)	Percent recovery
Distilled water blank		0	0.002					103.5
Std. solution containing 0.2 µg/L Hg		.006	.207					97.0
Std. solution containing 0.5 µg/L Hg		.013	.485					100.6
Std. solution containing 1.0 µg/L Hg		.027	1.006					98.6
Std. solution containing 2.0 µg/L Hg		.055	1.972					100.32
Std. solution containing 5.0 µg/L Hg		.141	5.016					
8-3e	1.0-1.2	0	.002	.2083	0			
8-3e	1.0-1.2	0	.002	.2682	0			
8-3e	1.0-1.2	0	.002	.2826	0			
8-3f	1.2-3.0	0	.002	.2018	0			
8-3f	1.2-3.0	0	.002	.2106	0			
8-3f	1.2-3.0	0	.002	.2043	0			
8-3b	0.4-0.6	0	.002	.2049	0			
8-3b	0.4-0.6	0	.002	.2165	0			
8-3b	0.4-0.6	0	.002	.3115	0			
8-3d	0.9-1.0	lost		.2497				
8-3d	0.9-1.0	0.002	.076	.2112	.07			
8-3d	0.9-1.0	0	.002	.2028	0			
8-3a	0-0.4	0	.002	.2548	0			
8-3a	0-0.4	0	.002	.2532	0			
8-3a	0-0.4	0	.002	.2172	0			
Std. solution containing 1.0 µg/L Hg		.029	1.080					108.0
8-3c	0.6-0.9	0	.002	.2709	0			
8-3c	0.6-0.9	0	.002	.308	0			
8-3c	0.6-0.9	0	.002	.2035	0			
8-2a	0-0.3	0	.002	.2029	0			
8-2a	0-0.3	0	.002	.2143	0			
8-2a	0-0.3	0	.002	.2089	0			
8-1a	0-0.05	0	.002	.2459	0			
8-1a	0-0.05	0	.002	.2102	0			
8-1a	0-0.05	0	.002	.2144	0			
8-2c	1.0-1.5	0	.002	.2809	0			
8-2c	1.0-1.5	0	.002	.2317	0			
8-2c	1.0-1.5	0	.002	.2073	0			
8-1b	0.05-1.0	0	.002	.413	0			
8-1b	0.05-1.0	0	.002	.2196	0			
8-1b	0.05-1.0	0	.002	.2343	0			
8-1c	1.0-1.5	0	.002	.2185	0			
8-1c	1.0-1.5	0	.002	.2081	0			
8-1c	1.0-1.5	0	.002	.2916	0			
8-2b	0.3-1.0	0	.002	.2188	0			
8-2b	0.3-1.0	0	.002	.212	0			
8-2b	0.3-1.0	0	.002	.2073	0			
Aldrich standard, 2.0 µg/L Hg		.055	1.972					98.6
Distilled water blank		0	.002					
Std. solution containing 0.5 µg/L Hg		.013	.485					97.0
Std. solution containing 1.0 µg/L Hg		.025	.932					93.2

Standard curve: $y = (x + 0.0007212164)/0.02825601$
where y = concentration of Hg, x = absorbance
$r^2 = 0.999$

Appendix 2f. Raw data, calculations, and statistical summary of mercury concentrations in soil samples collected at sites associated with elevated mercury concentrations in ground water, New Jersey Coastal Plain—Continued

Sample number/description	Soil-sample depth (ft)	Absor-bance	Raw concen-tration (µg/L)	Sediment mass (g)	C*V/m (µg/g)	Mean concen-tration (µg/g)	Concen-tration (µg/kg)	Percent recovery
Distilled water blank		0.003	0.053					
Std. solution containing 0.2 µg/L Hg		.007	.178					89.21
Std. solution containing 1.0 µg/L Hg		.032	.965					96.52
Std. solution containing 2.0 µg/L Hg		.066	2.035					101.76
NIST STM 8406		.02	.588	1.012	0.058	0.058	58.34	
NIST STM 8406		.022	.651	1.114	.058			
NIST STM 8406		.024	.713	1.218	.059			
4-7a	0-1.0	.005	.115	.998	.012	.012	12.21	
4-7a	0-1.0	.0055	.131	1.115	.012			
4-7a	0-1.0	.007	.178	1.342	.013			
4-7b	1.0-1.5	.01	.273	1.264	.022	.021	20.80	
4-7b	1.0-1.5	.009	.241	1.133	.021			
4-7b	1.0-1.5	.012	.336	1.721	.020			
Aldrich standard 0.5 µg/L Hg		.017	.493					98.63
Std. solution containing 0.2 µg/L Hg		.008	.210					104.95
Std. solution containing 1.0 µg/L Hg		.034	1.028					102.82

Standard curve: $y = (x - 0.001330645)/0.03177419$,
where y = concentration of Hg, x = absorbance
$r^2 = 0.9964$

Appendix 2f. Raw data, calculations, and statistical summary of mercury concentrations in soil samples collected at sites associated with elevated mercury concentrations in ground water, New Jersey Coastal Plain—Continued

Sample number/description	Soil-sample depth (ft)	Absor-bance	Raw concen-tration (µg/L)	Sediment mass (g)	C*V/m (µg/g)	Mean concen-tration (µg/g)	Concen-tration (µg/kg)	Percent recovery
Std. solution containing 0.2 µg/L Hg		0.005	0.19					95.90
Std. solution containing 0.5 µg/L Hg		.013	.48					96.07
Std. solution containing 1.0 µg/L Hg		.027	.99					98.52
Std. solution containing 2.0 µg/L Hg		.055	2.01					100.66
Distilled water blank		0	4.03					
Std. solution containing 0.5 µg/L Hg		.014	.53					106.89
Std. solution containing 2.0 µg/L Hg		.058	2.12					106.07
10-1d	0.85-1.18	.008	.32	.223	.143	.116	116.01	
10-1d	.85-1.18	.025	.91	.948	.096			
10-1d	.85-1.18	.015	.57	.523	.109			
10-1c	.45-.85	.033	1.22	1.126	.108	.121	121.43	
10-1c	.45-.85	.024	.90	.773	.116			
10-1c	.45-.85	.015	.57	.407	.140			
10-1b	.25-.45	.026	.97	.35	.276	.223	223.20	
10-1b	.25-.45	.076	2.77	1.501	.185			
10-1b	.25-.45	.074	2.70	1.293	.209			
Std. solution containing 1.0 µg/L Hg		.029	1.08					107.54

Standard curve: $y = (x - 0.0008181818)/0.02772727$,
where y = concentration of Hg, x = absorbance
$r^2 = 0.9993$

Appendix 2g. Raw data for mercury concentrations in ground-water samples from sites 1 and 4

[µg/L, micrograms per liter; DUP, duplicate; SP, spike; Hg, mercury; sample numbers correspond to well-site numbers in data base, appendix 1a; std., standard; dashed line separates calibration and quality-control samples from ground-water samples]

Sample number/name	Absorbance	Hg concentration (µg/L)	Percent recovery
Solution containing 0.1 µg/L Hg	0.0025	0.10	97.20
Solution containing 0.2 µg/L Hg	.0055	.22	109.36
Solution containing 1 µg/L Hg	.0275	1.11	111.00
Solution containing 2 µg/L Hg	.0505	2.04	102.09
Solution containing 5 µg/L Hg	.126	5.10	102.01
Solution containing 10 µg/L Hg	.278	11.26	112.58
Solution containing 25 µg/L Hg	.611	24.75	98.99
BLANK	.0005	.02	
1037	.003	.12	
1037DUP	.003	.12	
1050	.092	3.72	
1084	.11	4.45	
1114	.006	.24	
1117	.032	1.29	
4001	.308	12.47	
4001SP*	.329	13.32	98.32
4047	.278	11.26	
4048	.084	3.40	
4050	.003	.12	

* SP = 1 mL of 100 µg/L plus 100 mL sample

Appendix 2h. Raw data for mercury concentrations in ground-water samples from site 10

[µg/L, micrograms per liter; DUP, duplicate; SP, spike; Hg, mercury; std, standard; dashed lines separate calibration and quality-control samples from ground-water samples]

Sample number/description	Absorbance	Hg concentration (µg/L)	Percent recovery
Distilled water blank	0.0035	-0.009	
Std. solution containing 0.1 µg/L Hg	.006	.1112	111.90
Std. solution containing 0.2 µg/L Hg	.009	.257	128.71
Std. solution containing 0.5 µg/L Hg	.014	.500	99.99
Std. solution containing 1 µg/L Hg	.024	.985	98.50
Std. solution containing .2 µg/L Hg	.045	2.004	100.18
10031	.01	.306	
10019	.007	.160	
10029	.008	.209	
10029SP*	.021	.839	90.20
10012	.056	2.537	
10012DUP	.05	2.246	
0.75 µg/L Aldrich Std.	.02	.791	105.46
10011	.0065	.136	
10001	.388	18.641	
10002	.429	20.630	
10014	.013	.451	
10003	.004	.015	
10004	.01	.306	
10022	.003	-.034	
10023	.003	-.034	
Std. solution containing 0.2 µg/L Hg (reslope)	.008	.209	104.46
Std. solution containing 0.5 µg/L Hg (reslope)	.015	.548	109.69
Std. solution containing 1 µg/L Hg (reslope)	.025	1.034	103.35

Duplicate samples	Concentration (µg/L)	Mean concentration (µg/L)	Relative percent difference
10012	2.537	2.3915	12.17
10012DUP	2.246		

* SP = 1 mL of 100 µg/L plus 100 mL sample

Standard curve: $y = (x - 0.003692972)/0.02061636$,
where y = concentration of Hg, x = absorbance

Table 2i. Raw data for mercury concentrations in ground-water samples from Atlantic City Municipal Authority public supply wells and U.S. Geological Survey and State of New Jersey observation wells*

[µg/L, micrograms per liter; Hg, mercury; <, less than; Std., standard; dashed lines separate calibration and quality-control samples from ground-water samples]

Sample name/description	Absorbance	Raw Hg concentration (µg/L)	Percent recovery	Reported Hg concentration (µg/L)
Solution containing 0.1 µg/L Hg	0.0025	0.07	74.19	
Solution containing .2 µg/L Hg	.0055	.19	96.37	
Solution containing 1 µg/L Hg	.0275	1.06	106.21	
Solution containing 2 µg/L Hg	.0505	1.97	98.55	
Blank	.0005	-0.00		<0.2
ACMUA21	.001	.01		<.2
ACUMA19	0	-.02		<.2
ACMUA20	.003	.09		<.2
GSP#2	.001	.01		<.2
GSP#1	0	-.02		<.2
ACMUA23	.007	.25		.3
ACMUA20DUP	.0035	.11		<.2
Aldrich Std 2.0 µg/L Hg	.0498	1.94	97.17	
Aldrich Std 0.5 µg/L Hg	.013	.49	97.82	

Standard curve: $y = (x - 0.0006224490)/0.02530612$,
where y = concentration of Hg, x = absorbance
$r^2 = 0.9977$, $r = 0.9988$

Blank	.003	0	
Solution containing 0.2 µg/L Hg	.007	.17	85.0
Solution containing 0.5 µg/L Hg	.009	.26	52.0
Solution containing 1.0 µg/L Hg	.034	1.32	132.0
Solution containing 2.0 µg/L Hg	.05	2.00	100.0
Mullica 1D	.0035	.03	<.2
Mullica 50S	.005	.09	<.2
Mullica 50S DUP	.006	.13	<.2
Blank	.004	.05	
Solution containing 0.2 µg/L Hg	.007	.17	85.0
Solution contining 0.5 µg/L Hg	.014	.47	94.0
Solution contining 1.0 µg/L Hg	.023	.85	85.0
Solution contining 2.0 µg/L Hg	.05	2.00	100.0

Standard curve: $y = (x - 0.002931319)/0.02350275$,
where y = concentration of Hg, x = absorbance
$r^2 = 0.996$

* New Jersey unique well numbers for ACMUA 19, 20, 21, 23 are 010781, 010782, 010783, and 010785, respectively. Unique well numbers for Garden State Parkway 1 and 2 (GSP#1 and GSP#2) are 290513 and 290514, respectively. Unique well numbers for Mullica 1D and 50S are 070451 and 070452, respectively.

