DESIGN, DEVELOPMENT, AND IMPLEMENTATION OF A GROUND-WATER QUALITY MONITORING NETWORK FOR SOUTHERN NEW CASTLE COUNTY, DELAWARE

PHASE IV – CONTINUED IMPLEMENTATION
RESULTS OF SECOND, THIRD, AND FOURTH QUARTERS OF YEAR 1

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INTRODUCTION

New Castle County will continue to experience increased development of its water resources, especially ground water, for public, domestic, agricultural, and industrial use. At this time, aquifers provide more than 25 million gallons of water each day for all uses. All of the potable water used in southern New Castle County (6.8 MGD) comes from aquifers (Metcalf and Eddy, 1991). Surface water from four major streams is used for water supply in northern New Castle County. Between 60 and 70 percent of water in streams throughout New Castle County is attributable to ground water that has been naturally discharged from seeps and springs. The ground- and surface-water systems function as a related and interconnected hydrologic system.

A significant amount of the ground water used in New Castle County is withdrawn from regional, shallow, water-table aquifer systems. A relatively thin soil zone that acts as a filtering mechanism protects these near-surface aquifers, which naturally receive water from infiltration of precipitation. Favorable hydrologic characteristics coupled with the position of the aquifer close to land surface render it particularly susceptible to contamination. As has been documented in numerous reports (Denver, 1993; Bachman and Ferrari, 1995; Duffield Associates, Inc., 1994; and Ritter, 1987), the chemical quality of water in these systems has been adversely affected by both point and non-point sources of contamination associated with a variety of land uses.

Because most of the water in deeper confined aquifer systems passes through the shallow systems, any contamination of the near-surface aquifers has the potential for affecting the quality of water in confined aquifers.

The need for a well-planned and clearly defined assessment of ground-water quality has been demonstrated to support resolution of complex issues and for making decisions to ensure compatibility between economic development and preservation of water quality for existing and future New Castle County residents and businesses.

Systematic characterization and monitoring of New Castle County's ground-water quality and levels will improve the quality of ground-water management, protection, and development. In addition, it will result in improved access to and exchange of ground-water information among state, county, federal, and local governmental agencies and other water-user groups.

Monitoring the quality of ground water is essential to developing an understanding of southern New Castle County's ground-water resources. Development of this baseline survey of existing ground-water quality is an important first step in the implementation of a monitoring network. These initial data will serve as a baseline from which future results can be compared. Future sampling will indicate the extent to which southern New Castle County's ground-water is improving or declining in quality.

Purpose and Scope

The primary purpose of Phase IV of the investigation was the continued implementation of the ground-water quality monitoring network for southern New Castle County which was designed and developed in Phase I (Baxter and Talley, 1996). Phase IV completed the remainder of an annual cycle of testing which was started in Phase III (Baxter and Talley, 1997). This report is based on water-quality samples collected by the Delaware Geological Survey from July 1996 through June 1997 from 52 water supply and observation wells. Summary statistics are presented for each aquifer system.

Location and Geologic Setting

The area of investigation includes that portion of southern New Castle County in the Atlantic Coastal Plain Physiographic Province. The Chesapeake and Delaware Canal bounds the area on the north. The Delaware River and the Delaware-Maryland and New Castle-Kent County boundaries bound the eastern, western, and southern portions of the study area, respectively (Figure 1). The study area covers more than 200 square miles and includes eleven watersheds. The Delaware River basin portion of the area includes the Chesapeake and Delaware Canal, Augustine Creek, Drawyer Creek, Appoquinimink River, Blackbird Creek, Cedar Swamp, and the Smyrna River watersheds. The Chesapeake Bay basin includes Back Creek, Sandy Branch/ Great Bohemia Creek, Sassafras River, and the Cypress Branch watersheds.

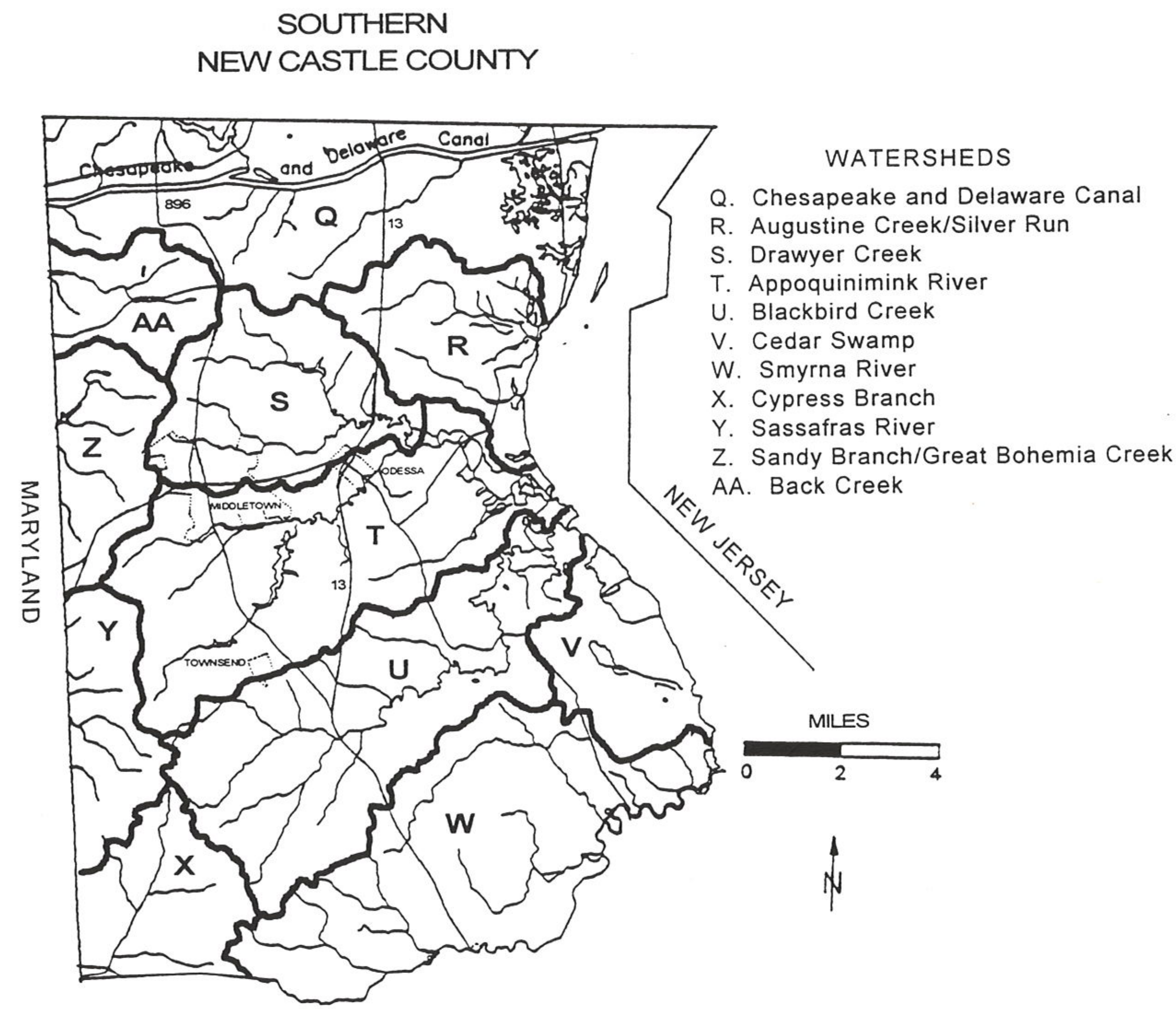


Figure 1. Location of study area.

The area is underlain by unconsolidated gravels, sands, silts, and clays that range in age from Lower Cretaceous through Holocene. Thickness of sedimentary rocks ranges from approximately 600 to 700 ft near the Chesapeake and Delaware Canal to approximately 2,300 ft in southeastern New Castle County. Within this area, the Columbia Formation overlies the truncated edges of older geologic units that dip in a seaward direction. Ground water is withdrawn from the water-table or unconfined aquifers (Columbia and underlying water-table portions of the Englishtown and Mt. Laurel formations and the Rancocas group) as well as from confined aquifers within several of these older units, including the Potomac, Magothy, Englishtown, Mt. Laurel, and Vincentown formations (Figure 2 and Figure 3).

Previous Work

Several investigations have been conducted pertaining to the water quality of southern New Castle County. The most recent of these reports include Bachman and Ferrari (1995), Denver (1993), and Ritter (1987). Bachman and Ferrari (1995) concluded that "considerable degradation" of water quality has occurred in the aquifers in southern New Castle County.

