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NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

WATER-RESOURCES INVESTIGATIONS REPORT 03-4337
Water quality--SHEET 4 OF 5
Gordon, A.D., Hydrology of the unconfined Kirkwood-Cohansey aquifer system, Forked River and Cedar, Oyster, Mill, Westecunk, and Tuckerton Creek Basins and adjacent basins in the southern Ocean County area, New Jersey, 1998-99

WATER QUALITY

The Kirkwood-Cohansey aquifer system is a major source of drinking water in the study area; therefore, the quality of water in the aquifer is of great importance. Furthermore, because streamflow in many parts of New Jersey is derived from ground water, protection of the ground-water resource is critical to maintaining surface-water quality. Results of chemical analyses of samples from 10 ground-water and 3 surface-water sites were used to document the general quality of ground water and surface water in the study area since 1978. Because the samples are intended to represent ambient water-quality conditions, samples from wells or surface-water sites located near, or at, landfills and hazardous-waste sites or thought to be affected by contamination were not selected. Analyses of six stream-bottom-material samples also are presented.

All data presented on this sheet were collected and analyzed by the USGS. These data were retrieved from the WATSTORE (National Water Data Storage and Retrieval System) database (available at the USGS office in West Trenton, N.J.), which is maintained by the USGS.

Ground-water samples were collected according to the methods described in Classen (1982) and Wood (1976). Surface-water samples were collected at streamflow-gaging stations using the equal-discharge-increment method described in Ward and Harr (1990) and Brown and others (1970). Stream-bottom-material samples were collected according to the methods described in Radtke (1997). Ten ground-water samples were analyzed for physical and chemical characteristics, major ions, nutrients, trace elements, volatile organic compounds (VOCs), and radionuclides (table 4-1). Four surface-water samples were analyzed for physical and chemical characteristics, major ions, nutrients, trace elements, and bacteria (table 4-2). One of the surface-water samples also was analyzed for herbicides and insecticides. Six stream-bottom material samples were analyzed for nutrients and trace elements (table 4-3). One of the stream-bottom-material samples was analyzed for polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). Water samples were analyzed according to the methods described by Fishman and Friedman (1989), Wershaw and others (1987), and Skougstad and others (1979). Procedures used to collect samples to be analyzed for pesticides and VOCs are described in Sandstrom (1990, 1995); analytical methods are described in Connor and others (1998) and Zaugg and others (1995). Gross alpha-particle and gross beta-particle activity were determined by using procedures approved by the U.S. Environmental Protection Agency (USEPA) (Krieger and Whittaker, 1980).

The results of analysis of the ground-water, surface-water, and stream-bottom-material samples are presented in tables 4-1, 4-2, and 4-3, respectively. Calcium, chloride, fluoride, magnesium, potassium, silica, sodium, and sulfate constitute the major ions; nitrate, nitrite, ammonia, and phosphorous species constitute the nutrients. Trace elements are metals and nonmetals that generally are found in low concentrations (less than 1 mg/L) in natural waters (Hem, 1985, table 13). These constituents include aluminum, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, selenium, silver, and zinc. VOCs are synthetic organic compounds that are components of gasoline, diesel and other fuels, and solvents and other industrial organic chemicals. Radionuclides in drinking-water supplies are measured in terms of gross alpha- and beta-particle activity, or concentrations or activities of other specific isotopes, such as thorium and cesium. Total coliform and fecal coliform bacteria are standard indicators of microbial contamination by sewage or other fecal matter. Insecticides and herbicides include a wide range of chemicals used to control insects and weeds. PAHs and PCBs are classes of synthetic organic compounds that sorb or bind strongly to sediments, soil particles, and organic matter.

Ground Water

The chemical characteristics of ground water are affected by temperature, pressure, duration of contact and geochemical reactions with lithologic materials, and human activities that introduce contaminants into the ground water. Water has the capacity, through various chemical processes, to dissolve and transport at least small amounts of almost all substances that it contacts (Heath, 1987, p. 64). The water quality in an unconfined aquifer system, such as the Kirkwood-Cohansey aquifer system, can vary more than that in a confined aquifer system because of the water table's proximity to land surface and the absence of an overlying regional confining unit, which can impede the downward movement of surface-related constituents; therefore, unconfined ground water can be affected easily by the presence of constituents related to human activities.