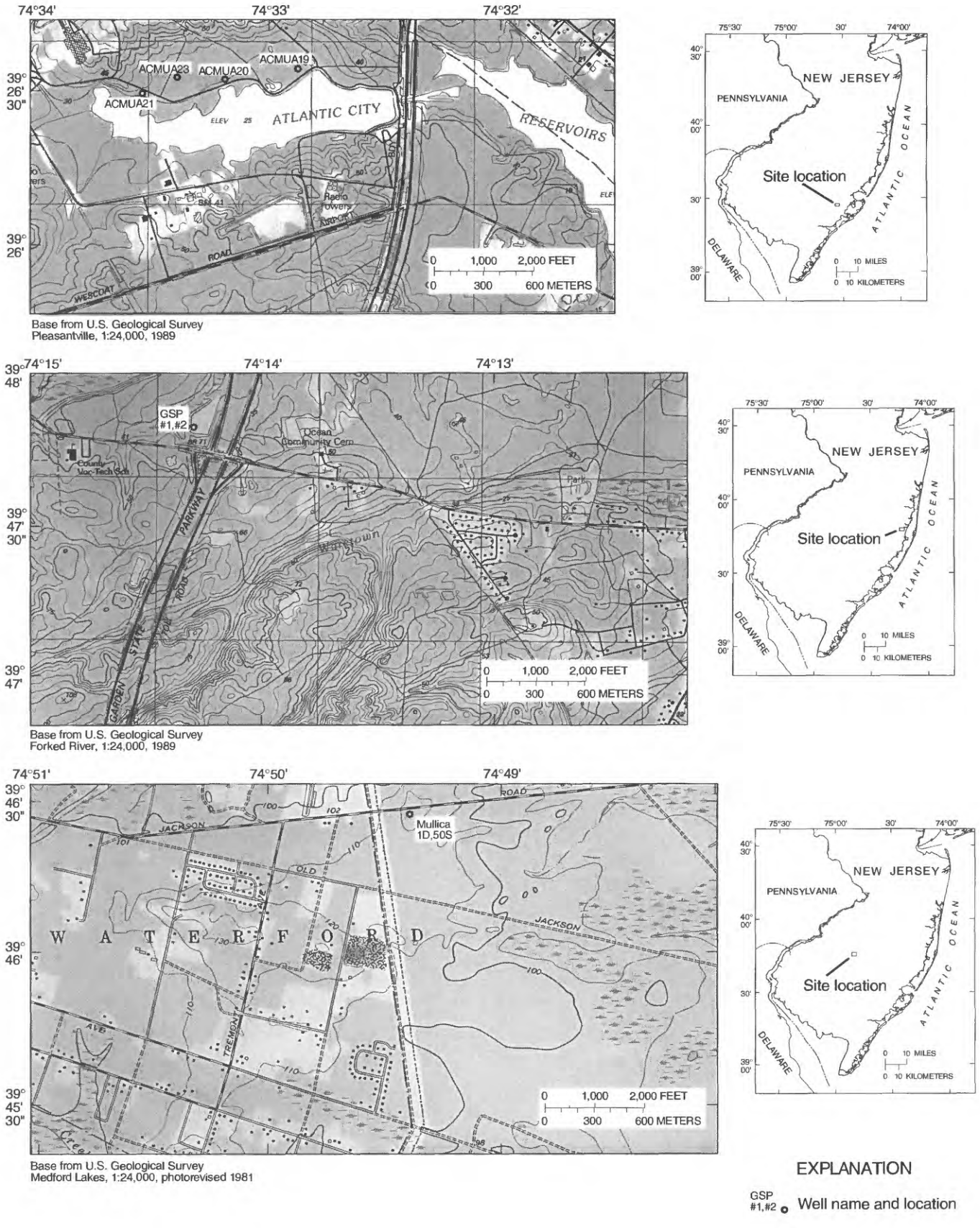


Figure 2i. Locations of Atlantic City Municipal Authority public supply wells and U.S. Geological Survey and State Of New Jersey observation wells.

Appendix 2j. Raw data for percent moisture, loss on ignition, and organic matter for soil samples collected at sites associated with elevated concentrations of mercury in ground water

[ft, feet; g, grams; mg, milligrams; sed, sediment; LOI, loss on ignition; corr, corrected; %, percent; OM, organic matter; dashed lines separate calibration data from soil-sample

Sample number/ description	Depth (ft)	Pan mass (g)	Wet pan+sed (g))	Dry pan+sed (g)	Sed mass (wet) (g)	Sed mass (dry)	Blank corr sed mass (dry) (g)	% moisture	Ash pan+sed (g)	Sed mass ash (g)	LOI (g)	LOI blank (g)	% LOI	OM (mg/g soil)
Blank	0-0.3	0.6431		0.6431					0.6212	-0.0219	0.0219	0.0000	0.00	
8-2a	0-0.3	.6513	2.2472	2.2077	1.5959	1.5564	1.5564	2.4751	2.1676	1.5163	.0401	.0182	1.17	11.69
8-3c	0.6-9	.6505	2.2698	2.1459	1.6193	1.4954	1.4954	7.6515	2.0856	1.4351	.0603	.0384	2.57	25.68
8-3a	0-0.4	.6462	2.6331	2.4307	1.9869	1.7845	1.7845	10.1867	2.3615	1.7153	.0692	.0473	2.65	26.51
8-3d	0.9-1.0	.6506	2.4923	2.1843	1.8417	1.5337	1.5337	16.7237	1.9028	1.2522	.2815	.2596	16.93	169.26
8-3b	0.4-0.6	.6500	2.5898	2.3654	1.9398	1.7154	1.7154	11.5682	2.4037	1.7537	-.0383	-.0602	-3.51	-35.09
8-3e	1.0-1.2	.6435	2.7472	2.6750	2.1037	2.0315	2.0315	3.4320	2.6293	1.9858	.0457	.0238	1.17	11.72
8-3f	1.2-3	.6499	2.5065	2.3509	1.8566	1.7010	1.7010	8.3809	2.2895	1.6396	.0614	.0395	2.32	23.22
8-1b	0.05-1.0	.6452	2.6647	2.4859	2.0195	1.8407	1.8407	8.8537	2.4345	1.7893	.0514	.0295	1.60	16.03
8-1c	1.0-1.5	.6482	2.7160	2.4812	2.0678	1.8330	1.8330	11.3551	2.4038	1.7556	.0774	.0555	3.03	30.28
8-2b	0.3-1.0	.6509	3.0927	2.9386	2.4418	2.2877	2.2877	6.3109	2.9012	2.2503	.0374	.0155	.68	6.78
8-2c	1.0-1.5	.6471	2.5669	2.4397	1.9198	1.7926	1.7926	6.6257	2.4024	1.7553	.0373	.0154	.86	8.59
8-1a	0-0.05	.6480	2.3319	2.3186	1.6839	1.6706	1.6706	0.7898	2.2803	1.6323	.0383	.0164	.98	9.82
8-2a	0-0.3	.6464	3.1381	3.0999	2.4917	2.4535	2.4535	2.5331	3.0481	2.4017	.0518	.0299	1.22	12.19
Blank		1.5979		1.5978		-0.0001	0		1.5978					
4-7b	1[1]-1.5	1.5948	7.2552	6.8765	5.6604	5.2817	5.2816	6.6921	6.8161	5.2213	.0604	.0604	1.14	11.44
3-4e	0.6-1.0	1.5452	9.5193	9.0628	7.9741	7.5176	7.5175	5.7260	8.9593	7.4141	.1035	.1035	1.38	13.77
1-1b	1.5-2.5	1.5579	6.6993	6.6321	5.1414	5.0742	5.0741	1.3090	6.6131	5.0552	.0190	.0190	.37	3.74
1-1a	0-1.2	1.5834	7.1471	7.0069	5.5637	5.4235	5.4234	2.5217	6.9693	5.3859	.0376	.0376	.69	6.93
3-4a	0-0.1	1.5535	9.5833	9.5638	8.0298	8.0103	8.0102	0.2441	9.4549	7.9014	.1089	.1089	1.36	13.59
4-1a	0-1.0	1.6216	6.0471	5.8922	4.4255	4.2706	4.2705	3.5024	5.8342	4.2126	.0580	.0580	1.36	13.58
1-4a	0-0.2	1.4998	15.0370	13.0838	13.5372	11.5840	11.5839	14.4291	12.9695	11.4697	.1143	.1143	.99	9.87
10-1b	0.25-0.45	1.6059	8.0553	7.6235	6.4494	6.0176	6.0175	6.6967	7.4483	5.8424	.1752	.1752	2.91	29.11
1-2a	0-0.4	1.5794	8.9279	8.3355	7.3485	6.7561	6.7560	8.0629	8.1457	6.5663	.1898	.1898	2.81	28.09
Blank		1.4836		1.4835		-.0001	0		1.4830	-.0006	.0005	0	0	
1-2b	0.4-1.5	1.6110	10.4327	10.1421	8.8217	8.5311	8.5310	3.2953	10.0871	8.4761	.0550	.0545	.64	6.39
3-4b	0.1-0.2	1.5001	11.1534	11.0085	9.6533	9.5084	9.5083	1.5021	10.9271	9.4270	.0814	.0809	.85	8.51
3-4c	0.2-0.45	1.6210	8.7405	8.2995	7.1195	6.6785	6.6784	6.1957	8.1786	6.5576	.1209	.1204	1.80	18.03
10-1d	0.85-1.18	1.5557	8.4310	7.7025	6.8753	6.1468	6.1467	10.5974	7.5617	6.0060	.1408	.1403	2.28	22.82
1-5a	0-1.5	1.4962	9.4944	9.2833	7.9982	7.7871	7.7870	2.6406	9.2401	7.7439	.0432	.0427	.55	5.48
4-1b	1-1.5	1.5847	11.3998	10.9645	9.8151	9.3798	9.3797	4.4360	10.8547	9.2700	.1098	.1093	1.17	11.65
10-1c	0.45-0.85	1.5986	9.2051	8.3983	7.6065	6.7997	6.7996	10.6080	8.2290	6.6304	.1693	.1688	2.48	24.82
3-4d	0.45-0.6	1.4790	10.9726	10.9463	9.4936	9.4673	9.4672	.2781	10.8970	9.4180	.0493	.0488	.52	5.15
10-1a	0-0.25	1.5983	9.6812	8.7655	8.0829	7.1672	7.1671	11.3301	8.4903	6.8920	.2752	.2747	3.83	38.33
1-3a	0-0.2	1.5835	16.8873	13.7691	15.3038	12.1856	12.1855	20.3760	13.7228	12.1393	.0463	.0458	.38	3.76
Blank		.6431		.6431					.6212	-.0219	.0219	0	0	
8-2aDUP	0-0.3	.6513	2.2472	2.2077	1.5959	1.5564	1.5564	2.48	2.1676	1.5163	.0401	.0182	1.17	11.6937

Appendix 2j. Raw data for percent moisture, loss on ignition, and organic matter for soil samples collected at sites associated with elevated concentrations of mercury in ground water--Continued