Naturally occurring dissolved iron has degraded water quality in the confined portions of the aquifer systems. Iron concentrations exceeded the U. S. Environmental Protection Agency's (USEPA) Secondary Maximum Contaminant Level (SMCL) of 300 μg/L in many instances in the Englishtown-Mt. Laurel aquifer system and in the Rancocas aquifer. Dissolved iron values consistently exceeded the SMCL value in the Magothy and Potomac aquifers (Bachman and Ferrari, 1995).

Prior to this study, Bachman and Ferrari (1995) conducted the only study with regards to radon in the ground water in southern New Castle County. They reported radon values above a proposed Maximum Contaminant Level (MCL) of 300 pCi/L occurred exclusively in the Englishtown-Mt. Laurel aquifer system and the Rancocas aquifer. Woodruff et al., (1992) looked at the radon potential of the glauconitic sediments in the study area and concluded that radon appears to occur where the underlying geology contains glauconite.

Elevated nitrate concentrations in the unconfined aquifer have been documented in southern New Castle County (Bachman and Ferrari, 1995; Denver, 1993; and Ritter, 1987). Hamilton and others (1993) reported that nitrate concentrations of less than 0.2 mg/L are probably present as a result of natural factors whereas ground water with nitrate concentrations greater than about 0.4 mg/L have been affected by human activity. Bachman and Ferrari (1995) reported elevated nitrate concentrations in the unconfined portion of the Englishtown-Mt. Laurel aquifer system, in the unconfined portion of the Rancocas aquifer and in the

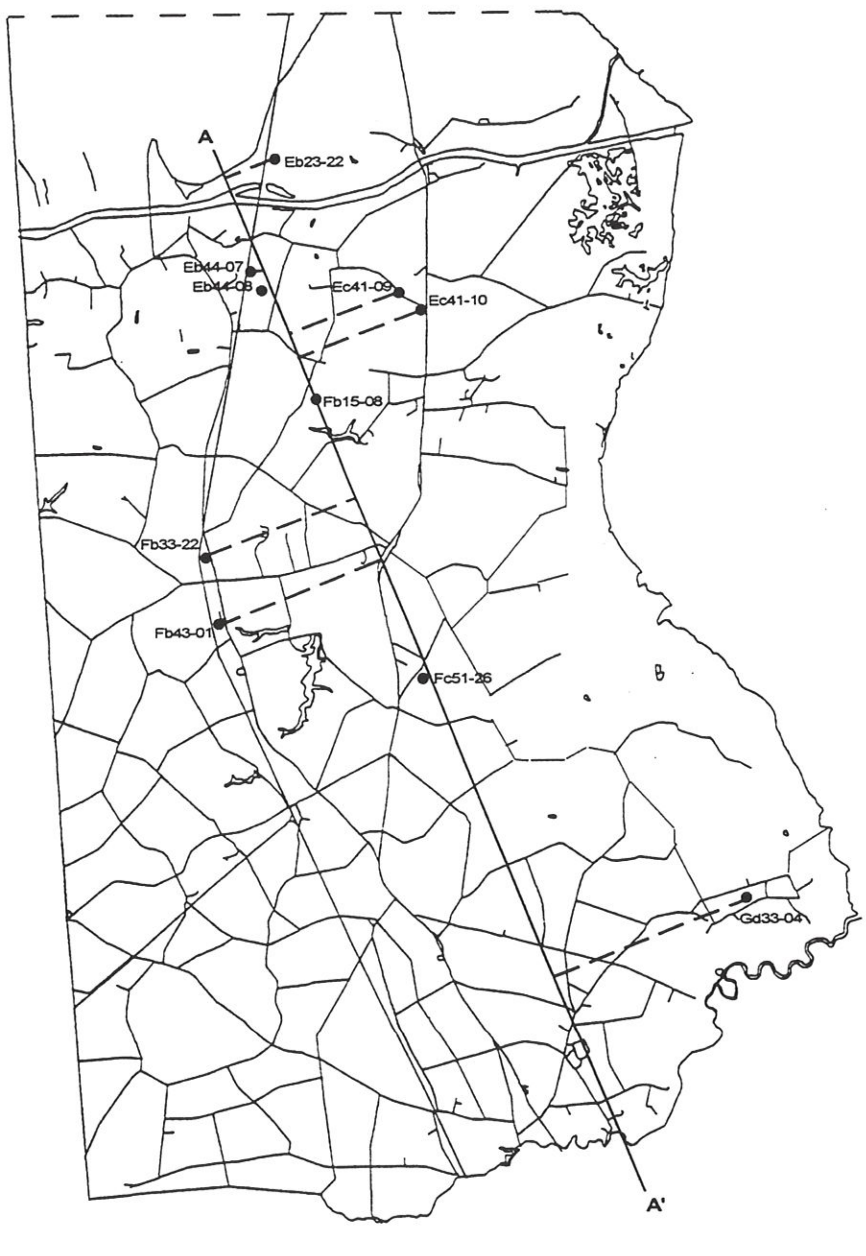


Figure 2. Location of wells shown on cross section in Figure 3.

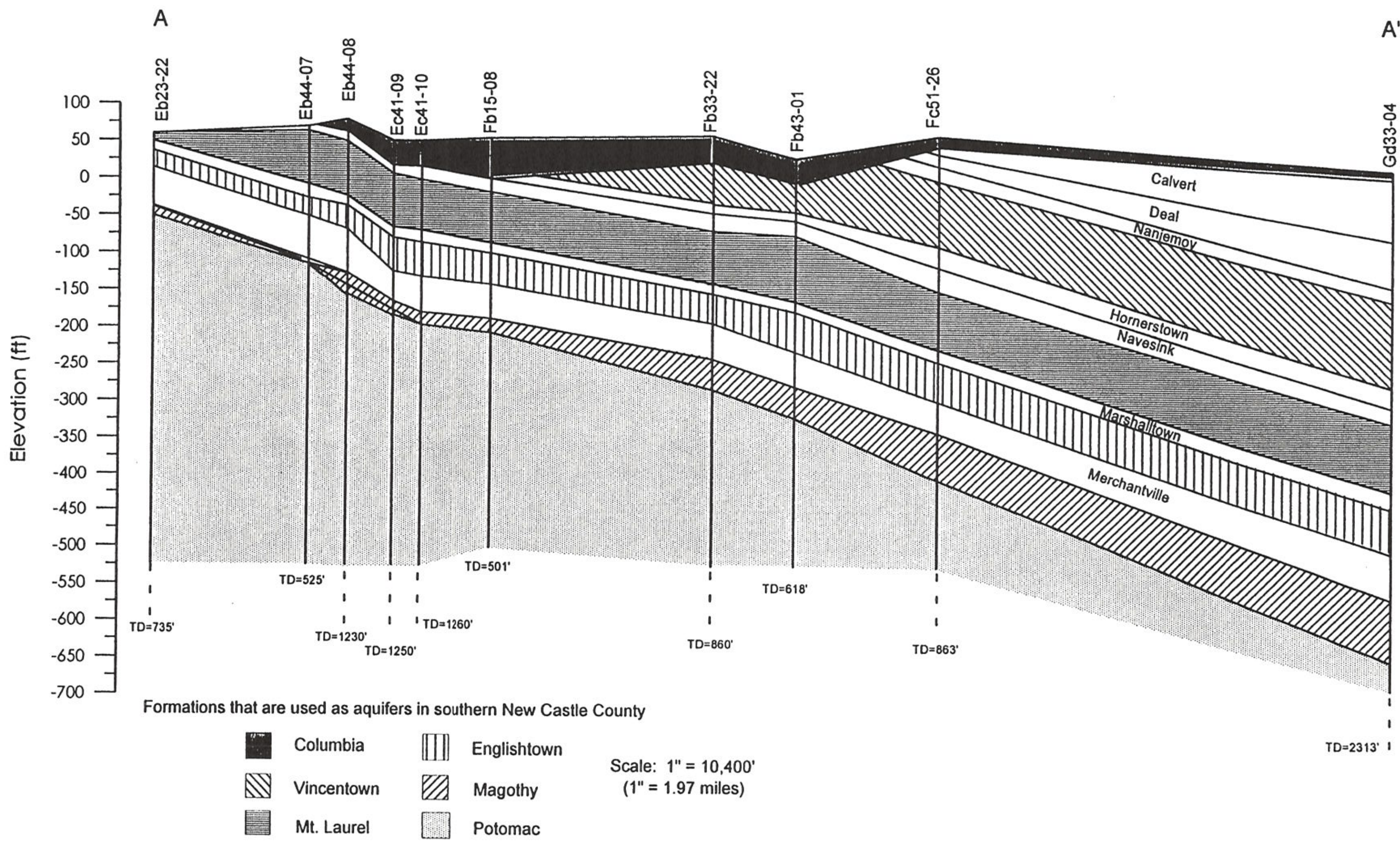


Figure 3. Geologic cross section of southern New Castle County. A-A' line is shown on Figure 2.