The results of analysis of 10 ground-water samples collected during 1981-83 and 1996 are presented in table 4-1. Those samples were selected to represent the water quality in the Kirkwood-Cohansey aquifer system in various parts of the study area, and had been analyzed for chemical constituents that were considered to reflect ambient water quality.

Results of ground-water analyses in table 4-1 were compared with USEPA and New Jersey drinking-water regulations established in accordance with the Federal Safe Drinking Water Act (SDWA) (P.L. 93-523) and the N.J. Safe Drinking Water Act, respectively (Shelton, 1996). All regulations promulgated by the USEPA are adopted automatically by the State of New Jersey; however, New Jersey has established its own drinking-water regulations, which are based on the Federal regulations but may be more stringent than them (Shelton, 1996). From the data shown in table 4-1, no regulated constituents were present in the ground-water samples in concentrations that exceeded NJDEP primary drinking-water standards, also called maximum contaminant levels (MCLs) (Shelton, 1996). An MCL is the highest amount of a specific contaminant allowed in the water delivered to any customer of a public water system (Shelton, 1996). MCLs are set by Federal and State agencies to protect the public health, and are enforceable under the authority of the N.J. Safe Drinking Water Act.

Concentrations of the VOCs listed in table 4-1 were less than the detection limit, and concentrations of all regulated compounds that were detected were less than the NJDEP MCL. Radionuclide activities were relatively low, less than 4 pCi/L (picocuries per liter). The gross alpha-particle activities in the samples were less than the NJDEP MCL of 15 pCi/L (Shelton, 1996). The gross beta-particle activities in the samples were less than the routine monitoring requirement screening level of 15 pCi/L (the level at which more detailed testing is required) (U.S. Environmental Protection Agency, 2000, p. 21,596).

Concentrations of two constituents exceeded the NJDEP secondary maximum contaminant level (SMCL) (Shelton, 1996). An SMCL is the limit for the concentration, amount, or level of a contaminant that affects the aesthetic quality of drinking water, such as taste, odor, and color. SMCLs are intended as guidelines and represent reasonable goals for drinking-water quality but are not enforceable (Shelton, 1996). The SMCL of 300 µg/L for iron was exceeded in ground-water samples from 2 of the 10 wells sampled. The pH of all 10 ground-water samples was less than the SMCL range of 6.5 to 8.5 units.

Ground-water quality can be related to the land use in the vicinity of the well, the well's location within the regional flow system, and the mineralogy of the local aquifer material. Three land-use regions are found in the study area. The western part of the study area is mostly in the New Jersey Pinelands (fig. 4-1); the eastern part is primarily wetlands, with urban development along the coast. Because the study area is mostly undeveloped and nonagricultural, concentrations of nitrate are expected to be relatively low when compared to concentrations sometimes found in agricultural areas. In urban areas, sources of nitrate include lawn fertilizers, septic-system wastes, leakage from sewer pipes, and industrial wastes (Clawges and others, 1999). Urban runoff and tidal effects can elevate concentrations of sodium and chloride in ground water. Localized saltwater intrusion exists in areas near Barnegat Bay (New Jersey Department of Environmental Protection, 1996b). The aquifer material is predominantly quartz sand, which does not dissolve readily in ground water.

Stiff diagrams for the 10 ground-water samples are plotted in figure 4-1. These diagrams represent the concentrations, in milliequivalents per liter, of the major cations to the left of the vertical axis and those of the major anions to the right of the vertical axis. Differences in the ionic composition of the samples can be evaluated by comparing the shapes of the diagrams. Despite some variations, the Stiff diagrams indicate that sodium and potassium were the predominant cations in all ground-water samples collected in the study area, and chloride was the predominant anion. The width of the diagram is an approximate indication of the total ionic content of the ground-water samples (Hem, 1985).

The Kirkwood-Cohansey aquifer system contains dilute (low ionic strength), acidic waters that have little buffering capacity. Because the low pH of the ground water in the study area causes the carbonate ion to be present primarily in the form of carbonic acid (H_2CO_3), concentrations of bicarbonate and carbonate in the ground water commonly are low. High dissolved-iron concentrations (1,700 and 1,100 µg/L, respectively) were observed in 2 of the 10 ground-water samples (table 4-1). The dissolved iron in the sample from well 29-798 may be derived from iron coatings on the quartz sand, or from detrital iron oxide, which typically dissolves in water with a low dissolved-oxygen content (Kozinski and others, 1995). The concentration of dissolved iron also was high in the sample from well 29-513, despite a dissolved-oxygen concentration of 4.7 mg/L. Well 29-513 is only 21 ft deep; therefore, the high dissolved-oxygen concentration may be the result of atmospheric oxygen mixing with the ground water during sampling.