Sample number/ description	Depth (ft)	Pan mass (g)	Wet pan+sed (g))	Dry pan+sed (g)	Sed mass (wet) (g)	Sed mass (dry)	Blank corr sed mass (dry) (g)	% moisture	Ash pan+sed (g)	Sed mass ash (g)	LOI (g)	LOI blank (g)	% LOI	OM (mg/g soil)
Blank		1.5979		1.5978		-.0001	0		1.5978	-.0001	0			
4-7a	0.1-1.0	1.5700	5.3200	5.2255	3.7500	3.6555	3.6554	2.52	5.2004	3.6304	.0251	.0251	.69	6.8664
3-4e	0.6-1.0	1.5452	9.5193	9.0628	7.9741	7.5176	7.5175	5.73	8.9593	7.4141	.1035	.1035	1.38	13.7677
Blank		1.5753		1.5748		-.0005			1.5746	-.0007	.0007	0	0	
2-11a	0-0.1	1.5033	4.1369	3.9312	2.6336	2.4279	2.4274	7.81	3.8825	2.3792	.0487	.0480	1.98	19.77
2-11b	0.1-0.35	1.5340	4.1534	3.9147	2.6194	2.3807	2.3802	9.11	3.8695	2.3355	.0452	.0445	1.87	18.69
2-11c	0.35-0.7	1.5613	4.2853	4.0265	2.7240	2.4652	2.4647	9.50	3.9459	2.3846	.0806	.0799	3.24	32.41
2-11d	0.7-1.0	1.4800	4.1721	3.9356	2.6921	2.4556	2.4551	8.78	3.8529	2.3729	.0827	.0820	3.34	33.39

Analyte: MPHG
Analyst:
Instrument id: TJA22

Date analyzed: 920403
Date calculated: Mon Apr 06, 1992 08:56:30 pm
Matrix: H20

STANDARD CONCENTRATION ppb	ABSORBANCE	CALCULATED ppb	% DIFFERENCE
	Instrument Calibration		
0.000	-.002	-.120	******
1.000	.052	.960	4.00
1.000	.058	1.080	-8.00
2.000	.108	2.080	-4.00
2.000	.110	2.120	-6.00
4.000	.205	4.020	-.50
6.000	.290	5.720	4.67
8.000	.410	8.120	-1.50
10.000	.507	10.060	-.60
10.000	.502	9.960	.40
	Rejected Calibration Data		
4.000	.249		
6.000	.325		
8.000	.424		

Readings above .5271 are off scale

Equation of the Line
Intercept = .004000 Slope = .050000
Correlation coefficient (R^2) = .99893

Figure 2k. Representative raw data from mercury analyses performed by a New Jersey laboratory.

Analyte: MPHG
Analyst:
Instrument id: TJA22

Date analyzed: 920403
Date calculated: Mon Apr 06, 1992 08:56:30 pm
Matrix: H20

UP LOAD ABLE	SAMPLE KEY	ABSORBANCE	DILUTION	RESULT ppb	FIELD SAMPLE RESULT	QC CODE
F	BLK	.021	1.0	.340		
F	C	.090	1.0	1.72		
F	D	.366	1.0	7.24		
F	65956	.035	1.0	.620		
F	+4	.263	1.0	5.18		
F	+4	.239	1.0	4.70		
F	RGTBLK	.003	1.0	-.020		
T	9201213	.001	1.0	-.060	.200	K
T	9201214	.018	1.0	.280	.280	
T	9201215	.030	1.0	.520	.520	
T	9201216	.148	1.0	2.88	2.88	
T	9201217	0.000	1.0	-.080	.200	K
T	9201218	.012	1.0	.160	.200	K
T	9201219	.002	1.0	-.040	.200	K
T	9201220	.089	1.0	1.70	1.70	
T	9201221	0.000	1.0	-.080	.200	K
T	9201222	0.000	1.0	-.080	.200	K
T	9201223	0.000	1.0	-.080	.200	K
T	9201224	0.000	1.0	-.080	.200	K
T	9201225	0.000	1.0	-.080	.200	K
T	9201226	0.000	1.0	-.080	.200	K
T	9201227	0.000	1.0	-.080	.200	K
T	9201228	0.000	1.0	-.080	.200	K
F	9201588	.033	1.0	.580		
F	BLK	.007	1.0	.060		
F	C	.078	1.0	1.48		
F	D	.345	1.0	6.82		
F	BLK	0.000	1.0	-.080		
F	C	.090	1.0	1.72		
F	D	.345	1.0	6.82		

Data file: /METALS/ABS/MPHGApr060856.TXT : : : 3 : : 44
Data verified by
Mapper file: /METALS/ABS/MPHGApr060856.MAP : : : 4
Data uploaded to LABSAM on by

Figure 2k. Representative raw data from mercury analyses performed by a New Jersey laboratory --Continued.

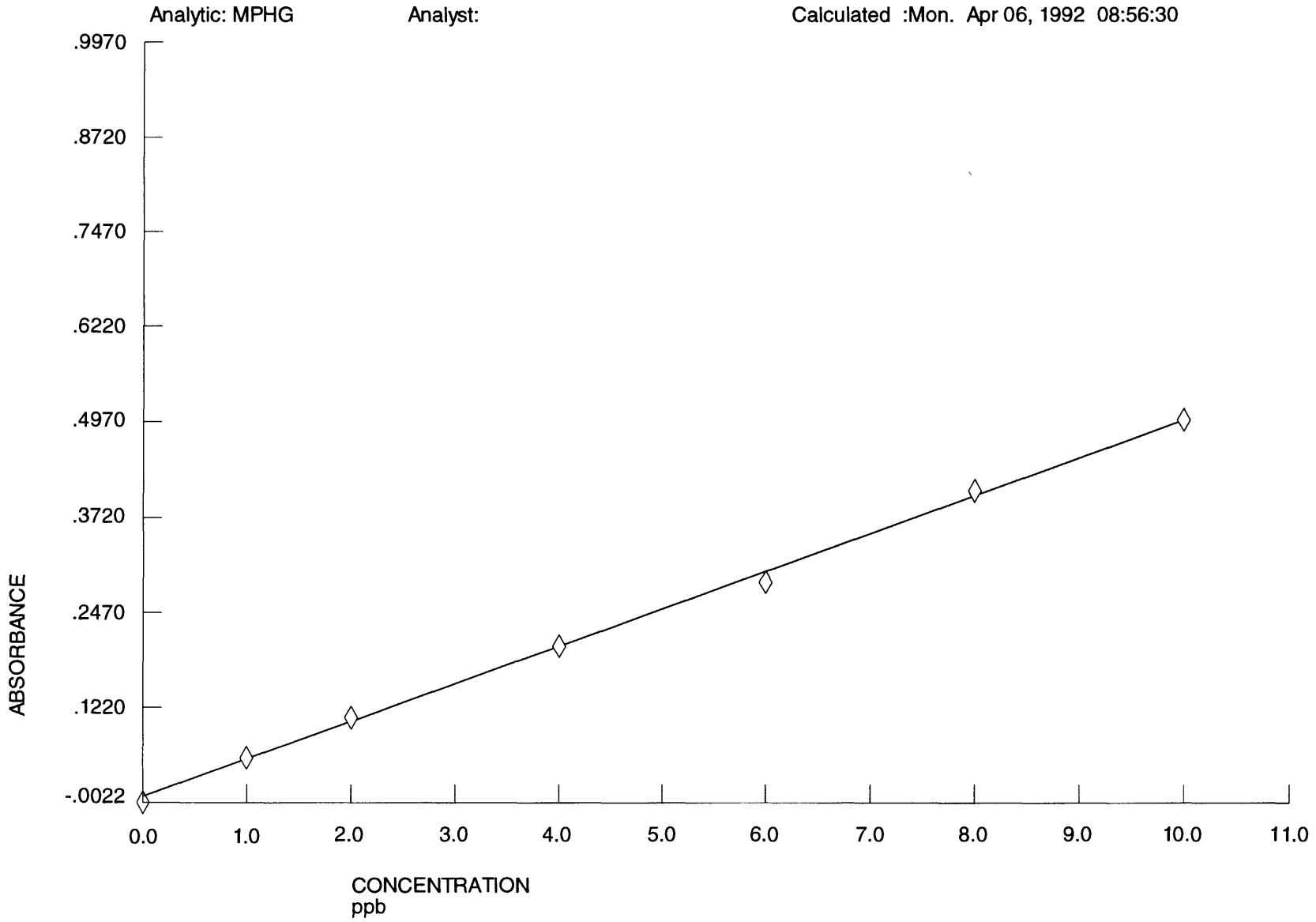


Figure 2k. Representative raw data from mercury analyses performed by a New Jersey laboratory--Continued.

Appendix 3. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water and location and number of sites with New Jersey pollution discharge elimination system (NJPDES) permit for discharges to ground water.

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water

Figure 3a. Location and number of sites with New Jersey pollution discharge elimination system (NJPDES) permit for discharges to ground water.

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water

[NJPDES, New Jersey pollutant discharge elimination system; µg/L, micrograms per liter; K, less than reporting limit; U, undetected]

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
4120	3303319	395857	741412	71890	2.00	K	4/08/87	15
4120	3310419	395857	741412	71890	2.00		1/10/90	2
4120	3321667	395806	741339	71890	2.00	K	7/13/88	7
4120	3321668	395806	741339	71890	2.00	K	7/11/88	8
4120	4010085	395857	741412	71890	2.00	K	7/06/88	10
4120	4010086	395857	741412	71890	2.00	K	7/07/88	10
4120	4010087	395857	741412	71890	2.00	K	7/06/88	9
4120	3315056	395739	741232	71890	1.50	K	2/12/90	2
4120	3323566	395906	741240	71890	1.10		8/01/89	7
4120	3323564	395839	741040	71890	.74		10/10/89	7
4120	3311479	395859	741419	71890	.50		2/12/90	2
4120	3317701	395752	741352	71890	.50	K	5/09/90	2
4120	3318263	395739	741232	71900	.50	K	9/08/92	1
4120	3323565	395813	740733	71890	.50	K	10/07/88	6
4120	3323567	395826	740933	71890	.50	K	10/07/88	8
4120	3323568	395826	740933	71890	.50	K	10/07/88	7
4120	3323569	395826	740933	71890	.50	K	10/07/88	8
4120	3303730	395857	741412	71890	.40	K	1/17/90	1
4120	3310813	395857	741412	71890	.40	K	1/18/90	1
4120	3311472	395859	741419	71890	.40	K	5/21/90	2
4120	3311476	395859	741419	71890	.40	K	2/13/90	2
4120	3311477	395859	741419	71890	.40	K	1/18/90	1
4120	3312106	395912	741432	71890	.40	K	1/17/90	1
4120	3313066	395726	741046	71900	.50	K	9/08/92	4
4120	3313067	395726	741046	71890	.40	K	1/29/90	4
4120	3313295	395659	741059	71890	.40	K	1/18/90	3
4120	3315053	395739	741232	71890	.40	K	5/22/90	2
4120	3315054	395739	741232	71890	.40	K	2/12/90	2
4120	3315055	395739	741232	71890	.40	K	5/22/90	2
4120	3315057	395739	741232	71890	.40	K	5/22/90	2
4120	3317699	395752	741352	71890	.40		1/22/90	2
4120	3317700	395752	741352	71890	.40	K	1/22/90	2
4120	3317736	395739	741232	71890	.40	K	1/22/90	2
4120	3317737	395739	741232	71890	.40	K	1/23/90	2
4120	3317738	395739	741232	71890	.40	K	1/23/90	2
4120	3317739	395739	741232	71890	.40	K	1/23/90	2
4120	3317740	395739	741232	71890	.40	K	1/23/90	2
4120	3318260	395739	741232	71890	.40	K	1/29/90	2
4120	3318261	395739	741232	71890	.40	K	1/30/90	2
4120	3318262	395739	741232	71900	.50	K	2/05/92	2
4120	3318342	395752	741246	71890	.40		1/30/90	2
4120	3318343	395752	741246	71890	.40		1/30/90	2
4120	3318898	395752	741219	71890	.40	K	1/30/90	2
4120	3318899	395752	741219	71890	.40	K	1/30/90	2
4120	3321640	395819	741339	71890	.40	K	11/09/88	7
4120	3321641	395819	741339	71890	.40	K	11/09/88	7
4171	3511435	392425	750135	71900	.79		8/04/93	7
4171	3511442	392425	750135	71900	1.10		2/11/92	1
4171	3511443	392425	750135	71900	1.30		2/11/92	7
4171	3512244	392425	750135	71900	1.20		2/11/92	5
4171	3512246	392425	750135	71890	.50	K	9/05/91	4
4324	3119237	393230	745430	71890	3.30		7/12/89	18