Columbia aquifer. Although the elevated nitrate levels were greater than 0.4 mg/L in the Englishtown-Mt. Laurel aquifer system and in the Rancocas aquifer (indicating the effect of human activities), they were below the USEPA MCL of 10 mg/L. This was not the case for the Columbia aquifer, however, where concentrations exceeded 10 mg/L in 22 percent of the samples (Bachman and Ferrari, 1995) and in several samples collected by Ritter (1987). Elevated levels in the confined portions of the entire aquifer system have not been detected.

There have been two investigations in southern New Castle County in which testing for herbicides have been completed. Denver (1993) conducted an investigation in an agricultural land use area near Vandyke in southwestern New Castle County. Sixteen wells were installed in the shallow water-table aquifer at this site. Denver (1993) reported that ". . . triazine herbicides were detected at least once in water from about half of the wells . . ." Denver (1993) reported that "concentrations of most herbicide detections by laboratory analyses were at or near a concentration of 0.1 μg/L" (ppb). Detected concentrations were low and all were less than the USEPA's maximum contaminant and health advisory levels. Ritter (1987) conducted an investigation in the Appoquinimink River watershed and reported that approximately one half (12) of the monitoring wells located in the shallow water-table aquifer had detectable atrazine concentrations above 1.0 ppb and in March 1985, water from eight wells had concentrations at or above the USEPA's MCL of 3.0 ppb.

METHODS OF STUDY

Well Network

Fifty-two wells were sampled throughout southern New Castle County (Figure 4 and Appendix A). The number of wells sampled during Phase IV varies from the original number proposed in Phase I (Baxter and Talley, 1996) due primarily to the inability to locate previously drilled wells in remote locations. The number of wells sampled in Phase IV also varies from the number of wells sampled in Phase III (Baxter and Talley, 1997) due to the addition of several wells, primarily in the Potomac-Magothy aquifer system, into the network.

Water-Sample Collection and Analysis

Ground-water samples were collected quarterly beginning in July 1996 and ending in June 1997. Samples were collected by means of pumps installed in existing wells and a small-diameter Grundfos Redi-Flo2 submersible pump in monitor wells. Wells were purged until pH, temperature and specific conductance stabilized. Three monitor wells, drilled as part of the Appoquinimink Study (Ritter, 1987), were bailed due to their small casing diameters. They were bailed until five casing volumes were removed and prior to sampling.

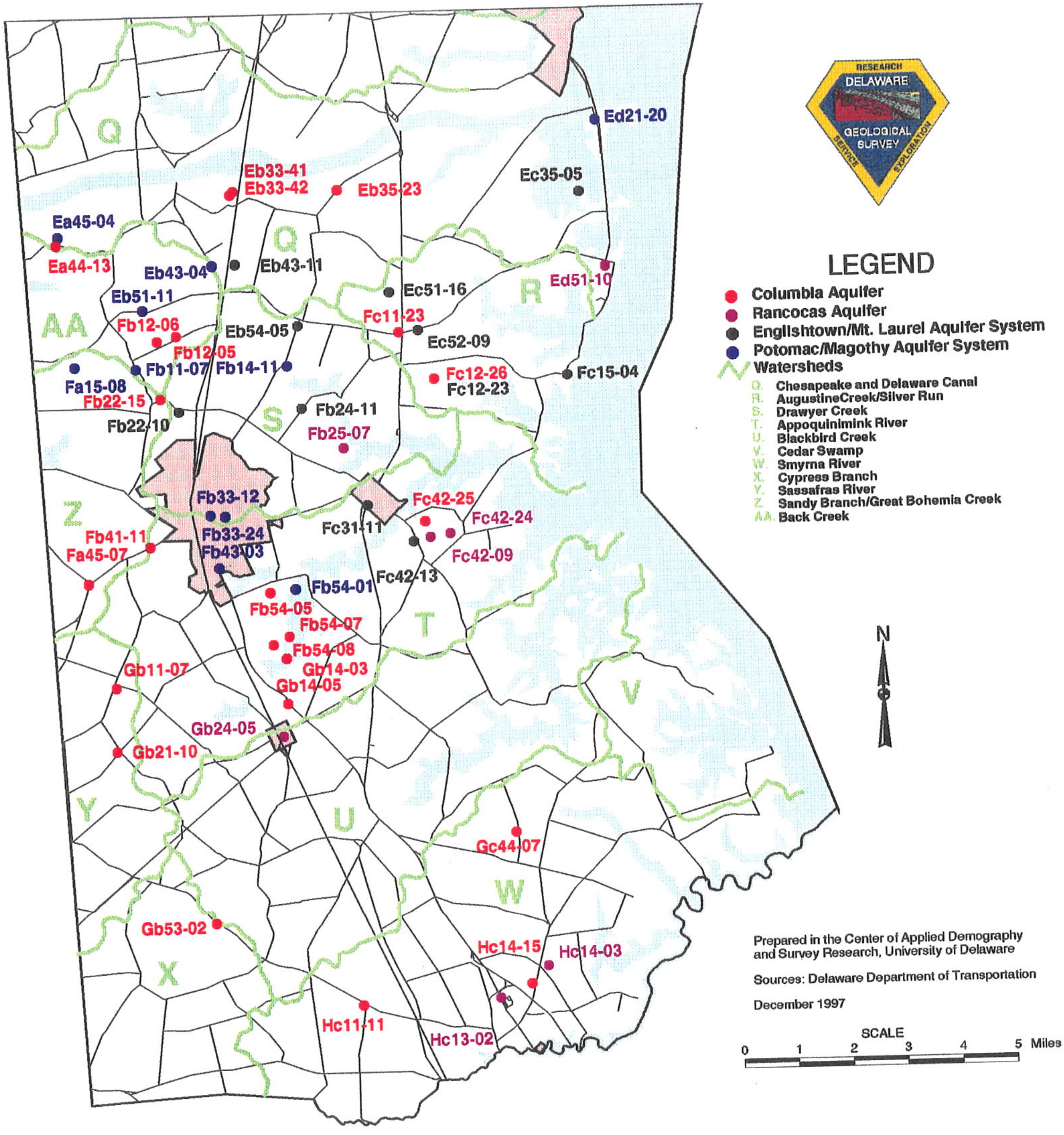


Figure 4. Map showing wells sampled during Phase IV.

Field measurements of temperature, pH, specific conductance, and dissolved oxygen were performed at each well prior to sample collection. Temperature, pH, and specific conductance were measured with a YSI Model 3560 Water-Quality Monitoring System. Dissolved oxygen was determined using the Winkler titration method.

Samples collected during Phase III (first quarter of sampling) for dissolved metals were filtered through a 0.45-micron filter and acidified with approximately 4 milliliters of nitric acid or until the pH was below 2.0. All of the samples were placed in individual baggies, chilled on ice and delivered within hours to the appropriate laboratories: New Castle County Department of Public Works (NCC), Delaware Department of Agriculture (DDA), Delaware Division of Public Health (DPH), or Artesian Laboratories, Inc. Radon samples were collected using a syringe and sampling device designed by the U. S. Geological Survey (USGS) and shipped overnight to the USGS National Laboratory in Denver, Colorado, where analyses were performed.

Results of chemical analyses are stored in a relational database management system at the DGS. Radon results are also stored in the National Water Information System (NWIS) database operated by the USGS.

Statistical analyses were performed using Microsoft Excel. Analysis of data incorporated descriptive, rank and percentile, and quartile statistics.

Quality Assurance and Quality Control

The quality assurance/quality control (QA/QC) program included planned and systematic procedures necessary to provide adequate confidence that the data generated during a project would satisfy quality requirements. The QA/QC plan for Phase IV addressed aspects of sample collection and analysis required to produce reliable data.

Types of QA/QC water samples included blanks and duplicates. Blank samples are a measure of bias and are taken to ensure the data-collection process has not contaminated samples. There are many types of blank samples, each designed to isolate a different part of the data collection process including, for example, sampling, storing, and transporting samples.

Trip blanks, source solution blanks, and equipment blanks were used extensively throughout the sampling process. Trip blanks were used to isolate potential contamination while transporting the samples. Source solution blanks were used to determine if any contamination, if present, was coming from the distilled water obtained from the DGS laboratory and used during the sampling process. Equipment blanks were used primarily to determine if adequate decontamination of equipment was taking place in the field.

Duplicates are used to estimate sample variability. Duplicate samples are a group of samples collected in a manner such that the samples are thought to be essentially identical in composition; they were used extensively throughout sampling.