Surface Water

The results of analysis of four surface-water samples collected along the lengths of three streams in the study area during 1978 and 1999 are presented in table 4-2. These samples were selected because they were considered to be representative of the surface-water quality in the study area and had been analyzed for constituents that were considered to reflect ambient water quality. One of the samples also was analyzed for various commonly used herbicides, insecticides, and degradation by-products of insecticides.

USEPA drinking-water regulations do not apply to untreated surface water. Instead, surface-water standards that vary according to the use of a surface-water body or stream segment have been developed by the State of New Jersey (New Jersey Department of Environmental Protection, 1998). Because these standards vary across the study area, they are not used in this report as a regional index with which to compare surface-water quality.

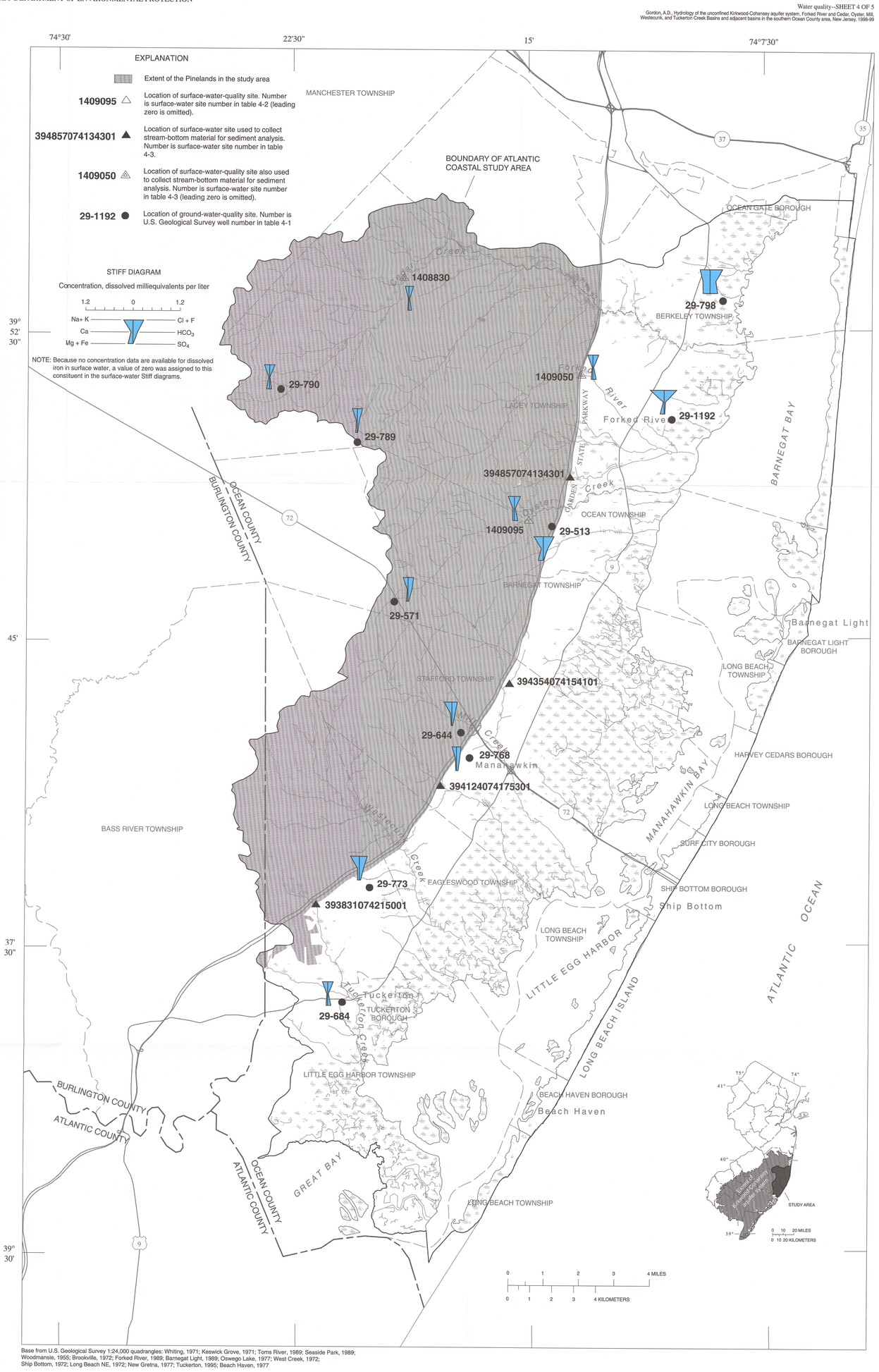
The ionic composition of the surface-water samples reflects the chemistry of the ground water that discharges to the streams and that of precipitation. The chemical characteristics of the surface water are affected by the physical and chemical characteristics of the drainage basin, such as quantity and quality of precipitation, base flow, and runoff; population, land use, and impervious area; presence or absence of effluent discharges; and other factors. The surface-water samples, like ground-water samples, were acidic (low pH) and contained only low concentrations of nutrients. Concentrations of all herbicides, insecticides, and degradation by-products of insecticides analyzed for were less than the respective detection limits (table 4-2).