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water--Continued

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
4324	3119233	393230	745430	71890	2.00	U	10/11/88	20
4324	3119234	393230	745430	71890	2.00		4/26/89	18
4324	3119235	393230	745430	71890	2.00		4/26/89	17
4324	3119236	393230	745430	71890	2.00		4/26/89	18
4324	3119238	393230	745430	71890	2.00		4/26/89	16
4324	3119239	393230	745430	71890	2.00		4/26/89	19
4324	3119240	393230	745430	71890	2.00		4/26/89	19
4324	3507554	393148	745505	71890	2.00		4/26/89	18
4324	3507555	393149	745551	71890	2.00		4/26/89	18
4324	3507556	393145	745553	71890	2.00		4/26/89	18
4324	3119328	393230	745430	71890	.20	K	1/09/92	1
5177	3603025	392915	743606	71890	2.00	K	4/07/87	15
5177	3603270	392952	743526	71890	2.00	K	4/07/87	17
5177	3603875	392926	743526	71890	2.00		9/25/84	15
5177	3607160	392926	743619	71890	2.00		4/07/87	13
5177	3607161	392919	743600	71890	2.00	K	4/07/87	13
5177	3638741	392921	743607	71890	.64		2/22/90	1
5177	3630252	392913	743610	71890	.20	K	2/22/90	1
5177	3630279	392914	743602	71890	.20	K	2/22/90	1
5312	3403238	392638	751242	71890	40.00	K	1/04/89	11
5312	3402278	392619	751352	71890	.20	K	1/04/89	11
5312	3403240	392633	751230	71890	.20	K	1/04/89	11
5312	3403329	392634	751229	71890	.20	K	1/04/89	5
21172	3509159	391350	744818	71890	20.00	K	9/23/91	5
21172	3509158	391413	744853	71890	.90		7/30/93	7
21172	3509163	391413	744853	71890	.90		7/30/93	6
21172	3509162	391413	744853	71890	.80		7/30/93	6
21172	3509157	391413	744853	71890	.60		7/30/93	6
21172	3509020	391350	744818	71890	.50	K	9/15/92	6
21172	3509160	391413	744853	71890	.50		9/12/90	7
21172	3509161	391413	744853	71890	.50	K	9/15/92	7
21172	3509164	391413	744853	71890	.50		9/15/92	6
21768	3214934	395224	743454	71890	1.00	K	9/19/88	5
21768	3214935	395215	743456	71890	1.00	K	9/19/88	5
21768	3214936	395220	743451	71890	1.00	K	9/19/88	5
21768	3214937	395227	743449	71890	1.00		1/18/89	4
21768	3214938	395226	743454	71890	1.00	K	9/19/88	5
21768	3214987	395257	743509	71890	1.00	K	9/19/88	1
21962	3119132	394059	745144	71890	3.00		4/02/90	12
21962	3119135	394059	745144	71890	3.00		10/10/90	12
21962	3119133	394059	745144	71890	2.00		10/10/90	9
21962	3119131	394059	745144	71890	1.90		7/28/93	11
21962	3119137	394059	745144	71890	1.30		1/14/91	12
21962	3119138	394059	745144	71890	1.30		1/14/91	12
21962	3119130	394059	745144	71890	1.20		1/14/91	11
21962	3119134	394059	745144	71890	1.00	K	4/02/90	11
21962	3119136	394059	745144	71890	1.00	K	4/02/90	12
23809	3701228	390019	745548	71890	1.00		9/13/90	4
23809	3702512	390025	745543	71890	1.00	K	10/31/89	6
23809	3702514	390200	745613	71890	1.00	K	10/31/89	6
23809	3702515	390021	745554	71890	1.00	K	10/31/89	6
23809	3702516	390024	745602	71890	1.00	K	10/31/89	6
23809	3702517	390023	745553	71890	1.00	K	10/31/89	6
34371	2919838	400053	741053	71890	2.30		2/13/92	4

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water--Continued

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
41203	3321669	395806	741339	71890	2.00	K	7/11/88	8
50318	5500061	392800	750347	71890	7.90		3/03/89	3
50318	3504576	392815	750301	71890	2.00	K	1/31/90	3
50318	3504577	392757	750336	71890	2.00		1/31/90	3
50318	3504578	392812	750347	71890	2.00		1/31/90	3
50318	5500062	392757	750346	71890	2.00	K	1/31/90	3
50318	5500063	392756	750326	71890	2.00		1/31/90	3
50474	3503562	392908	745346	71890	2.00	K	1/26/84	5
50474	3503563	392908	745346	71890	2.00	K	1/26/84	5
50474	3503564	392908	745346	71890	2.00	K	1/26/84	4
50482	3302678	394737	741805	71890	26.00		2/14/90	6
50482	3320627	394734	741821	71890	2.10		11/23/92	6
50482	3320621	394749	741808	71890	2.00		2/14/90	6
50482	2907835	394800	741800	71890	1.00	K	2/14/90	4
50482	3302676	394739	741816	71890	1.00	K	2/14/90	6
50482	3302677	394743	741825	71890	1.00	K	2/14/90	6
50482	3320626	394736	741815	71890	1.00	K	2/14/90	6
50482	3320628	394755	741827	71890	1.00	K	2/14/90	6
50482	3307835	394741	741802	71890	.50	K	11/16/87	2
50547	3501169	391419	744658	71890	6.00		4/08/92	4
50547	4010037	391419	744658	71890	6.00		7/09/88	1
50547	3504008	391437	744715	71890	3.70		3/28/89	10
50547	3504006	391428	744655	71890	2.30		3/28/89	11
50547	3504002	391419	744658	71890	2.00	K	3/07/88	6
50547	3504003	391444	744645	71890	2.00	K	3/07/88	6
50547	3504004	391445	744716	71890	2.00	K	3/07/88	5
50547	3504005	391438	744655	71890	2.00	K	3/07/88	11
50547	3504007	391439	744648	71890	2.00	K	3/07/88	6
50547	3504009	391426	744722	71890	2.00	K	3/07/88	11
50547	3504010	391413	744700	71890	2.00	K	3/07/88	10
50547	3504011	391418	744657	71890	2.00	K	3/07/88	11
50547	3504012	391415	744717	71890	2.00	K	3/07/88	10
50547	3504013	391411	744711	71890	2.00	K	3/07/88	10
50547	3504014	391406	744703	71890	2.00	K	3/07/88	11
50547	3504015	391405	744702	71890	2.00	K	3/07/88	10
50547	3504016	391358	744652	71890	2.00	K	3/07/88	10
50547	3505380	391418	744658	71890	2.00	K	3/07/88	10
50547	3505381	391423	744656	71890	2.00	K	3/07/88	9
50547	3510124	391346	744706	71890	.60		4/25/91	4
50946	4020012	400110	741055	71890	1.50	K	2/13/92	4
50946	2919840	400120	741053	71890	1.30		2/01/91	4
50946	2919835	400053	741053	71890	1.00	K	1/25/89	4
50946	2919836	400053	741053	71890	1.00	K	1/25/89	4
50946	2919837	400053	741053	71890	1.00	K	1/25/89	4
50946	2919839	400120	741053	71890	1.00	K	1/25/89	4
50946	4020011	400110	741055	71890	1.00	K	1/25/89	4
51128	2915945	400107	741446	71890	8.00		7/22/87	7
51128	2921951	400133	741506	71890	2.80		7/11/89	4
51128	2915948	400103	741520	71890	2.60		7/16/86	7
51128	2915947	400104	741459	71890	2.00		7/23/87	7
51128	3317055	400119	741501	71890	1.70		7/16/86	2
51128	2916259	400110	741506	71890	1.20		7/16/86	4
51128	3207833	400120	741443	71890	.90		7/07/92	7

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water--Continued

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
51128	2917372	400127	741544	71890	.70	K	7/23/87	6
51128	2926538	400106	741454	71890	.70		7/09/92	2
51128	3207830	400119	741443	71890	.60		7/21/87	7
51128	3207831	400059	741510	71890	.50		7/16/86	8
51128	3317054	400119	741501	71890	.40		7/16/86	3
51128	2925083	400120	741520	71890	.30		7/13/93	3
51128	3207834	400058	741440	71890	.22		7/07/92	7
51128	2915942	400136	741505	71890	.20	K	7/16/86	5
51128	2915943	400136	741505	71890	.20	K	7/16/86	5
51128	2915944	400107	741446	71890	.20	K	7/16/86	7
51128	2915946	400104	741459	71890	.20	K	7/16/86	7
51128	2915949	400103	741520	71890	.20	K	7/16/86	7
51128	2915950	400108	741523	71890	.20	K	7/16/86	2
51128	2915951	400108	741523	71890	.20	K	7/16/86	2
51128	2915952	400127	741538	71890	.20	K	7/16/86	1
51128	2915953	400127	741538	71890	.20	K	7/16/86	1
51128	2917369	400122	741538	71890	.20	K	7/23/87	6
51128	2917370	400127	741544	71890	.20	K	7/23/87	5
51128	2917371	400122	741538	71890	.20	K	7/23/87	6
51128	2921952	400133	741506	71890	.20	K	7/11/89	4
51128	2921953	400120	741520	71890	.20	K	7/12/89	4
51128	2921954	400120	741520	71890	.20	K	7/12/89	4
51128	2926539	400105	741451	71890	.20	K	7/09/92	2
51128	2926540	400132	741458	71890	.20	K	7/09/92	2
51128	2926541	400132	741458	71890	.20		7/09/92	2
51128	3207828	400140	741534	71890	.20	K	7/16/86	6
51128	3207829	400120	741520	71890	.20	K	7/16/86	
51128	3207832	400058	741439	71890	.20	K	7/16/86	8
51128	3207835	400059	741510	71890	.20	K	7/16/86	8
51896	3211275	395738	742431	71890	1.74		8/28/87	3
51896	3211274	395732	742422	71890	1.55		7/28/87	4
51896	3211277	395738	742418	71890	.61		8/28/87	2
51896	3211276	395743	742424	71890	.60		8/04/88	3
51942	3702197	390326	745206	71890	20.00	K	10/12/89	2
51942	3800904	394000	745100	71890	5.00	K	9/25/85	3
51942	3800905	394000	745100	71890	5.00	K	9/25/85	3
51942	3800906	394000	745100	71890	5.00	K	9/25/85	3
51942	3800907	394000	745100	71890	5.00	K	9/25/85	3
51942	3702199	390326	745206	71890	.28		10/12/87	3
51942	3702196	390326	745206	71890	.26	K	10/13/87	3
51942	3702198	390326	745206	71890	.26	K	10/13/87	3
51942	3702200	390326	745206	71890	.26		10/13/87	3
51977	3316258	395646	741646	71890	5.00	K	7/17/86	16
51977	3316259	395646	741646	71890	5.00	K	7/17/86	16
51977	3316260	395646	741646	71890	5.00	K	7/17/86	16
51977	3310718	395425	741326	71890	1.09		11/27/89	13
51977	3310717	395431	741357	71890	.50	K	11/27/89	12
51977	3310719	395412	741346	71890	.50	K	8/17/89	14
51977	3310720	395414	741331	71890	.50	K	11/27/89	13
51977	3316261	395646	741646	71890	.50	K	8/17/89	15
52019	3133094	393703	745326	71890	11.60		1/27/93	1
52019	3133905	393703	745326	71890	3.50		6/12/91	3
52019	3113664	393711	745312	71890	1.00	K	2/03/87	4