Quality control procedures were followed as outlined in Phase III (Baxter and Talley, 1997). QA/QC results are listed in Appendices B, C, and D. In addition to the project QA/QC program, all laboratory facilities involved in analyzing the samples routinely conduct internal QA/QC programs.

RESULTS

Thirty-three parameters were measured on most of the wells during the first quarter (Phase III) of sampling. Measurements included those made in the field at each well (pH, eH, temperature, specific conductivity and dissolved oxygen) as well as laboratory analyses of metals, total organic carbon, radon, and pesticides. Radon was sampled once at selected wells from each aquifer system. Pesticides were sampled twice in wells screened in the shallow water-table aquifer.

A discussion of metals, radon, and pesticides is presented in the report for Phase III of the Ground-Water Monitoring Network (Baxter and Talley, 1997). This report will focus primarily on the results of several parameters that were subsequently tested quarterly including pH, iron, nitrate, and chloride. Results of all analyses, however, have been included in Appendix E of this report.

Median values for the majority of the parameters tested quarterly are within the limits established by the USEPA. However, all four aquifer systems (Potomac-Magothy, Englishtown-Mt. Laurel, Rancocas, and Columbia) had at least some results outside the limits established by the USEPA for pH and above the limit established by the USEPA for iron. A total of 193 samples were tested for pH and 49% of the results were outside the SMCL (6.5-8.5) (Figure 5). A total of 192 samples were tested for iron and 46% were greater than the SMCL (0.3 mg/L) (Figure 6). Exceedence of an SMCL does not pose a health risk to the public. A total of 193 samples were tested for nitrate and 61% of the samples had concentrations greater than the background level of 0.4 mg/L (Figure 7) indicating that anthropogenic influences may be affecting all four aquifer systems. However, only 8% of the samples exceeded the MCL of 10 mg/L. These samples were drawn primarily from wells screened in the Rancocas and

Figure 5. Frequency Distribution of pH

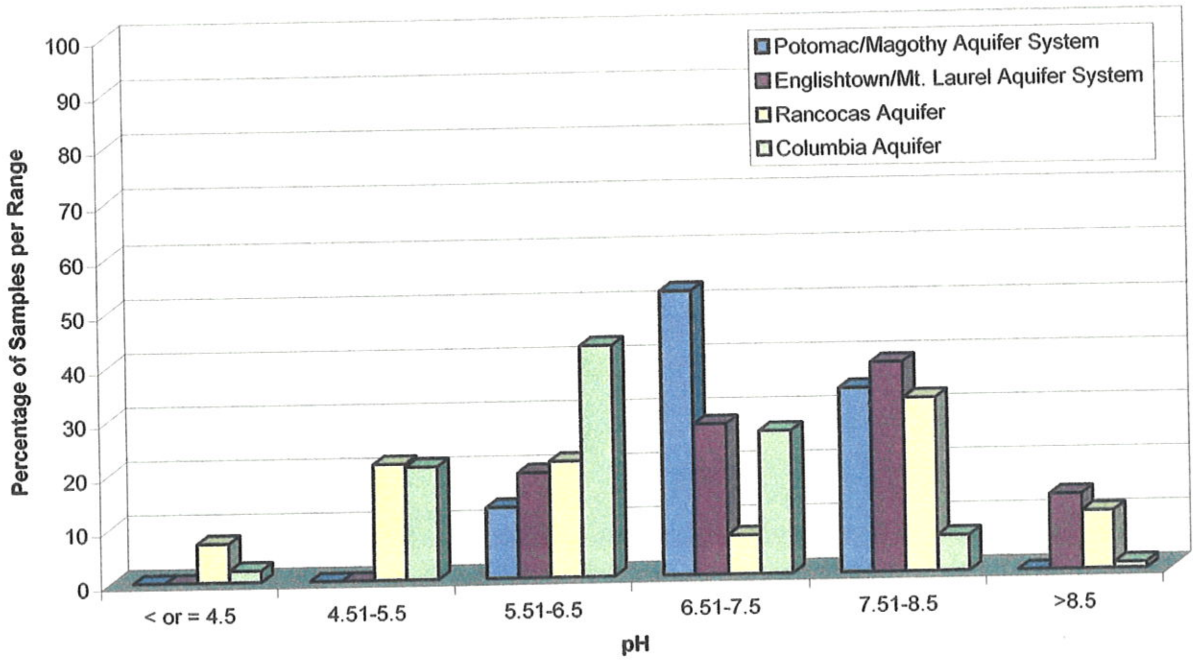


Figure 6. Frequency Distribution of Dissolved Iron

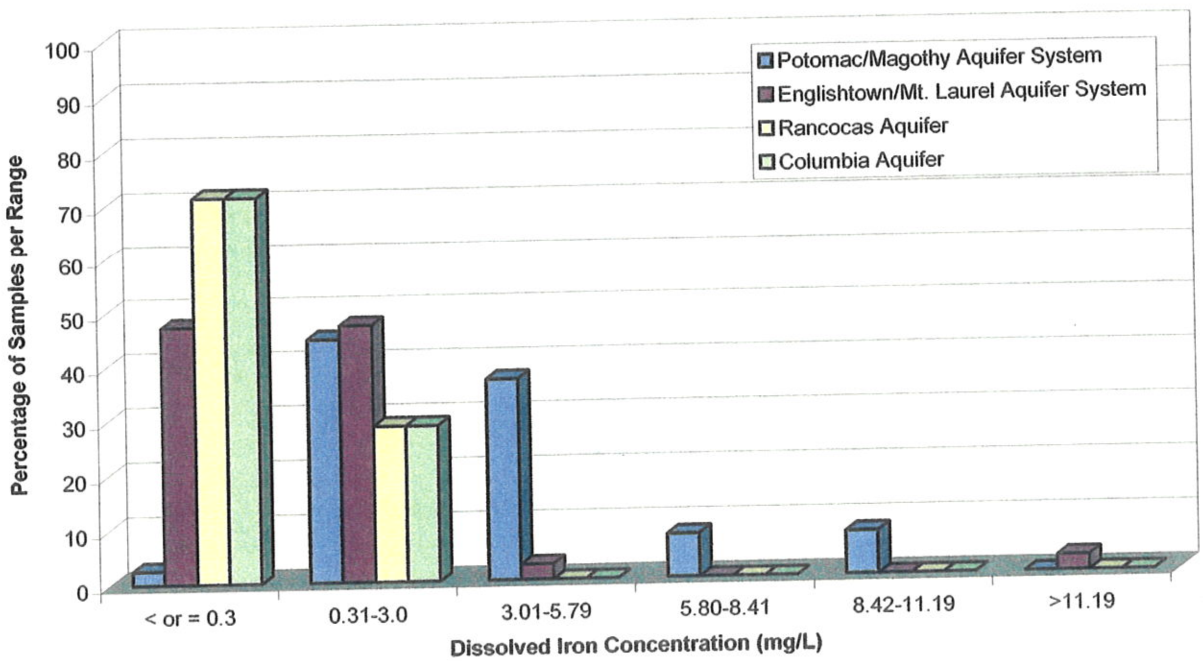
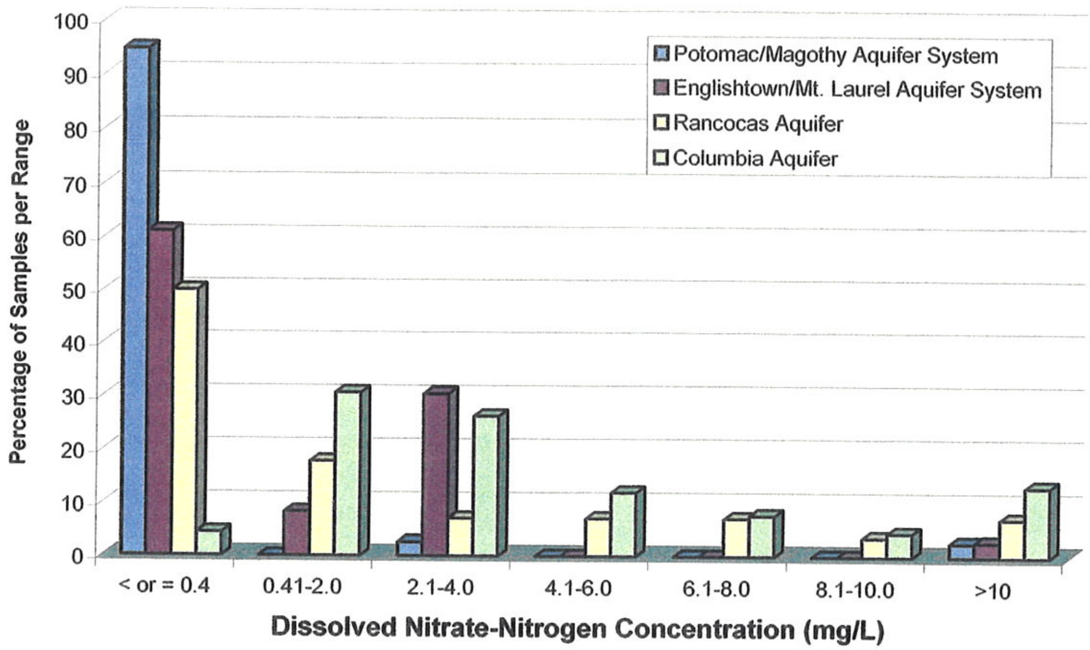
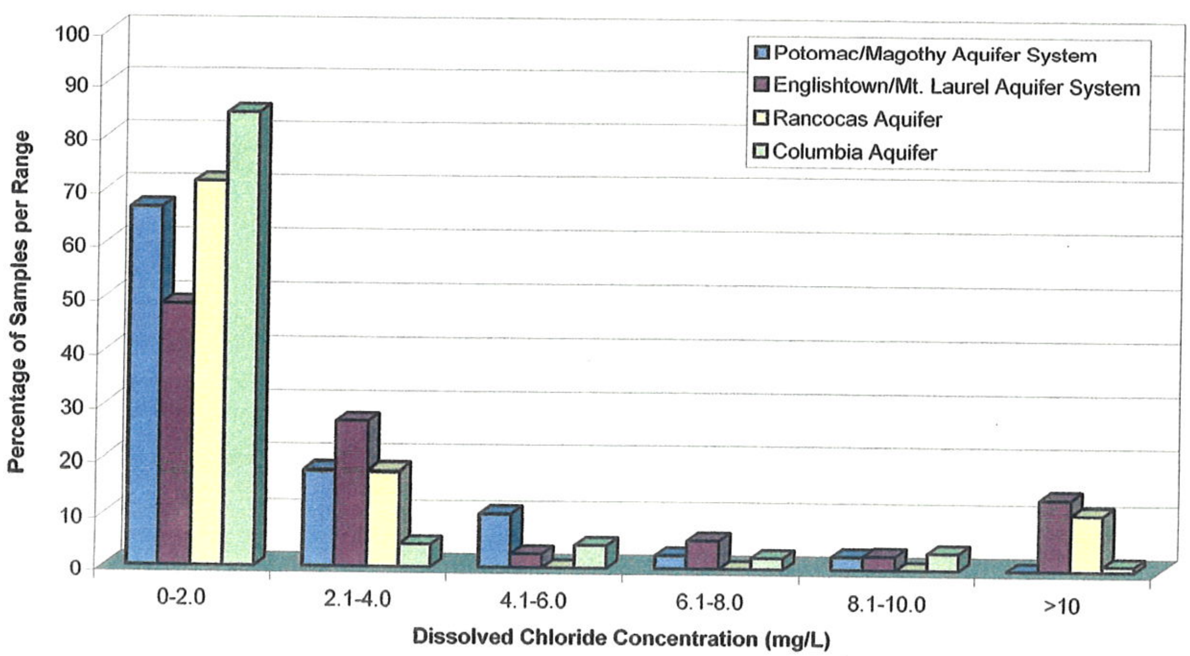