Stiff diagrams for three surface-water samples are plotted in figure 4-1. (Because the surface-water samples were not analyzed for dissolved iron, this constituent is not shown.) The Stiff diagrams indicate that, as in the ground-water samples, sodium and potassium were the predominant cations and chloride was the predominant anion. Concentrations of calcium and bicarbonate were lower than those of the other cations shown.

Urban runoff and tidal effects can elevate concentrations of sodium and chloride in surface water. The application of deicing salts on roads during winter in New Jersey can lead to an increase in concentrations of both sodium and chloride in surface water (Robinson and others, 1996; Heisig, 2000). The pH of the surface-water samples (4.4–4.5) was lower than that of the ground-water samples, probably as a result of acidic precipitation. Results of previous investigations of a drainage basin adjacent to the study area show that hydrogen was the predominant cation in precipitation (Johnsson and Barringer, 1993), and the pH of the precipitation samples ranged from 4.1 to 4.7 (Lord and others, 1990).

Stream-Bottom Material

Six samples of stream-bottom material were analyzed for metallic trace elements and nutrients (table 4-3). One sample was analyzed for PAHs and PCBs. Concentrations of PAHs were less than the minimum reporting level (MRL) (50 µg/kg (micrograms per kilogram) dry weight). (The MRL is the lowest measured concentration of a constituent that may be reliably reported using a given analytical method (Timme, 1995)). The concentration of PCBs was less than the MRL of 5 µg/kg dry weight.



Base from U.S. Geological Survey 1:24,000 quadrangles: Whiting, 1971; Keswick Grove, 1971; Toms River, 1989; Seaside Park, 1989; Woodmansie, 1955; Brookville, 1972; Forked River, 1989; Barnegat Light, 1989; Oswego Lake, 1977; West Creek, 1972; Ship Bottom, 1972; Long Beach NE, 1972; New Gretna, 1977; Tuckerton, 1995; Beach Haven, 1977

Figure 4-1. Locations of water-quality and stream-bottom-material sampling sites, and Stiff diagrams showing the ionic composition of water from the Atlantic Coastal study area, New Jersey.

Table 4-1. Selected results of water-quality analyses of ground-water samples from 10 wells screened in the Kirkwood-Cohansey aquifer system, Atlantic Coastal study area, New Jersey

[Site locations are shown in figure 4-1; NGVD, National Geodetic Vertical Datum of 1929; µS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; --, no reported value; mg/L, milligrams per liter; µg/L, micrograms per liter; constituents not detected in a sample are reported as the value of the method reporting level for that analysis preceded by a "less-than" symbol (<); wat fit, filtered water; wat unfit, unfiltered water; M, presence of material verified, but not quantified; number in parentheses is parameter code used to identify the constituent, property, or characteristic in the U.S Geological Survey water-quality database; Th, Thorium; Cs, Cesium; pCi/L, picocuries per liter]