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water--Continued

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
52019	3113666	393714	745319	71890	1.00	K	2/03/87	4
52019	3122927	393659	745312	71890	1.00	K	2/03/87	4
52019	3122928	393703	745326	71890	1.00	K	2/03/87	5
52019	3122929	393657	745312	71890	1.00	K	2/03/87	7
52019	3122930	393658	745305	71890	1.00	K	2/03/87	4
52019	3122931	393659	745312	71890	1.00	K	2/03/87	4
52019	4020007	393703	745326	71890	1.00	K	2/03/87	4
52019	4020008	393703	745326	71890	1.00	K	12/05/85	5
52019	3135813	393703	745326	71890	.70		1/27/93	2
52019	3135815	393703	745326	71890	.50	K	1/30/92	3
52019	3135818	393703	745326	71890	.50	K	1/30/92	3
52019	3133904	393703	745326	71890	.10	K	6/13/91	1
52019	3135814	393703	745326	71890	.10	K	6/12/91	1
52019	3135816	393703	745326	71890	.10	K	6/12/91	1
52019	3135817	393703	745326	71890	.10	K	6/12/91	1
52019	3135819	393703	745326	71890	.10	K	6/12/91	1
52027	3604023	392119	743628	71890	42.00		1/04/93	21
52027	3605563	392129	743623	71890	24.00		4/02/87	20
52027	3605561	392125	743627	71890	12.00		1/03/91	20
52027	3603840	391326	744152	71890	8.00		1/08/90	21
52027	3603841	392109	743626	71890	7.00		1/08/90	21
52027	3604954	392125	743625	71890	5.00		1/09/90	20
52027	5600020	392128	743653	71890	5.00		4/12/84	22
52027	3603842	392114	743627	71890	4.80		1/02/91	19
52027	3604025	392148	743647	71890	4.80		1/04/91	20
52027	3604022	392119	743628	71890	4.00		1/08/90	23
52027	3603940	392134	743639	71890	3.00		4/10/85	20
52027	3603982	392132	743627	71890	3.00		7/05/90	21
52027	3603839	392126	743659	71890	2.00	K	1/08/90	24
52027	3603843	392125	743628	71890	2.00	K	1/09/90	23
52027	3603983	392132	743627	71890	2.00	K	1/09/90	20
52027	3604020	392135	743647	71890	2.00	K	1/10/90	20
52027	3604021	392135	743647	71890	2.00	K	1/10/90	21
52027	3604024	392190	743626	71890	2.00	K	1/08/90	21
52027	3605562	392129	743623	71890	2.00		1/11/89	19
52027	3610763	392108	743638	71890	2.00		1/08/90	16
52027	3610764	392133	743706	71890	2.00	K	1/08/90	17
52027	5600019	392140	743631	71890	2.00	K	1/10/90	21
52027	5600022	392138	743645	71890	2.00	K	1/10/90	21
52027	3606840	392138	743645	71890	.20	K	1/04/93	1
52027	3606841	392138	743645	71890	.20	K	1/04/93	1
52027	4010147	392138	743645	71890	.20	K	1/09/70	2
52027	4010148	392138	743645	71890	.20	K	4/10/89	2
52027	4603940	392138	743645	71890	.20	K	1/09/90	1
52035	3123886	393539	744832	71890	1.00	K	2/26/87	5
52035	3123887	393539	744832	71890	1.00	K	2/26/87	5
52035	3123888	393539	744832	71890	1.00	K	2/26/87	4
52035	3123889	393539	744832	71890	1.00	K	2/26/87	5
52035	3123890	393539	744832	71890	1.00	K	2/26/87	5
52035	3123891	393539	744832	71890	1.00	K	2/26/87	5
52035	5100096	393515	744737	71890	1.00	K	2/26/87	4
52035	5100097	393515	744737	71890	1.00	K	2/26/87	4
52043	3601215	392830	742816	71890	2.00		10/01/90	6

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water--Continued

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
52043	3601216	392832	742837	71890	1.00	K	4/06/92	5
52043	3607173	392827	742828	71890	1.00	K	4/06/92	2
52043	3607174	392843	742831	71890	1.00	K	4/06/92	7
52043	3611091	392839	742840	71890	1.00	K	1/23/91	6
52043	3611092	392839	742840	71890	1.00	K	1/23/91	6
52043	3613613	392839	742853	71890	1.00	K	4/06/92	4
52043	3613614	392839	742853	71890	1.00	K	4/08/92	4
52043	3613615	392839	742853	71890	1.00	K	4/08/92	4
52043	3613616	392839	742853	71890	1.00	K	4/06/92	4
52043	3613617	392839	742853	71890	1.00	K	4/06/92	4
52043	3613618	392839	742853	71890	1.00	K	4/06/92	3
52043	3613619	392830	742821	71890	1.00	K	4/06/92	1
52043	3613620	392839	742853	71890	1.00	K	4/06/92	4
52086	3606938	391126	744526	71890	.70		1/13/88	3
52086	3606941	391126	744526	71890	.60		1/13/88	3
52086	3606939	391126	744526	71890	.50		1/13/88	3
52086	3606940	391126	744526	71890	.50	K	1/13/88	3
52086	3606942	391126	744526	71890	.50	K	1/13/88	3
52167	3503431	392415	750800	71890	2.00		2/26/86	5
52167	3503429	392415	750800	71890	.50	K	2/26/88	4
52175	3401939	392615	751930	71890	1.00	K	2/26/86	3
52175	3401940	392615	751930	71890	1.00	K	2/26/86	2
52477	3120962	395019	745437	71890	.50		5/14/92	1
52477	3120965	395017	745445	71890	.50	K	5/13/92	1
52477	3120976	395019	745437	71890	.50	K	5/13/92	1
52477	3122978	395007	745435	71890	.50	K	5/13/92	1
52477	3134351	395019	745437	71890	.50	K	5/14/92	1
52477	3137051	394952	745446	71890	.50	K	5/14/92	1
52477	3137920	395019	745437	71890	.50	K	7/10/92	1
53376	3313011	395500	741230	71890	2.00		1/25/88	5
53376	3313013	395500	741230	71890	2.00	K	1/25/88	5
53376	3313014	395500	741230	71890	2.00	K	1/25/88	5
53376	3313012	395500	741230	71890	.50	K	1/31/91	1
53457	3312056	393945	741951	71890	6.20		1/03/90	4
53457	3312057	393938	741949	71890	1.50		2/12/92	4
53457	3312058	393943	741940	71890	1.00	K	1/03/90	4
53503	3603838	393126	743726	71890	25.00		1/16/85	4
53503	3603836	393126	743726	71890	11.00		1/16/85	4
53503	3215302	393230	743730	71890	4.00		1/20/89	3
53503	3215301	393230	743730	71890	1.00		1/20/89	3
53503	3215303	393230	743730	71890	.50	K	3/03/92	2
53503	3603837	393230	743730	71890	.50	K	3/03/92	2
53597	3122731	394202	745911	71890	8.00		5/22/89	3
53597	3122732	394209	745906	71890	1.00	K	4/27/87	4
53597	4010527	394206	745902	71890	1.00	K	4/27/87	2
53597	3122729	394212	745859	71890	.50	K	6/01/88	3
53597	3128408	394201	745910	71890	.50		6/01/88	3
53597	4010526	394206	745902	71890	.50		6/01/88	1
53627	5100126	394708	745446	71890	2.00		8/02/89	3
53627	5100127	394708	745446	71890	2.00		8/02/89	3
53627	5100130	394708	745446	71890	2.00		8/02/89	3
53805	3505269	391326	744832	71890	1.20		12/21/87	4
53805	3505267	391322	744818	71890	1.00	K	12/21/87	4

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water--Continued

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
53805	3505268	391314	744823	71890	1.00	K	12/21/87	4
53805	3505270	391306	744819	71890	1.00	K	12/21/87	4
53805	3505271	391318	744802	71890	1.00	K	12/21/87	4
53805	3505272	391330	744809	71890	1.00	K	12/21/87	4
53805	3505514	391311	744806	71890	1.00	K	12/21/87	4
53805	3505515	391327	744759	71890	1.00	K	12/21/87	4
54241	3605648	392632	744232	71890	1.50		1/03/91	5
54241	3605647	392632	744232	71890	1.00	K	1/11/89	6
54241	3605649	392632	744232	71890	1.00	K	1/11/89	6
54241	3605650	392632	744232	71890	1.00	K	1/11/89	6
54241	3605651	392632	744232	71890	.50		1/17/90	5
54259	3210914	395603	742840	71890	.70		1/04/89	1
54259	5200005	395610	742845	71890	.30		1/04/89	1
54259	3206038	395545	742829	71890	.20	K	1/04/89	1
54259	3206039	395609	742829	71890	.20	K	1/04/89	1
54267	3504456	393126	745539	71890	2.00	U	1/17/89	4
54283	3402324	393152	751912	71890	3.00		1/23/91	4
54283	3402323	393152	751912	71890	1.00	K	1/15/88	4
54283	3402325	393152	751859	71890	1.00	K	1/15/88	4
54283	3402326	393152	751859	71890	1.00		1/15/88	4
54381	3605159	392646	743619	71890	1.00		5/12/87	10
54381	3605160	392646	743619	71890	1.00		5/12/87	10
54381	3605921	392632	743659	71890	1.00	K	5/12/87	10
54381	3610685	392648	743630	71890	.60		4/27/92	7
54381	3605919	392632	743659	71890	.50	K	1/14/91	7
54381	3610684	392653	743626	71890	.50	K	1/14/91	7
54399	3122587	393219	750019	71890	10.00	K	3/20/89	1
54399	3122588	393219	750019	71890	3.00		1/29/87	2
54399	3122585	393219	750019	71890	2.00	K	1/14/87	3
54399	3122586	393219	750019	71890	2.00		1/19/88	2
54402	3116657	393217	750926	71890	5.60		1/21/89	6
54402	3131959	393226	750919	71890	1.80		1/22/92	4
54402	3131958	393226	750919	71890	1.20		1/22/92	4
54402	3116656	393217	750926	71890	.50	K	1/23/88	6
54402	3116658	393217	750926	71890	.50	K	1/23/88	6
54402	3122582	393219	750912	71890	.50	K	1/23/88	6
54411	3212013	393516	744035	71890	60.40		2/24/92	2
54411	3212017	393517	744018	71890	1.80		2/24/92	2
54411	3212012	393511	744029	71890	.50	K	10/23/87	2
54411	3212015	393523	744025	71890	.50		10/23/87	2
54411	3212016	393523	744020	71890	.50	K	10/23/87	2
54411	3610098	393146	743040	71890	.50	K	1/18/90	4
54411	3610100	393146	743040	71890	.50	K	1/18/90	4
54411	3910099	393142	743034	71890	.50	K	1/28/91	1
54411	3910100	393142	743034	71890	.50	K	1/28/91	1
54411	3610099	393142	743034	71890	.20	K	1/27/93	1
54453	3123520	393246	745912	71890	.50	K	10/31/90	2
54453	3131428	393253	745919	71890	.50	K	10/31/90	2
54453	3131429	393253	745919	71890	.50	K	10/31/90	2
54488	3504550	392257	750316	71890	.50	K	1/18/89	5
54488	3506913	392259	750331	71890	.50	K	1/18/89	5
54488	3506915	392249	750320	71890	.50	K	1/18/89	5
54488	3507466	392249	750320	71890	.50	K	1/18/89	4