Figure 7. Frequency Distribution of Dissolved Nitrate-Nitrogen



Columbia aquifers. Chloride concentrations were near those of natural water (Denver, 1989) in all four aquifer systems. A total of 194 samples were tested for chloride and approximately 6% of the samples exceeded 10 mg/L which is far below the SMCL of 250 mg/L (Figure 8). One sample drawn from the Columbia aquifer exceeded the SMCL for chloride with a concentration of 363 mg/L.

Figure 8. Frequency Distribution of Dissolved Chloride



Potomac-Magothy Aquifer System

Of the 52 wells sampled, 11 were screened in the Potomac-Magothy aquifer system (Figure 4). The Potomac and Magothy are generally mapped as separate aquifers. However, because they are mineralogically similar and both environments are anoxic, they are considered a single aquifer system for water-quality analyses (Bachman and Ferrari,1995; Hamilton et al., 1991).

The Potomac-Magothy aquifer system can be categorized as having primarily calcium-magnesium-bicarbonate-type water with a few wells yielding sodium-bicarbonate-type water (Baxter and Talley, 1997; Bachman and Ferrari, 1995).

Of 38 samples tested for pH, results were generally within the SMCL range (6.5-8.5) with the exception of five samples (13%) that had pH values slightly below 6.5 (Figure 5).

Iron was detected at values greater than the SMCL (0.3 mg/L) in 97% of the 38 samples drawn from the Potomac-Magothy aquifer system (Figure 6). This was expected since pyrite and siderite are dominant minerals in these units (Benson and Spoljaric, 1996) and produce iron through dissolution.

Nitrate values are consistently low throughout the sampling periods with 95% of 38 samples having values <0.4 mg/L indicating the deeper and confined Potomac-Magothy aquifer system is not being influenced by human activity (Figure 7). The one exception (Ed21-20) had nitrate values of 2.65 mg/L (September 1996) and 15.1 mg/L (March 1997). In January, 1997 the nitrate value at this well was <0.01 mg/L. Due to the high variability of these results, this well will require further study.

Chloride values were consistently low with all eleven wells (39 samples) having average concentrations less than 10 mg/L. These low values indicate that, at this time, salt-water intrusion does not appear to be a problem in this aquifer system near the C & D Canal (Ea45-04, Eb43-04, and Eb51-11) or in the vicinity of the Delaware Bay (Ed21-20).

Statistical analyses for all parameters tested in the Potomac-Magothy aquifer system are presented in Table 1.

Table 1. Statistical Summary for the Potomac-Magothy Aquifer System

Constituent	Number of analyses	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of samples exceeding water-quality criteria
Temperature	38	11.1	13.8	14.4	15.5	17.6	*
Specific Conductance (µS/cm)	39	20.3	117	139	166.5	236	*
Dissolved Oxygen (mg/L)	39	0	0	0	0	4.5	*
pH (standard units)	38	6.37	6.69	6.95	7.63	8.21	5 samples < SMCL of 6.5-8.5
Bicarbonate (mg/L)	38	47.6	80.8	97.5	116.7	136.6	*
Ammonia (mg/L as N)	7	0.02	0.03	0.08	0.15	0.21	*
Nitrate (mg/L as N)	38	0.01	<0.4	<0.4	<0.4	15.1	1 sample > MCL of 10 mg/L
Total Organic Carbon (mg/L)	7	0.0	0.0	0.0	0.0	0.0	*
Calcium (mg/L)	7	1.88	11.5	15.0	23.8	36.3	*
Magnesium (mg/L)	7	0.43	3.2	4.2	4.6	6.4	*
Sodium (mg/L)	32	2	3.6	9.2	29.3	69	*
Potassium (mg/L)	7	0.4	0.8	1.3	1.6	1.8	*
Chloride (mg/L)	39	0	<2.0	2	2.84	8.86	0 samples > SMCL of 250 mg/L
Sulfate (mg/L)	17	<0.05	<0.05	<0.05	5	19	0 samples > SMCL of 250 mg/L
Fluoride (mg/L)	7	0.11	0.18	0.22	0.26	0.29	0 samples > MCL of 4.0 mg/L
Silica (mg/L)	7	3.7	4.2	4.4	6.9	10	*
Iron (mg/L)	38	0.23	1.3	3.2	4.6	9.5	37 samples > SMCL of 0.30 mg/L
Manganese (mg/L)	7	<0.02	<0.02	0.04	0.1	0.21	2 samples > SMCL of 0.05 mg/L
Phosphorous (mg/L)	3	<0.05	<0.05	<0.05	<0.05	<0.05	*
Zinc (mg/L)	7	<0.02	<0.02	0.03	0.1	0.22	0 samples > SMCL of 5 mg/L
Lead (mg/L)	7	<0.002	<0.002	0.003	0.003	0.003	0 samples > MCL of 0.05 mg/L
Copper (mg/L)	7	<0.01	<0.01	<0.01	<0.01	0.02	0 smaples > SMCL of 1 mg/L
Radon (pCi/L)	7	81	101	146	186	238	0 samples > proposed MCL of 300 pCi/L

* Water-quality criteria have not been established for these constituents

Englishtown-Mt. Laurel Aquifer System

Eleven wells sampled were screened in the Englishtown-Mt. Laurel aquifer system (Figure 4). This aquifer system can be categorized as having primarily calcium-magnesium-bicarbonate type water (Baxter and Talley, 1997).