U.S. Geological Survey well number	Latitude[1]	Longitude[1]	Sampling date	Depth of well (feet below land surface)	Elevation of land-surface datum (feet above NGVD 29)	Temperature, water (°C) (00010)	Specific conductance, wat unfit (µS/cm) at 25 °C (00095)	Dissolved oxygen, (mg/L) (00300)	Dissolved oxygen, (percent saturation) (00301)	pH, wat unfit (standard units) (00400)
29- 513	394744	741418	09-26-96	21	44.2	13.1	49	4.7	44	5.7
29- 571	394554	741920	12-15-81	146	150	5.5	27	--	--	6.4
29- 644	394242	741713	02-17-82	78	70	11.0	--	--	--	5.8
29- 684	393610	742100	09-05-96	90	20	16.0	32	4.6	46	4.8
29- 768	394205	741657	05-06-82	154	75	12.0	29	--	--	5.7
29- 773	393855	742008	06-02-83	37	45	12.5	33	9.8	92	5.6
29- 789	394949	742029	09-26-96	69	200	17.1	20	--	--	5.2
29- 790	395107	742255	09-24-96	51	155	11.8	30	8.9	82	4.9
29- 798	395314	740850	09-03-96	55	5	13.2	98	.3	3	5.8
29-1192	395021	741028	10-01-96	110	11	13.5	61	.4	4	5.0

U.S. Geological Survey well number	Hardness, wat unfit (mg/L as $CaCO_3$) (00900)	Calcium, wat fit (mg/L) (00915)	Magnesium, wat fit (mg/L) (00925)	Potassium, wat fit (mg/L) (00935)	Sodium, wat fit (mg/L) (00930)	Alkalinity, wat unfit, fixed-end point field[2] (mg/L as $CaCO_3$) (00410)	Alkalinity, wat unfit, fixed-end point lab[3] (mg/L as $CaCO_3$) (90410)	Bicarbonate, wat unfit, incremental titration field (mg/L) (99440)	Chloride, wat fit (mg/L) (00940)	Fluoride, wat fit (mg/L) (00950)
29- 513	6	0.99	0.76	0.5	5.1	7	6	7.0	9.4	<0.1
29- 571	2	.35	.38	.3	2.7	5	--	--	5.0	--
29- 644	2	.64	.18	.3	4.4	4	--	--	5.0	--
29- 684	3	.42	.41	1.0	2.5	1	1	1.0	4.7	<.1
29- 768	2	.45	.16	.2	2.5	4	--	--	4.0	--
29- 773	5	.98	.55	.3	5.0	--	5	--	6.6	<.1
29- 789	3	.42	.47	.3	2.6	3	3	3.0	4.5	<.1
29- 790	5	.48	.88	.4	2.8	2	2	2.0	4.6	<.1
29- 798	15	3.60	1.40	.9	5.2	8	5	9.0	11.0	<.1
29-1192	6	.43	1.20	.7	7.6	3	2	2.0	11.0	<.1

U.S. Geological Survey well number	Silica, wat fit (mg/L) (00955)	Sulfate, wat fit (mg/L) (00945)	Ammonia + org-N, wat fit (mg/L as N) (00623)	Ammonia, wat fit (mg/L as N) (00608)	Nitrite + nitrate, wat fit (mg/L as N) (00631)	Nitrite, wat fit (mg/L as N) (00613)	Ortho-phosphate, wat fit (mg/L as P) (00671)	Alumi-num, wat fit (µg/L) (01106)	Arsenic, wat fit (µg/L) (01000)	Barium, wat fit (µg/L) (01005)
29- 513	6.5	0.3	<0.20	<0.015	<0.050	<0.010	<0.010	<5	<1.0	29
29- 571	--	<1.0	<.10	<.100	<.010	<.010	<.010	--	--	<100
29- 644	--	1.0	.36	--	.030	<.010	.010	--	--	<100
29- 684	15.0	3.9	<.20	<.015	.060	<.010	<.010	48	<1.0	20
29- 768	--	2.0	.10	<.050	.030	<.010	<.010	--	--	<100
29- 773	7.1	1.2	.78	<.050	<.100	<.010	--	10	1.0	--
29- 789	5.2	.6	<.20	.030	<.050	<.010	<.010	32	<1.0	12
29- 790	4.5	2.5	<.20	<.015	.460	.020	<.010	32	<1.0	16
29- 798	13.0	9.3	<.20	.120	.510	.010	.010	10	<1.0	19
29-1192	6.1	.8	<.20	.020	1.40	<.010	<.010	13	<1.0	29