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water--Continued

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
54488	3512336	392306	750333	71890	.50	K	1/20/93	1
54488	3512337	392306	750333	71890	.50	K	1/20/93	1
54488	3512338	392306	750333	71890	.50	K	1/20/93	1
54488	4600187	392306	750333	71890	.50	K	1/18/89	5
54488	4600189	392306	750333	71890	.50	K	1/18/89	5
54518	3123859	393616	745114	71890	1.60		1/03/89	3
54518	3123858	393616	745114	71890	1.00		2/05/92	3
54518	3123857	393616	745114	71890	.50		1/03/89	4
54542	3124315	393352	745046	71890	1.10		3/13/90	2
54542	3124316	393352	745046	71890	1.10		3/13/90	3
54542	3124317	393352	745046	71890	1.00	K	3/30/88	3
54542	3124318	393352	745046	71890	1.00	K	3/30/88	3
54542	3124319	393347	745059	71890	1.00	K	3/30/88	4
54542	3506403	392937	745520	71890	.50	K	1/18/90	1
54542	3506404	392934	745520	71890	.50	K	1/18/90	1
54542	3506405	392931	745521	71890	.50	K	1/18/90	1
54542	3506406	392939	745512	71890	.50	K	1/18/90	1
54551	3212014	393459	744032	71890	.50	K	10/23/87	2
54640	3600465	392226	744538	71890	3.40		1/14/88	3
54640	3611002	392226	744538	71890	1.00		1/29/93	2
54640	3600464	392226	744538	71890	.50	K	1/14/88	3
54640	3607229	392219	744552	71890	.50	K	1/14/88	3
54691	3604538	392939	743632	71890	1.00	K	1/25/91	5
54691	3604540	392939	743632	71890	1.00	K	1/25/91	5
54691	3604541	392939	743632	71890	1.00	K	1/25/91	5
54691	3614545	393044	743444	71890	1.00	K	4/08/92	1
54691	3800964	393044	743444	71890	.50	K	10/23/87	1
54712	3611822	393146	743933	71890	6.00		10/23/89	3
54712	3607180	392745	743040	71890	3.00		10/27/89	5
54712	3603187	392742	743036	71890	1.00	K	1/25/91	5
54712	3607175	392746	743038	71890	1.00	K	1/23/91	5
54712	3607176	393126	743912	71890	1.00	K	1/25/91	5
54712	3607177	393126	743912	71890	1.00	K	1/25/91	5
54712	3607178	393126	743912	71890	1.00		10/23/89	5
54712	3607181	392743	743035	71890	1.00		10/27/89	5
54712	3611811	392826	743306	71890	1.00	K	4/06/92	4
54712	3611812	392826	743306	71890	1.00	K	4/06/92	5
54712	3611813	392826	743306	71890	1.00	K	4/06/92	4
54712	3611821	392746	743119	71890	1.00	K	1/25/91	3
54721	3603780	392606	744539	71890	.50	K	1/19/88	3
54721	3603781	392606	744539	71890	.50	K	1/19/88	3
54721	5600048	392558	744611	71900	10.00		2/16/93	3
54721	3505387	392539	744632	71890	.50	K	1/19/88	1
54852	3509517	391832	745712	71890	3.10		2/20/92	2
54852	3501319	391633	745731	71890	1.80		5/28/92	6
54852	3501320	391629	745723	71890	1.00	K	4/25/86	6
54852	3505258	391626	745731	71890	1.00		5/28/91	4
54852	3509516	391627	745723	71890	.50	K	5/28/91	2
54861	3505224	391859	745659	71890	2.00		7/08/88	6
54861	3505223	391859	745659	71890	1.70		7/07/87	4
54861	3505221	391852	745716	71890	.90		2/20/92	3
54861	3509571	391852	745716	71890	.50	K	3/01/93	1
54879	3505976	391856	750949	71890	.20	K	7/21/92	1

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water--Continued

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
54879	3509337	391856	750949	71890	.20	K	7/21/92	1
54879	3510329	391906	750946	71890	.20	K	7/21/92	1
54925	3005440	393653	751853	71890	60.00		5/11/89	5
54925	3003670	393646	751859	71890	6.00		7/21/86	4
54925	3003668	393646	751859	71890	5.00	K	7/21/86	6
54925	3003669	393646	751859	71890	5.00	K	7/21/86	7
54925	3005438	393639	751840	71890	.40	U	7/28/89	5
54925	3005437	393639	751840	71890	.20	K	11/11/88	4
54925	3005439	393639	751840	71890	.20	K	11/11/88	5
54925	3005443	393633	751850	71890	.20	U	3/02/89	4
54933	3502109	391802	750230	71890	.50	K	1/19/89	3
54933	3505174	391739	750246	71890	.50	K	1/19/89	3
54933	3505175	391739	750246	71890	.50	K	1/19/89	3
54933	3505176	391739	750246	71890	.50	K	1/19/89	3
54933	3505177	391739	750246	71890	.50	K	1/19/89	3
54933	3505178	391739	750246	71890	.50	K	1/19/89	3
54941	3402378	392752	751552	71890	240.00		1/14/91	5
54941	3402376	392752	751552	71890	13.00		1/05/90	4
54941	3903943	392610	751418	71890	5.00		1/21/93	1
54941	4020009	392610	751418	71890	5.00	K	1/21/93	5
54941	4020003	392610	751418	71890	1.10		1/21/93	5
54941	4020010	392610	751418	71890	1.00		1/05/90	5
54941	3403943	392610	751418	71890	.80		1/06/92	1
54941	3402379	392752	751552	71890	.75		1/21/93	5
54941	3402377	392752	751552	71890	.50	K	1/20/89	5
54941	3403944	392610	751418	71890	.50	K	1/06/92	2
54941	3403945	392610	751418	71890	.50	K	1/06/92	2
54941	3403946	392610	751418	71890	.50	K	1/06/92	2
54941	4020004	392610	751418	71890	.50	K	1/20/89	5
54941	5400010	392610	751418	71890	.50	K	1/20/89	5
54941	5400011	392610	751418	71890	.50	K	1/20/89	5
54950	3505065	391539	750526	71890	.50	K	2/17/89	2
54950	3505066	391539	750526	71890	.50	K	2/17/89	2
54950	3505164	391539	750526	71890	.50	K	2/17/89	2
54968	3501676	391846	750722	71890	.70		1/11/93	1
54968	3505067	391846	750712	71890	.60		4/19/88	4
54968	3501675	391846	750722	71890	.50	K	1/09/90	2
54968	3505068	391846	750712	71890	.50		4/19/88	4
54976	3402726	392432	751832	71890	1.00	K	1/03/90	6
54976	3402750	392432	751832	71890	1.00	K	1/03/90	6
55069	3506548	392937	744905	71890	.50		10/09/90	2
55069	3506549	392937	744905	71890	.40	K	7/29/87	2
55069	3506550	392933	744906	71890	.40	K	7/29/87	2
55069	3506551	392938	744858	71890	.40	K	7/29/87	2
55085	3505611	391552	745126	71890	1.50		1/13/88	3
55085	3505613	391552	745126	71890	.60		1/13/88	3
55085	3505610	391552	745126	71890	.50	K	1/13/88	3
55085	3505612	391552	745126	71890	.50		1/13/88	3
55166	2916053	400338	741502	71890	2.00	K	1/22/88	6
55166	2923057	400352	741504	71890	.50	K	1/25/91	3
55204	3506067	392712	750552	71890	19.00		4/07/93	5
55204	3506085	392712	750552	71890	19.00		4/07/93	5
55204	3506068	392712	750552	71890	10.00	K	1/11/90	6

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water–Continued

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
55204	3506082	392659	750552	71890	10.00	K	1/11/90	6
55204	3506094	392659	750552	71890	10.00	K	1/11/90	7
55204	3506095	392646	750539	71890	4.00	K	4/06/93	7
55204	3506075	392712	750539	71890	2.00	K	1/11/88	10
55204	3506076	392659	750539	71890	2.00	K	1/11/88	9
55204	3506077	392712	750552	71890	2.00	K	1/11/88	6
55204	3506078	392712	750552	71890	2.00	K	1/07/88	6
55204	3506080	392659	750552	71890	2.00	K	1/11/88	6
55204	3506081	392659	750552	71890	2.00	K	1/07/88	5
55204	3506083	392712	750552	71890	2.00	K	1/11/88	7
55204	3506086	392659	750552	71890	2.00	K	1/07/88	6
55204	3506087	392659	750552	71890	2.00	K	1/11/88	7
55204	3506088	392659	750552	71890	2.00	K	1/11/88	5
55204	3506089	392659	750539	71890	2.00	K	1/11/88	6
55204	3506090	392659	750539	71890	2.00	K	1/07/88	5
55204	3506091	392659	750539	71890	2.00	K	1/07/88	6
55204	3506092	392659	750552	71890	2.00	K	1/11/88	7
55204	3506093	392659	750552	71890	2.00	K	1/07/88	6
55204	3506096	392646	750539	71890	2.00	K	1/07/88	6
55204	3506097	392646	750539	71890	2.00	K	1/07/88	6
55204	3506098	392659	750552	71890	2.00	K	1/11/88	6
55204	3506099	392659	750552	71890	2.00	K	1/07/88	10
55204	3506100	392659	750552	71890	2.00	K	1/07/88	10
55204	3506101	392659	750539	71890	2.00	K	1/11/88	10
55204	3506102	392708	750615	71890	2.00	K	1/11/88	9
55204	3506103	392659	750539	71890	2.00	K	1/11/88	10
55204	3506104	392712	750539	71890	2.00	K	1/11/88	11
55204	3506769	392720	750546	71890	2.00	K	1/05/88	6
55204	3506770	392720	750546	71890	2.00	K	1/05/88	7
55204	4010040	392708	750615	71890	2.00	K	1/12/88	1
55204	4010041	392708	750615	71890	2.00	K	1/12/88	1
55204	4010042	392708	750615	71890	2.00	K	1/12/88	1
55204	4010043	392708	750615	71890	2.00	K	1/12/88	1
55204	3506066	392712	750552	71890	1.00	K	1/09/89	6
55204	3506079	392712	750552	71890	1.00	K	1/03/89	5
55204	3506084	392712	750552	71890	1.00	K	1/09/89	5
55204	4010020	392708	750615	71890	1.00	K	10/10/88	2
55204	4010021	392708	750615	71890	1.00	K	10/10/88	2
55204	4010022	392708	750615	71890	1.00	K	10/10/88	3
55204	4010023	392708	750615	71890	1.00	K	10/10/88	3
55204	3506291	392708	750615	71890	.50	K	5/18/92	3
55204	4010186	392708	750615	71890	.50	K	5/18/92	1
55204	4010187	392708	750615	71890	.50	K	5/18/92	1
55204	4010188	392708	750615	71890	.50	K	1/07/92	10
55204	4010229	392708	750615	71890	.50	K	5/18/92	2
55204	4010230	392708	750615	71890	.50	K	1/07/92	5
55204	4010231	392708	750615	71890	.50	K	5/18/92	1
55204	3800318	392708	750615	71890	.20	K	11/04/87	1
55204	4010115	392708	750615	71890	1.00		1/10/89	1
55204	4010116	392708	750615	71890	1.00		1/10/89	1
55204	4010117	392708	750615	71890	1.00	K	1/10/89	1
55204	4010118	392708	750615	71890	1.00	K	1/10/89	1