Of 36 samples, 12 samples (33%) had values outside the SMCL range for pH (6.5-8.5) (Figure 5). These samples were slightly more acidic than 6.5.

Fifty-three percent of 36 samples tested for iron had values greater than or equal to the SMCL of 0.3 mg/L (Figure 6). This is consistent with the mineralogy of the Englishtown Formation which contains the iron-bearing minerals pyrite, siderite, and goethite (Benson and Spoljaric, 1996). The observation that only 5 of the wells (45%) had average iron values above the SMCL is because the Englishtown-Mt. Laurel aquifer system is dominated by chemical processes that act upon the calcium-carbonate found in the system more so than the processes that control dissolution and precipitation of the iron-bearing minerals (Bachman and Ferrari, 1995).

Forty-one percent of the 37 samples tested for nitrate had values >0.4 mg/L indicating the aquifer system is being influenced by human activity (Figure 7). However, values were well below the MCL of 10 mg/L. The one exception was well Ec35-05 which had a nitrate value of 11.2 mg/L when sampled in March 1997. In January 1997 the nitrate value at this well was 0.35 mg/L. This well will require further study due to the high variability of these results.

Chloride concentrations were less than 10 mg/L in 84% of the 37 samples from the Englishtown-Mt. Laurel aquifer system. The highest reported value was 21.0 mg/L from well Fc12-23 which had an average chloride concentration of 20.0 mg/L. This well, and Ec51-16 (average 6.5 mg/L), are located in areas that were once used for agriculture and the effects of applying potassium chloride for crops may be showing up in these wells (Denver, 1986). Although high in comparison to other wells in this aquifer system, these concentrations are far below the SMCL of 250 mg/L set for chloride.

Statistical analyses for all parameters tested in the Englishtown-Mt. Laurel aquifer system are presented in Table 2.

Rancocas Aquifer

Seven wells sampled for water quality were screened in the Rancocas aquifer (Vincentown and Hornerstown formations) (Figure 4). A total of 28 samples were drawn from this aquifer which is a mix of calcium-magnesium-bicarbonate and calcium-magnesium-chloride type water (Baxter and Talley, 1997; Bachman and Ferrari, 1995).

Fourteen samples (50%) had pH values that were more acidic than the SMCL set by the USEPA (6.5-8.5). Three samples (11%) had pH values greater than 8.5 (Figure 5). The acidic samples were drawn from wells that are hydraulically connected to the shallow water-table aquifer. Due to various processes, precipitation entering the water-table aquifer becomes acidic as it flows to the Rancocas aquifer (Bachman and Ferrari, 1995: Denver, 1986, 1989). Two wells with samples greater than 8.5 (Hc13-02 and Hc14-03) are located in the deeper confined portions of the aquifer where pH tends to be buffered during dissolution and precipitation of ferric oxyhydroxides (Bachman and Ferrari 1995).

Table 2. Statistical Summary for the Englishtown-Mt. Laurel Aquifer System

Constituent	Number of analyses	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of samples exceeding water-quality criteria
Temperature	36	8.1	13	13.5	14.2	18.2	*
Specific Conductance (µS/cm)	37	133	151	176	204	314	*
Dissolved Oxygen (mg/L)	37	0	0	2.5	4.9	9	*
pH (standard units)	36	6	6.68	7.56	7.8	8.96	12 samples < or > SMCL of 6.5-8.5
Bicarbonate (mg/L)	37	4.15	71.9	121.9	140.2	168.3	*
Ammonia (mg/L as N)	10	0.02	0.03	0.09	0.11	0.15	*
Nitrate (mg/L as N)	37	0.01	<0.4	<0.4	2.2	11.2	1 sample > MCL of 10 mg/L
Total Organic Carbon (mg/L)	10	0.0	0.0	0.0	1.1	2.4	*
Calcium (mg/L)	10	0.1	31.9	40.4	43.4	53.4	*
Magnesium (mg/L)	10	0.02	2.4	4.1	5.7	15.8	*
Sodium (mg/L)	31	2.0	4	6	9.5	74.8	*
Potassium (mg/L)	10	0.07	0.8	1.4	1.8	18.2	*
Chloride (mg/L)	37	0.2	2.0	3.0	4	21	0 samples > SMCL of 250 mg/L
Sulfate (mg/L)	16	<0.05	<0.05	<0.05	<0.05	12.3	0 samples > SMCL of 250 mg/L
Fluoride (mg/L)	10	0.13	0.14	0.19	0.35	0.43	0 samples > MCL of 4.0 mg/L
Silica (mg/L)	10	5.3	7.7	8.7	10.8	13.9	*
Iron (mg/L)	36	0.05	0.19	0.33	0.46	23	19 samples > SMCL of 0.30 mg/L
Manganese (mg/L)	10	0.02	0.02	0.02	0.06	0.24	3 samples > SMCL of 0.05 mg/L
Phosphorous (mg/L)	10	<0.05	<0.05	<0.05	<0.05	<0.05	*
Zinc (mg/L)	10	0.02	0.02	0.02	0.07	0.18	0 samples > SMCL of 5 mg/L
Lead (mg/L)	10	<0.002	<0.002	<0.002	0.003	0.004	0 samples > MCL of 0.05 mg/L
Copper (mg/L)	10	<0.01	<0.01	<0.01	<0.01	<0.01	0 samples > SMCL of 1 mg/L
Radon (pCi/L)	10	150	430	495	582.5	1200	9 samples > proposed MCL of 300 pCi/L

* Water-quality criteria have not been established for these constituents

Eight samples (29%) had iron values greater than the SMCL of 0.3 mg/L (Figure 6). In the unconfined portions of this aquifer system, this relatively low iron concentration may be due to relatively higher amounts of dissolved oxygen (DO). Higher DO concentrations hinder the dissolution of iron resulting in lower concentrations in ground water.

Nitrate values greater than the background level of 0.4 mg/L were reported in 14 samples (50%) (Figure 7). Of these samples, two had concentrations above the MCL of 10 mg/L (13.0 and 22.0 mg/L). Both samples came from well Fc42-09 which is a shallow, water-table monitor well located near an area where crops are grown on property surrounding Water Farm #1 near Odessa. Fertilizers used during the growing season or feedlot waste products may be two sources of the nitrates.

Chloride concentrations were <10 mg/L in 89% of the samples from the Rancocas aquifer (Figure 8). Three samples had reported values >10 mg/L. Two of the three were from well Fc42-09 (10.6 and 18.5 mg/L) located at Water Farm #1. The elevated chloride levels from Fc42-09 correspond with high nitrate concentrations found in samples from the same well. Chloride concentrations have been shown to correspond with nitrate concentrations in agriculture wells where potassium chloride is commonly applied as a supplement to nitrogen-based fertilizers (Denver, 1986). Well Ed51-10 had the highest reported value in the Rancocas aquifer (48.7 mg/L) and requires further investigation.

Statistical analyses for all parameters tested in the Rancocas aquifer are presented in Table 3.

Table 3. Statistical Summary for the Rancocas Aquifer

Constituent	Number of analyses	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of samples exceeding water-quality criteria
Temperature	28	12.4	13.9	14.5	14.8	17.2	*
Specific Conductance (µS/cm)	28	142	168.5	187.5	228.5	294	*
Dissolved Oxygen (mg/L)	28	0	0	7.25	9.35	13.8	*
pH (standard units)	28	4.08	5.2	6.57	7.72	9.42	17 samples < or > SMCL of 6.5-8.5
Bicarbonate (mg/L)	28	1.1	2.3	8.5	179.20	190.2	*
Ammonia (mg/L as N)	7	0.01	0.06	0.11	0.13	0.19	*
Nitrate (mg/L as N)	7	<0.4	<0.4	0.8	8.5	13	2 samples > MCL of 10 mg/L
Total Organic Carbon (mg/L)	7	0.0	0.0	0.0	0.0	1.2	*
Calcium (mg/L)	7	11.6	16.0	16.6	36.3	48.5	*
Magnesium (mg/L)	7	3.61	5.9	10.3	12.2	12.7	*
Sodium (mg/L)	16	2.0	4.9	7	7.3	34.3	*
Potassium (mg/L)	7	0.54	0.89	1.1	6.9	12.8	*
Chloride (mg/L)	28	0	1	2	2.2	48.7	0 samples > SMCL of 250 mg/L
Sulfate (mg/L)	16	<0.05	<0.05	<0.05	6.3	40	0 samples > SMCL of 250 mg/L
Fluoride (mg/L)	7	0.12	0.21	0.27	0.40	0.59	0 samples > MCL of 4.0 mg/L
Silica (mg/L)	7	5.36	6.41	6.70	10.1	13.8	*
Iron (mg/L)	28	0.02	0.12	0.2	0.38	2.89	8 samples > SMCL of 0.30 mg/L
Manganese (mg/L)	7	0.02	0.02	0.02	0.02	0.11	1 samples > SMCL of 0.05 mg/L
Phosphorous (mg/L)	7	<0.05	<0.05	<0.05	<0.05	<0.05	*
Zinc (mg/L)	7	0.02	0.02	0.02	0.06	0.09	0 samples > SMCL of 5 mg/L
Lead (mg/L)	7	<0.002	<0.002	<0.002	<0.002	0.003	0 samples > MCL of 0.05 mg/L
Copper (mg/L)	7	<0.01	<0.01	<0.01	<0.01	0.14	0 samples > SMCL of 1 mg/L
Radon (pCi/L)	6	230	276	405	644	825	3 samples > proposed MCL of 300 pCi/L