U.S. Geological Survey well number	Beryl-lium, wat fit (µg/L) (01010)	Cadmium, wat fit (µg/L) (01025)	Chromium, wat fit (µg/L) (01030)	Copper, wat fit (µg/L) (01040)	Iron, wat fit (µg/L) (01046)	Lead, wat fit (µg/L) (01049)	Manga-nese, wat fit (µg/L) (01056)	Mercury, wat fit (µg/L) (71890)
29- 513	--	<1.0	<1.0	<1	1,100	--	22	<0.1
29- 571	<5	<5.0	<50.0	30	140	<100	17	--
29- 644	<5	<5.0	<50.0	130	50	<100	<10	--
29- 684	--	<1.0	<1.0	330	130	2	8	<.1
29- 768	<5	<5.0	<50.0	<20	60	<100	<10	--
29- 773	--	2.0	<1.0	10	M	1	8	<.5
29- 789	--	<1.0	<1.0	2	20	7	5	<.1
29- 790	--	<1.0	<1.0	<1	<3	<1	7	<.1
29- 798	--	<1.0	<1.0	<1	1,700	<1	30	.2
29-1192	--	<1.0	<1.0	8	40	<1	14	.3

U.S. Geological Survey well number	Sele-nium, wat fit (µg/L) (01145)	Silver, wat fit (µg/L) (01075)	Zinc, wat fit (µg/L) (01090)	Organic carbon, wat fit (µg/L) (00681)
29- 513	<1.0	<1	--	0.20
29- 571	<5	<1.0	40	<.30
29- 644	--	<10	10	<.30
29- 684	<1.0	<1	21	.10
29- 768	--	<10	--	.20
29- 773	--	--	14	.60
29- 789	<1.0	<1	18	.80
29- 790	<1.0	<1	<3	.40
29- 798	<1.0	<1	31	.60
29-1192	<1.0	<1	<3	.20

[1]Latitude and longitude are in degrees, minutes, and seconds and are referenced to the North American Datum of 1927.
[2]Analysis done by using whole-water total fixed-endpoint titration.
[3]Analysis done by using whole-water titration to pH 4.5.

Table 4-1. Selected results of water-quality analyses of ground-water samples from 10 wells screened in the Kirkwood-Cohansey aquifer system, Atlantic Coastal study area, New Jersey--Continued

Volatile organic compounds

U.S. Geological Survey well number	Xylenes, wat unfit (µg/L) (81551)	1,1,1-Tri-chloro-ethane, wat unfit (µg/L) (34506)	1,1-Di-chloro-ethane, wat unfit (µg/L) (34496)	1,1,-Di-chloro-ethene, wat unfit (µg/L) (34501)	1,2-Di-chloro-ethane, wat unfit (µg/L) (32103)	1,2-Di-chloro-propane, wat unfit (µg/L) (34541)	trans-1,2-Di-chloro-ethene, wat unfit (µg/L) (34546)	1,3-Di-chloro-benzene, wat unfit (µg/L) (34566)
29- 513	<0.2	<0.20	<0.20	<0.20	<0.2	<0.20	<0.20	<0.20
29- 571	--	--	--	--	--	--	--	--
29- 644	--	--	--	--	--	--	--	--
29- 684	--	--	--	--	--	--	--	--
29- 768	--	--	--	--	--	--	--	--
29- 773	--	--	--	--	--	--	--	--
29- 789	<.2	<.20	<.20	<.20	<.2	<.20	<.20	<.20
29- 790	<.2	<.20	<.20	<.20	<.2	<.20	<.20	<.20
29- 798	<.2	<.20	<.20	<.20	<.2	<.20	<.20	<.20
29-1192	--	--	--	--	--	--	--	--

Volatile organic compounds

U.S. Geological Survey well number	1,4-Di-chloro-benzene, wat unfit (µg/L) (34571)	1,2-Dichloro-benzene, wat unfit (µg/L) (34536)	Benzene, wat unfit (µg/L) (34030)	Tri-bromo-methane, wat unfit (µg/L) (32104)	Tetra-chloro-methane, wat unfit (µg/L) (32102)	Chloro-benzene, wat unfit (µg/L) (34301)	Di-bromo-chloro-methane, wat unfit (µg/L) (32105)	Tri-chloro-methane, wat unfit (µg/L) (32106)
29- 513	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.80
29- 571	--	--	<1.00	--	--	--	--	--
29- 644	--	--	<1.00	--	--	--	--	--
29- 684	--	--	--	--	--	--	--	--
29- 768	--	--	<1.00	--	--	--	--	--
29- 773	--	--	--	--	--	--	--	--
29- 789	<.20	<.20	30	<.20	<.20	<.20	<.2	1.50
29- 790	<.20	<.20	<.20	<.20	<.20	<.20	<.2	2.20
29- 798	<.20	<.20	<.20	<.20	<.20	<.20	<.2	<.20
29-1192	--	--	--	--	--	--	--	--