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water--Continued

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
55280	3608522	392834	743201	71890	1.80		1/26/89	3
55280	3608523	392834	743201	71890	1.40		1/26/89	3
55280	3608521	392834	743201	71890	1.00		1/26/89	3
55280	3615666	392834	743201	71890	.34		1/19/93	1
55298	3600826	391510	744123	71890	.50	K	5/26/88	2
55298	3600862	391510	744119	71890	.50	K	5/25/89	1
55298	3605572	391515	744125	71890	.50	K	5/26/88	4
55298	3605573	391512	744126	71890	.50	K	5/26/88	5
55298	3605574	391508	744123	71890	.50	K	5/26/88	5
55298	3608862	392706	744440	71890	.50	K	2/11/92	2
55468	3126290	394606	745512	71890	1.35		1/14/88	4
55468	3126289	394606	745512	71890	1.00	K	1/05/89	4
55468	3126291	394606	745512	71890	1.00	K	1/05/89	4
55573	3316042	394259	741726	71890	6.00		2/26/90	5
55573	3316039	394259	741726	71890	1.00		2/27/90	5
55573	3316041	394259	741726	71890	1.00		2/26/90	4
55573	3316043	394259	741726	71890	1.00	K	2/26/90	5
55573	4010213	394250	741740	71890	1.00		2/20/91	3
55573	4010214	394250	741740	71890	1.00		2/20/91	3
55573	5300032	394250	741740	71890	1.00	K	2/26/90	6
55573	3316040	394259	741726	71890	.50	K	10/28/87	3
55620	3118768	395039	744937	71890	2.00		3/26/87	4
55620	3118769	395045	744929	71890	2.00	K	9/17/92	5
55620	3124247	395042	744941	71890	2.00		3/26/87	6
55620	3124248	395045	744937	71890	2.00		3/26/87	6
55620	3125816	395046	744933	71890	2.00		3/26/87	5
55620	3125937	395040	744926	71890	2.00		3/26/87	6
55620	3125938	395040	744931	71890	2.00		3/26/87	5
55620	3525816	395040	744931	71890	.20	K	1/15/91	1
55891	3605939	392625	742948	71890	.50	K	6/23/89	2
55891	3606777	392619	743004	71890	.50	K	6/23/89	2
55913	3123468	393557	750253	71890	.50	K	1/16/89	1
55913	3123469	393556	750249	71890	.50	K	1/16/89	1
55913	3123470	393559	750248	71890	.50	K	1/16/89	1
55981	3505062	391846	750952	71890	.50		4/19/88	3
55981	3505063	391846	750952	71890	.50		4/19/88	3
56081	5700032	390100	745300	71890	5.00		6/03/86	17
56081	5700031	390117	745427	71890	2.30		7/18/91	16
56081	3703433	390012	745415	71890	1.70		7/18/91	12
56081	3701652	390115	745421	71890	1.30		7/18/91	17
56081	3703432	390012	745415	71890	1.30		7/18/91	12
56081	3703579	390100	745300	71890	1.30		7/18/91	1
56081	5700028	390105	745429	71890	1.30		7/18/91	17
56081	3703758	390129	745422	71890	1.10		7/18/91	12
56081	3701651	390101	745410	71890	1.00	K	1/25/89	17
56081	3703757	390129	745422	71890	1.00	K	1/09/90	11
56081	5700029	390100	745300	71890	1.00	K	1/25/89	17
56081	5700030	390015	745410	71890	1.00	K	1/25/89	17
56081	5700033	390119	745423	71890	1.00	K	1/25/89	16
56090	3702347	385659	745659	71890	.20	K	4/18/88	2
56090	3702348	385659	745659	71890	.20		4/18/88	2
56090	3702349	385659	745659	71890	.20		4/18/88	2
56090	3702350	385659	745659	71890	.20	K	4/18/88	2

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water--Continued

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
56120	3122709	394152	745232	71890	.50	K	7/24/89	1
56120	3122711	394152	745232	71890	.50	K	7/24/89	1
56138	3002143	394017	751203	71890	1.00		2/03/87	7
56138	3002144	394017	751158	71890	1.00	K	2/03/87	7
56138	3004129	394019	751139	71890	1.00	K	2/03/87	5
56138	3008568	394100	751000	71890	.50	K	8/17/92	1
56154	3122836	394435	745921	71890	120.00		1/30/87	3
56154	3123484	394430	745914	71890	3.80		1/21/87	4
56154	3123485	394435	745912	71890	1.00		1/14/86	3
56421	3123704	394912	745352	71890	20.00	U	1/03/89	6
56421	3123703	394912	745352	71890	2.00	K	1/28/88	6
56421	3123705	394912	745352	71890	2.00	K	1/29/88	6
56421	3123706	394912	745352	71890	2.00	K	1/28/88	6
56421	4010528	394911	745336	71890	2.00	K	1/28/88	4
56421	4010529	394911	745336	71890	2.00		1/28/88	5
56502	3003680	393824	751210	71890	1.00	K	2/02/87	3
56502	3003681	393824	751210	71890	1.00		2/02/87	5
56502	3003682	393824	751210	71890	1.00		2/02/87	5
56502	3003683	393824	751210	71890	1.00		2/02/87	5
56502	3007767	393824	751210	71890	.70		5/07/92	1
56502	3007768	393824	751210	71890	.70		5/07/92	1
56502	3036807	393824	751210	71890	.50	K	1/06/90	1
56502	3036815	393824	751210	71890	.50	K	1/06/90	1
56502	3036823	393824	751210	71890	.50	K	1/06/90	1
56502	3036831	393824	751210	71890	.50	K	1/06/90	1
56642	3212558	393533	742204	71890	2.10		6/23/87	2
56642	5200043	393527	742208	71890	.50	K	6/23/87	2
56642	5200044	393526	742207	71890	.50	K	1/28/91	1
56685	3217981	395123	744422	71890	102.00		11/13/91	6
56685	3211732	395116	744425	71890	88.00		1/30/89	12
56685	3211731	395115	744414	71890	2.00	K	1/07/86	11
56685	3211733	395122	744425	71890	2.00	K	1/07/86	11
56685	3211734	395124	744416	71890	2.00	K	1/07/86	11
56685	3217982	395120	744426	71890	.50	K	11/14/91	6
56685	4010225	395124	744417	71890	.50	K	11/13/91	4
56685	4010250	395124	744417	71890	.50	K	11/13/91	4
56766	3402603	392152	751219	71890	.90		1/11/89	4
56766	3402602	392152	751219	71890	.50	K	1/28/88	4
56766	3402604	392152	751219	71890	.50	K	1/28/88	4
56766	3403162	392200	751226	71890	.50	K	1/11/89	2
56774	3505549	392752	750912	71890	1.20		1/30/92	4
56774	3505548	392752	750912	71890	.50	K	1/10/89	4
56774	3505550	392752	750912	71890	.50	K	1/10/89	4
56774	3505551	392752	750912	71890	.50	K	1/10/89	4
56782	3402477	392912	751259	71890	.80		1/11/90	1
56782	3402478	392912	751259	71890	.50	K	1/11/90	1
56782	3402479	392912	751259	71890	.50	K	1/11/90	1
56782	3402480	392912	751259	71890	.50	K	1/11/90	1
56880	3318498	394459	741423	71890	2.00	K	1/23/87	7
56880	3318499	394459	741432	71890	2.00	K	1/23/87	7
56880	3318500	394501	741409	71890	2.00	K	1/23/87	7
56910	3317496	395634	741325	71890	2.00	K	1/12/88	3
56910	3317497	395644	741327	71890	2.00	K	1/12/88	3

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water--Continued

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
56910	3317498	395643	741311	71890	2.00	K	1/12/88	3
56910	3317499	395645	741321	71890	2.00	K	1/12/88	3
57207	3316804	395859	740939	71890	2.00		1/30/87	5
57207	3316805	395152	741312	71890	2.00		1/30/87	5
57207	3316806	395152	741312	71890	1.00	K	1/30/87	5
57207	3316807	395152	741259	71890	1.00		1/30/87	5
57509	3310838	393954	741857	71890	5.00	K	4/09/86	6
57509	3310839	393952	741855	71890	5.00	K	4/09/86	6
57509	3319122	393952	741859	71890	2.00		7/16/86	5
57509	3319123	393952	741859	71890	2.00		7/16/86	6
57681	3607126	391048	744028	71890	1.00	K	3/29/88	4
57681	3607127	391053	744037	71890	1.00	K	3/29/88	4
57908	3505185	392309	750205	71890	.20	K	4/30/88	2
57908	3505186	392310	750216	71890	.20	K	4/30/88	3
57908	3505187	392306	750215	71890	.20	K	4/30/88	3
57908	3505188	392305	750213	71890	.20	K	4/30/88	3
58254	3701720	390019	744752	71890	1.00		1/19/87	3
58254	3701721	390019	744752	71890	1.00		1/19/87	3
58254	3701722	390019	744752	71890	1.00	K	1/19/87	3
58254	3701723	390019	744752	71890	1.00		1/19/87	3
60160	5300034	400135	741515	71890	4.70		8/03/88	2
60160	5300033	400135	741515	71890	.52		8/28/87	2
60160	2915976	400149	741520	71890	.50	K	8/28/87	2
60160	2915977	400440	741509	71890	.50	K	8/28/87	2
60160	2915978	400140	741526	71890	.50	K	8/25/87	2
60160	2915979	400141	741526	71890	.50	K	8/25/87	2
60160	5300035	400141	741518	71890	.50	K	8/28/87	2
60160	5300037	400141	741509	71890	.50		8/28/87	2
60160	5300038	400142	741518	71890	.50	K	8/04/88	1
60941	3127151	393554	750432	71890	2.00	K	12/15/87	3
60941	3127445	393553	750432	71890	2.00	K	12/15/87	3
60941	3127446	393601	750429	71890	2.00	K	12/15/87	13
60941	3127447	393556	750429	71890	2.00	K	12/15/87	12
60941	3127448	393557	750424	71890	2.00	K	12/15/87	12
60941	3127449	393558	750419	71890	2.00	K	12/15/87	12
60941	3127450	393601	750419	71890	2.00	K	12/15/87	11
60941	3128245	393613	750453	71890	2.00	K	4/15/88	12
60941	3131138	393615	750435	71890	.20	K	1/23/91	4
60941	3131139	393615	750435	71890	.20		10/04/89	6
61085	2918591	400426	741306	71890	20.00		1/09/89	6
61085	2918592	400357	741103	71890	20.00		1/09/89	6
61085	2918596	400348	741112	71890	20.00		1/09/89	6
61085	2918597	400355	741129	71890	20.00		1/09/89	6
61085	2942215	400352	741106	71890	1.00	K	1/09/90	4
61085	4010168	400346	741118	71890	1.00	K	1/09/90	3
61085	4010169	400346	741118	71890	1.00	K	1/09/90	3
61085	4010195	400346	741118	71890	.50	K	3/15/91	2
61581	3608737	392133	743719	71890	1300.00		3/13/92	6
61581	3608739	392133	743719	71890	720.00		3/13/92	6
61581	3608740	392133	743719	71890	290.00		3/13/92	6
61581	3608735	392133	743719	71890	180.00		3/13/92	6
61581	3608738	392133	743719	71890	60.00		3/13/92	6