* Water-quality criteria have not been established for these constituents

Columbia Aquifer

Twenty-three wells sampled for water quality were screened in the Columbia Formation (Figure 4). Nine of the 23 wells were pre-existing; 14 new monitor wells were drilled throughout the study area by the DGS. Completion reports for the 14 wells can be found in the report for Phase III (Baxter and Talley, 1997) of the ground-water monitoring network. The Columbia aquifer is a mix of calcium-magnesium-bicarbonate and sodium-potassium-bicarbonate-type water (Baxter and Talley, 1997).

Of 91 samples tested for pH, 61 samples (67%) had values outside the SMCL range of 6.5-8.5 (Figure 5). Lower acidity could be due to a couple of factors. First, water entering the aquifer in the form of precipitation has a naturally low pH (3.5 to 4.5) (Denver, 1986). Secondly, acid is produced during the process of nitrification which is a two-step process that converts organic nitrogen to ammonium which is then oxidized to nitrate. This process can lower the pH of the ground water. However, since bicarbonate values are low (Appendix E) one can assume that bicarbonate was consumed in the process of buffering the pH which may explain why the pH values are not quite as low as those of natural water.

Of 90 samples tested for iron in the Columbia aquifer, 24 samples (27%) had iron values greater than the SMCL of 0.3 mg/L (Figure 6). The highest reported value (15.1 mg/L) was from monitor well Gc44-07 located in the southeastern portion of the study area. A large range in iron values is not unusual given the scattered occurrence of iron in the Columbia Formation (Johnston, 1973).

Nitrate values above background (0.4 mg/L) were detected in 87 samples (97%) drawn from the Columbia aquifer (Figure 7). Twelve samples (13%) were greater than the MCL of 10 mg/L. The highest reported values (26 mg/L and 27 mg/L) were drawn from monitor well Gb11-07. All wells in the Columbia aquifer with elevated nitrate levels are shallow monitoring wells located on or near property used for agricultural purposes.

Chloride concentrations were less than 10 mg/L in 89 samples (99%) (Figure 8). The highest reported value was 363 mg/L from well Fb41-11 (average concentration of 94.3 mg/L). This well is located directly adjacent to land used for agriculture where potassium chloride may have been applied to the soil. High chlorides may also be a result of road deicing salts as this well is located directly next to a high traffic volume road.

Statistical analyses for all parameters tested in the Columbia aquifer are presented in Table 4.

Table 4. Summary Statistics for the Columbia Aquifer

Constituent	Number of analyses	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of samples exceeding water-quality criteria
Temperature	91	8.3	13	14.1	15.7	20.6	*
Specific Conductance (µS/cm)	90	4	150	192	323.3	3530	*
Dissolved Oxygen (mg/L)	87	0	5.85	8.8	10.4	18.6	*
pH (standard units)	91	38	5.58	6.11	6.76	8.52	61 samples < or > SMCL of 6.5-8.5
Bicarbonate (mg/L)	88	1.1	4.6	10.9	21.2	193.9	*
Ammonia (mg/L as N)	25	0.02	0.03	0.1	0.2	0.97	*
Nitrate (mg/L as N)	90	0.1	1.20	2.3	6.1	27	12 samples > MCL 10 mg/L
Total Organic Carbon (mg/L)	22	0	0	0	0.99	4	*
Calcium (mg/L)	22	1.4	11	14.7	37.2	168	*
Magnesium (mg/L)	22	0.66	5.0	7.8	12.2	51.5	*
Sodium (mg/L)	22	1.46	5.0	8.8	16.8	545	*
Potassium (mg/L)	22	0.43	0.75	0.93	1.3	20.2	*
Chloride (mg/L)	90	0.05	0.72	0.89	1.7	363	1 sample > SMCL of 250 mg/L
Sulfate (mg/L)	56	<0.05	<0.05	15	23.3	44	0 samples > SMCL of 250 mg/L
Fluoride (mg/L)	22	0.11	0.14	0.16	0.22	1.4	0 samples > MCL of 4.0 mg/L
Silica (mg/L)	22	2.6	4.9	5.9	8.4	27.4	*
Iron (mg/L)	90	0.02	0.06	0.1	0.32	15.1	24 samples > SMCL of 0.30 mg/L
Manganese (mg/L)	22	0.02	0.02	0.02	0.07	1.41	6 samples > SMCL of 0.05 mg/L
Phosphorous (mg/L)	22	<0.05	<0.05	<0.05	<0.05	<0.05	*
Zinc (mg/L)	22	0.02	0.02	0.02	0.04	0.07	0 samples > SMCL of 5 mg/L
Lead (mg/L)	22	<0.002	<0.002	<0.002	<0.002	<0.002	0 samples > MCL of 0.05 mg/L
Copper (mg/L)	22	0.01	0.01	0.01	0.01	0.21	0 samples > SMCL of 1 mg/L
Radon (pCi/L)	17	150	250	320	430	2600	9 samples > proposed MCL of 300 pCi/L

* Water-quality criteria have not been established for these constituents

DISCUSSION BY PARAMETER

Average pH concentrations outside the SMCL range of 6.5-8.5 occurred in 42% of the total number of wells sampled. Values lower than 6.5 were most common with only one well (Ec35-05) having a value greater than 8.5. The greatest number of wells (16) with values outside the SMCL occurred in the Columbia aquifer. Low pH values are generally natural and a result of several processes occurring in the ground water.

Average iron concentrations of >0.3 mg/L were detected in 50% of the total number of wells sampled (Figure 9). The largest concentrations occurred in wells screened in the Potomac-Magothy aquifer system followed by those screened in the confined portion of the Englishtown-Mt. Laurel aquifer system. These results were not unexpected since these aquifers are comprised of sediments containing the iron-bearing minerals pyrite and siderite which exist under anoxic conditions in the Potomac-Magothy aquifer system and the confined portion of the Englishtown-Mt. Laurel aquifer system.

Average nitrate-nitrogen concentrations greater than background (0.4 mg/L) were detected in the majority (63%) of the total number of wells sampled (Figure 10). However, only three shallow monitor wells had average nitrate-nitrogen concentrations exceeding the MCL of 10 mg/L. The shallow, water-table aquifer had the largest percentage of samples (96%) exceeding the background level followed by the unconfined portions of the Rancocas aquifer (57%) and Englishtown-Mt. Laurel aquifer system (56%). The Potomac-Magothy aquifer system had the lowest number of wells (one) with average concentrations greater than or equal to 0.4 mg/L. This well will require further investigation.

Average chloride concentrations were at levels considered "natural" (Denver, 1986) in 90% of all wells sampled. However, one well located in the northeast portion of the study area near the Delaware Bay (Ed51-10) had an average concentration of 17.3 mg/L. This well requires further investigation due to the erratic nature of the chloride results (1.15 mg/L, 48.7 mg/L and 2.02 mg/L) and may or may not be indicative of salt-water intrusion near the Delaware Bay in the Rancocas aquifer.

SUMMARY

All four aquifer systems had at least one well with pH values that fell below the SMCL range of 6.5-8.5. Only 1 well, Ec35-05, had an average value above 8.5. The majority of wells screened in the Potomac/Magothy and Englishtown/Mt. Laurel aquifer systems and in the Rancocas aquifer had average pH values within the SMCL range set by the USEPA. Seventy percent of the samples drawn from wells screened in the Columbia aquifer had average pH values below 6.5. Lower acidity in the shallow water-table aquifer could be due to infiltration of precipitation which has a naturally low pH (3.5 to 4.5) (Denver, 1986). Lower pH values could also be produced during the process of nitrification which is a two-step process that converts organic nitrogen to ammonium which is then oxidized to nitrate. This process can lower the pH of the ground water.