Volatile organic compounds

U.S. Geological Survey well number	cis-1,2-Di-chloro-ethene, wat unfit (µg/L) (77093)	Bromo-di-chloro-methane, wat unfit (µg/L) (32101)	Di-chloro-di-fluoro-methane, wat unfit (µg/L) (34668)	Ethyl-benzene, wat unfit (µg/L) (34371)	Freon-113, wat unfit (µg/L) (77652)	Methyl tert-butyl ether, wat unfit (µg/L) (78032)	Di-chloro-methane, wat unfit (µg/L) (34423)	Styrene, wat unfit (µg/L) (77128)
29- 513	<0.20	<0.20	<0.2	<0.20	<0.20	<0.2	<0.2	<0.20
29- 571	--	--	--	<1.00	--	--	--	--
29- 644	--	--	--	<1.00	--	--	--	--
29- 684	--	--	--	--	--	--	--	--
29- 768	--	--	--	<1.00	--	--	--	--
29- 773	--	--	--	--	--	--	--	--
29- 789	<.20	<.20	<.2	<.20	<.20	<.2	<.2	<.20
29- 790	<.20	<.20	<.2	<.20	<.20	<.2	<.2	<.20
29- 798	<.20	<.20	<.2	<.20	<.20	<.2	<.2	<.20
29-1192	--	--	--	--	--	--	--	--

Volatile organic compounds and radionuclides

U.S. Geological Survey well number	Tetrachloro-ethene, wat unfit (µg/L) (34475)	Toluene, wat unfit (µg/L) (34010)	Tri-chloro-ethene, wat unfit (µg/L) (39180)	Tri-chloro-fluoro-methane, wat unfit (µg/L) (34488)	Vinyl chloride, wat unfit (µg/L) (39175)	Alpha radio-activity, 2 sigma, wat fit, Th-230 (pCi/L) (75987)	Alpha radio-activity, wat fit, Th-230 (pCi/L) (04126)	Beta radio-activity, 2 sigma, wat fit, Cs-137 (pCi/L) (75989)	Gross beta radio-activity, wat fit, Cs-137 (pCi/L) (03515)
29- 513	<0.2	<0.20	<0.20	<0.20	<0.2	0.54	<3.00	0.69	<4.00
29- 571	--	<1.00	--	--	--	--	--	--	--
29- 644	--	--	--	--	--	.46	<3.00	.74	<4.00
29- 768	--	<1.00	--	--	--	--	--	--	--
29- 773	--	--	--	--	--	--	--	--	--
29- 789	<.2	<.20	<.20	<.20	<.2	.27	<3.00	.61	<4.00
29- 790	<.2	<.20	<.20	<.20	<.2	.45	<3.00	.67	<4.00
29- 798	<.2	<.20	<.20	<.20	<.2	.31	<3.00	.73	<4.00
29-1192	--	--	--	--	--	.48	<3.00	.70	<4.00

Table 4-2. Selected results of water-quality analyses of surface-water samples from three sites, Atlantic Coastal study area, New Jersey

[Site locations are shown in figure 4-1; mi², square miles; µS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; --, no reported value; mg/L, milligrams per liter; µg/L, micrograms per liter; E, estimated value; MPN, most probable number per 100 milliliters; >, greater than; constituents not detected in a sample are reported as the value of the method reporting level for that analysis preceded by a "less-than" symbol (<); wat fit, filtered water; wat unfit, unfiltered water; 0.7 U GF, 0.7 microgram glass-fiber filter; number in parentheses is parameter code used to identify the constituent, property, or characteristic in the U.S. Geological Survey water-quality database]

U.S. Geological Survey surface-water-site number	Surface-water-site name	Sampling date	Drainage area (mi²)	Dissolved oxygen (percent saturation) (00301)	Dissolved oxygen (mg/L) (00300)	pH, wat unfit, field (standard units) (00400)
01409095	Oyster Creek near Brookville, NJ	06-29-78	7.43	--	7.9	4.5
01408830	Cedar Creek at Cedar Crest, NJ	11-17-99	20.1	94	12.3	--
[1]01409050	North Branch Forked River near Forked River, NJ	05-18-99	13.4	93	10.0	4.4
01409050	North Branch Forked River near Forked River, NJ	09-07-99	13.4	75	6.9	4.5