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water--Continued

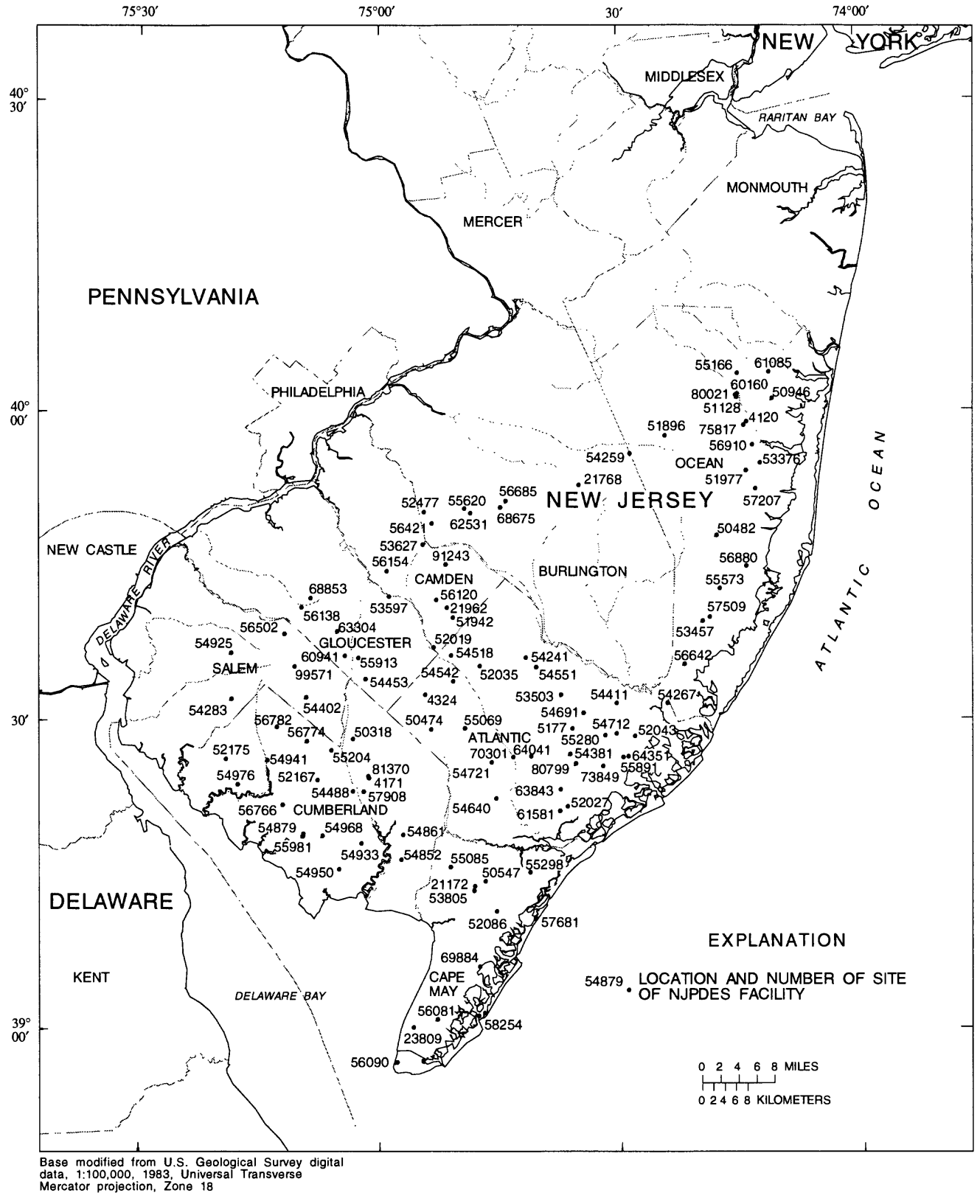
NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
61581	3608736	392133	743719	71890	40.00		3/13/92	6
62537	3129020	395015	744845	71890	.50	K	2/23/89	3
62537	3129069	395024	744905	71890	.50	K	2/23/89	4
62537	3129070	395027	744902	71890	.50	K	2/23/89	2
62537	3129071	395023	744859	71890	.50	K	2/23/89	3
62537	3129072	395021	744900	71890	.50	K	2/23/89	4
62537	3129073	395021	744903	71890	.50	K	2/23/89	4
63304	3126806	393838	750529	71890	2.00	K	5/19/89	4
63304	3126807	393835	750532	71890	1.00		4/28/88	4
63304	3126808	393837	750533	71890	1.00		4/28/88	4
63843	3610185	392320	743746	71890	1.00		1/12/90	3
63843	3610183	392320	743746	71890	.50	K	1/16/89	4
63843	3610184	392320	743746	71890	.50	K	1/12/90	3
63843	3610186	392320	743746	71890	.50	K	1/12/90	3
64041	3607323	392659	744112	71890	1.00		5/21/87	3
64041	3607324	392632	744115	71890	1.00		5/21/87	2
64041	3607325	392659	744112	71890	1.00		5/19/88	2
64041	3607326	392632	744115	71890	1.00		5/21/87	2
64351	3695009	392631	742910	71890	1.50		4/11/88	6
64351	3695011	392631	742910	71890	1.20		7/01/88	6
64351	3695010	392631	742910	71890	.70		11/27/89	4
64351	3695012	392631	742910	71890	.20	K	4/11/88	6
64351	3695013	392631	742910	71890	.20	K	4/11/88	7
68675	3215350	395047	744459	71890	.20	K	4/19/93	1
68675	3215351	395047	744459	71890	.20	K	4/19/93	1
68675	3215352	395047	744459	71890	.20	K	4/19/93	1
68675	3215353	395047	744459	71890	.20	K	4/19/93	1
68853	3130163	394213	750800	71890	2.10		10/21/92	8
68853	3323164	394155	750855	71890	.25		1/12/93	3
68853	3130164	394213	750800	71890	.20	K	4/03/90	9
68853	3131242	394155	750855	71890	.20	K	10/23/90	5
68853	3223164	394155	750855	71890	.20	K	10/23/90	3
68853	3323166	394213	750746	71890	.20	K	7/19/90	7
68853	3323167	394213	750800	71890	.20	K	7/18/90	8
69884	3509186	390701	744722	71890	1.00	K	7/17/89	2
70301	3613664	392706	744226	71890	1.00	K	6/25/92	9
70301	3613665	392706	744226	71890	1.00	K	6/25/92	9
70301	3613666	392706	744226	71890	1.00	K	6/25/92	9
70301	3613667	392706	744226	71890	1.00	K	6/25/92	9
70301	3613668	392706	744226	71890	1.00	K	6/25/92	9
70343	3603119	392918	743552	71890	2.00	K	4/07/87	17
70343	3603874	392918	743552	71890	2.00	K	4/07/87	15
70343	3603027	392918	743552	71890	.20	K	11/16/88	9
73849	3606449	392533	743219	71890	.20	K	11/04/92	1
73849	3611347	392600	743400	71890	.20	K	11/04/92	1
73849	3611348	392600	743400	71890	.20	K	11/04/92	1
73849	3611351	392600	743400	71890	.20	K	11/04/92	1
73849	3611384	392535	743229	71890	.20	K	11/04/92	1
73849	3613912	392533	743219	71890	.20	K	11/04/92	1
73849	3615532	392533	743219	71890	.20	K	11/04/92	1
73849	3615539	392536	743200	71890	.20	K	11/04/92	1
75817	3305194	395835	741430	71890	2.00	K	4/29/87	16
75817	3321514	395819	741339	71890	2.00	K	7/08/88	7

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water--Continued

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
75817	3321515	395819	741339	71890	2.00	K	7/07/88	9
75817	3321638	395819	741339	71890	2.00	K	7/08/88	7
75817	3324799	395839	741546	71890	2.00	K	7/11/88	8
75817	3324800	395839	741546	71890	2.00	K	7/11/88	8
75817	3324801	395839	741546	71890	2.00	K	7/13/88	7
75817	3324802	395839	741546	71890	2.00	K	7/15/88	9
75817	4010084	395835	741430	71890	2.00	K	7/06/88	10
75817	3321517	395819	741339	71890	1.00	K	11/07/89	9
75817	3324803	395839	741546	71890	1.00		11/08/88	9
75817	4010081	395835	741430	71890	1.00	K	8/01/90	8
75817	4010082	395835	741430	71890	1.00	K	8/01/90	8
75817	3321639	395819	741339	71890	.50	K	7/06/92	9
75817	3324804	395839	741546	71890	.50	K	7/07/92	9
75817	3324805	395839	741546	71890	.50	K	7/08/92	9
75817	3325786	395853	741333	71890	.50	K	7/08/92	2
75817	3328027	395835	741430	71900	.50	K	8/13/92	2
75817	3328028	395835	741430	71900	.50	K	1/29/92	2
75817	3328551	395835	741430	71900	.50	K	8/11/92	2
75817	3328552	395835	741430	71900	.50	K	8/11/92	2
75817	2101428	395835	741430	71890	.40	K	2/14/90	2
75817	3321516	395819	741339	71890	.40	K	11/09/88	7
75817	3324806	395839	741546	71890	.40		11/08/88	8
75817	3327857	395835	741430	71900	.40	K	2/11/92	2
75817	4010080	395835	741430	71890	.40	K	2/02/89	1
75817	4010083	395835	741430	71890	.40	K	2/02/89	8
80021	2928736	400122	741450	71890	2.20		7/13/93	1
80021	2928735	400123	741450	71890	.20	K	7/13/93	1
80799	3614863	392548	743540	71890	12.00		12/03/91	3
80799	3614866	392548	743540	71890	5.70	K	12/04/91	3
80799	3614865	392548	743540	71890	5.00		12/03/91	3
80799	3614869	392548	743540	71890	4.90		12/04/91	3
80799	3613416	392548	743540	71890	2.00	K	9/17/91	2
80799	3613419	392548	743540	71890	2.00	K	9/17/91	3
80799	3613479	392548	743540	71890	2.00	K	9/18/92	1
80799	3613834	392548	743540	71890	2.00	K	9/17/91	1
80799	3613835	392548	743540	71890	2.00	K	9/17/91	3
80799	3613836	392548	743540	71890	2.00	K	9/17/91	3
80799	3614703	392548	743540	71890	2.00	K	12/04/91	1
80799	3614793	392548	743540	71890	2.00	K	9/17/91	2
80799	3614794	392548	743540	71890	2.00	K	9/17/91	2
80799	3614864	392548	743540	71890	2.00	K	9/16/91	3
80799	3614868	392548	743540	71890	2.00	K	9/16/91	1
80799	3614870	392548	743540	71890	2.00	K	9/17/91	3
81370	3511444	392433	750140	71890	.50	K	9/05/91	7
81370	3512868	392433	750140	71900	.50		11/02/92	4
91243	5100021	394513	745151	71890	.70		1/03/89	4
91243	5100027	394513	745151	71890	.30		7/14/87	5
91243	5100019	394513	745151	71890	.20	K	7/15/87	4
91243	5100020	394513	745151	71890	.20	K	7/15/87	3
91243	5100022	394513	745151	71890	.20	K	7/14/87	4
91243	5100023	394513	745151	71890	.20	K	7/14/87	4
91243	5100024	394513	745151	71890	.20	K	7/14/87	4
91243	5100025	394513	745151	71890	.20	K	7/14/87	4

Table 3a. Maximum mercury concentrations in water from monitoring wells at New Jersey permitted discharges to ground water--Continued

NJPDES permit number	Well identification number	Latitude	Longitude	Parameter code	Maximum mercury concentration (µg/L)	Remarks code	Date sampled	Total number of samples collected over period of record
91243	5100026	394513	745151	71890	.20	K	7/14/87	4
99571	3134186	393524	751113	71890	4.30		5/07/91	3
99571	3119376	393525	751058	71890	3.00		5/07/91	14
99571	3119377	393529	751100	71890	2.00		5/07/91	14
99571	3134188	393525	751048	71890	2.00		5/07/91	4
99571	3119375	393524	751120	71890	1.40		8/13/91	15
99571	3134187	393520	751051	71890	1.00		5/07/91	4
99571	3119374	393521	751054	71890	.90		10/15/87	14



Base modified from U.S. Geological Survey digital data, 1:100,000, 1983, Universal Transverse Mercator projection, Zone 18

Figure 3a. Location and number of sites with New Jersey pollution discharge elimination system (NJPDES) permit for discharges to ground water.