U.S. Geological Survey surface-water-site number	Sampling date	Specific conductance, wat unfit (µS/cm) at 25 °C (00095)	Temperature, water (°C) (00010)	Hardness, wat unfit (mg/L as $CaCO_3$) (00900)	Calcium, wat fit (mg/L) (00915)	Magnesium, wat fit (mg/L) (00925)	Potassium, wat fit (mg/L) (00935)	Sodium, wat fit (mg/L) (00930)	Alkalinity, wat unfit, fixed-end point field[2] (mg/L as $CaCO_3$) (00410)	Alkalinity, wat unfit, fixed-end point, lab[3] (mg/L as $CaCO_3$) (90410)	Chloride, wat fit (mg/L) (00940)
01409095	06-29-78	42	20.0	4	0.70	0.50	0.5	3.3	<1	--	5.6
01408830	11-17-99	27	4.0	3	.56	.32	.4	1.9	--	1	4.0
01409050	05-18-99	39	12.5	3	.37	.47	.3	2.8	--	<1	5.5
01409050	09-07-99	38	19.0	3	.34	.43	.3	2.8	--	<1	5.0

U.S. Geological Survey surface-water-site number	Sampling date	Fluoride, wat fit (mg/L) (00950)	Silica, wat fit (mg/L) (00955)	Sulfate, wat fit (mg/L) (00945)	Ammonia + org-N, wat fit (mg/L as N) (00623)	Ammonia + org-N, wat unfit (mg/L as N) (00625)	Ammonia, wat unfit (mg/L as N) (00610)	Ammonia, wat fit (mg/L as N) (00608)	Ammonia, wat unfit (mg/L) (71845)	Total nitrogen, wat unfit (mg/L) (00600)	Nitrite + nitrate, wat fit (mg/L as N) (00631)
01409095	06-29-78	--	--	4.3	--	0.15	<0.01	--	--	0.16	--
01408830	11-17-99	<.1	5.7	3.1	E.10	.16	.03	<.030	.04	--	<.037
01409050	05-18-99	<.1	2.0	3.5	.13	.14	--	<.030	--	--	<.050
01409050	09-07-99	<.1	5.5	4.0	E.10	E.10	<.03	<.030	--	--	<.050

U.S. Geological Survey surface-water-site number	Sampling date	Nitrite, wat fit (mg/L as N) (00613)	Nitrite, wat fit (mg/L) (71856)	Total nitrogen, wat unfit (mg/L as NO_3) (71887)	Ortho-phos-phate, wat unfit (mg/L as P) (70507)	Organic, carbon, wat fit (mg/L) (00681)	Biochemical oxygen demand, 5-day[4], wat unfit (mg/L) (00310)	Residue at 180 °C, wat fit (mg/L) (70300)	Residue, sum of constituents, wat fit (mg/L) (70301)	Boron, wat fit (µg/L) (01020)	Barium, wat unfit, recoverable (µg/L as Ba) (01007)
01409095	06-29-78	--	--	0.7	<0.010	--	<1.0	29	--	--	--
01408830	11-17-99	<.003	--	--	--	3.0	<1.0	16	17	E13	--
01409050	05-18-99	.003	.010	--	--	4.2	E1.5	19	--	E9	--
01409050	09-07-99	<.003	--	--	--	4.4	E1.6	26	--	<16	12.5

U.S. Geological Survey surface-water-site number	Sampling date	Beryllium, wat unfit, recoverable (µg/L) (01012)	Cadmium, wat unfit, (µg/L) (01027)	Iron, wat unfit, recoverable (µg/L) (01045)	Lead, wat unfit, recoverable (µg/L) (01051)	Manganese, wat unfit, recoverable (µg/L) (01055)	Nickel, wat unfit, recoverable (µg/L) (01067)	Silver, wat unfit, recoverable (µg/L) (01077)	Fecal coliform, EC broth[5], (MPN)[7] (31615)	Fecal Strepto-cocci, AD-EVA[6] (MPN)[7] (31677)
01409095	06-29-78	--	--	--	--	--	--	--	12	540
01408830	11-17-99	--	--	--	--	--	--	--	--	--
01409050	05-18-99	--	--	--	--	--	--	--	--	--
01409050	09-07-99	<4	<.1	100	<1	4	<2	<1	--	--

Table 4-2. Selected results of water-quality analyses of surface-water samples from three sites, Atlantic Coastal study area, New Jersey--Continued

Herbicides

| U.S. Geological Survey surface-water-site number | Sampling date | Alachlor, wat fit 0.7 U GF (µg/L) (46342) | Atrazine, wat fit 0.7