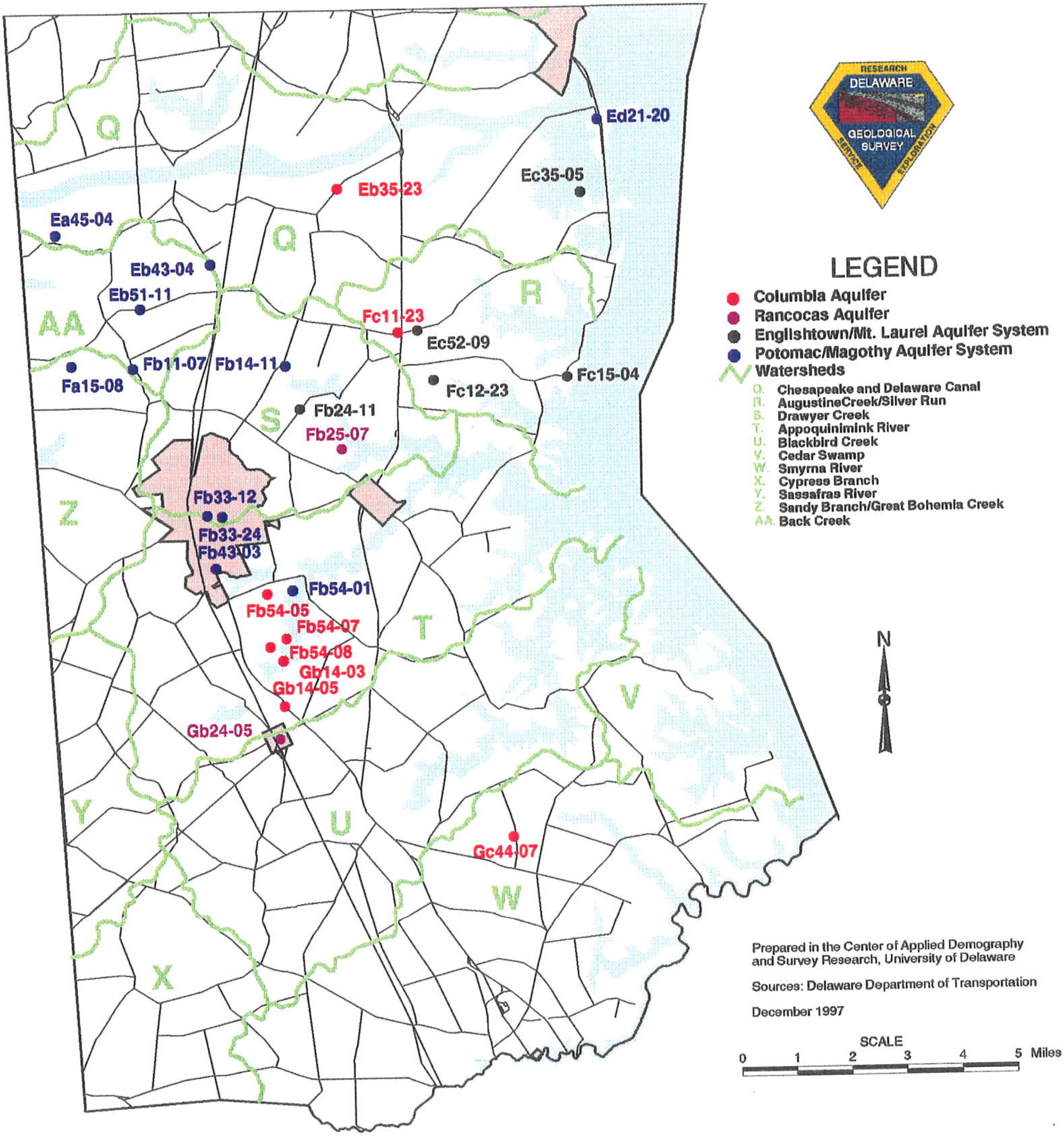


Figure 9. Wells with average iron concentrations >0.3 m/L

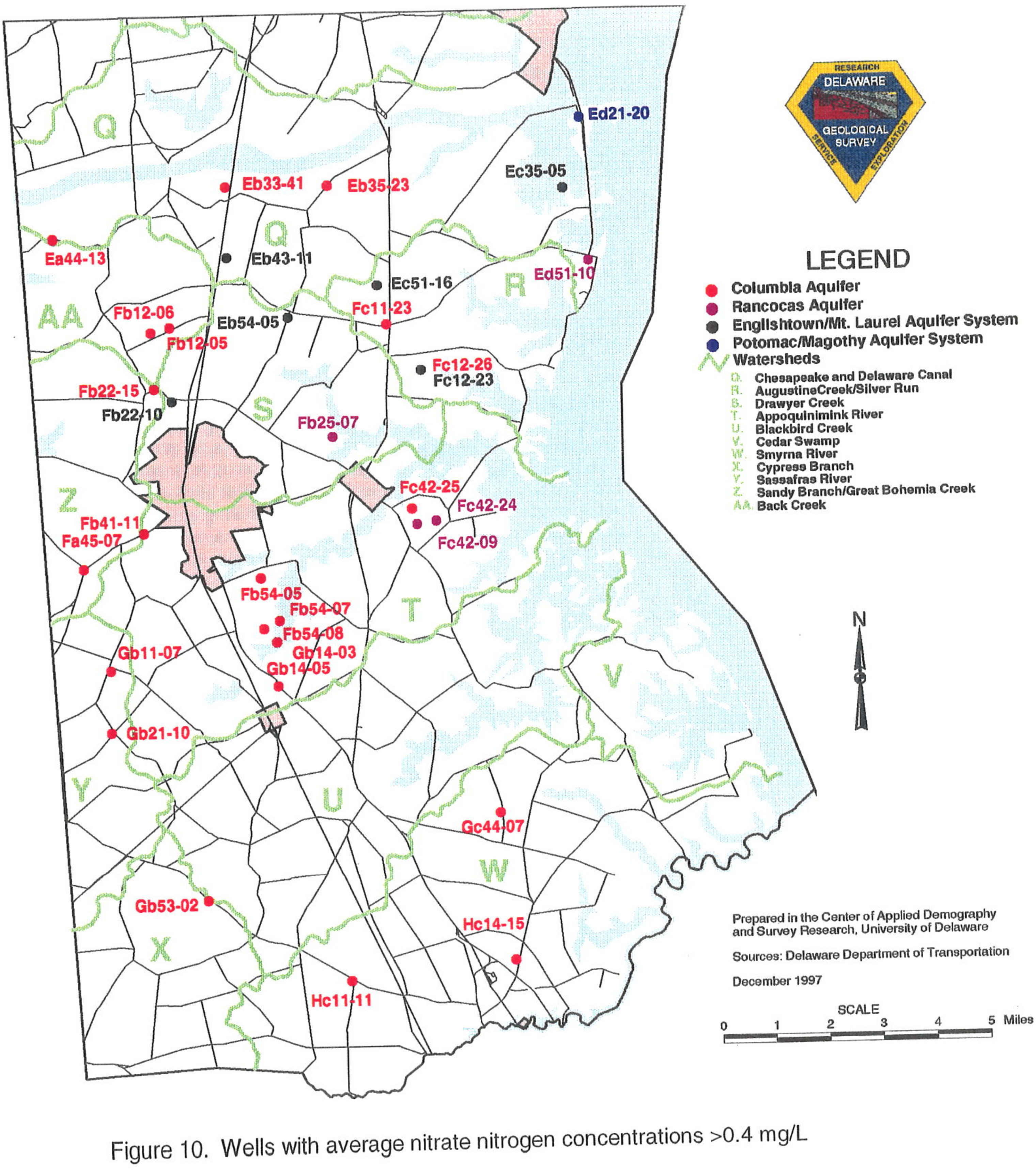


Figure 10. Wells with average nitrate nitrogen concentrations >0.4 mg/L

It is evident from figures 4 through 8 that the deeper, confined aquifer systems (Potomac-Magothy and confined portions of the Englishtown-Mt. Laurel) are most affected by high iron concentrations. This degradation is due to natural processes occurring in these aquifer systems where anoxic conditions favor dissolution of iron-bearing minerals. Nitrate contamination does not appear to be a problem in these confined aquifers.

The shallow water-table aquifer (Columbia) and the unconfined portions of the Englishtown-Mt. Laurel aquifer system and Rancocas aquifer are more prone to anthropogenic contamination. Nitrate-nitrogen concentrations are greater than background levels in these aquifers (Figure 7) where the primary source of nitrogen is from fertilizers and septic system effluent.

Although chloride concentrations are consistently below the SMCL in all four aquifer systems, average concentrations above what is considered natural (5.79 mg/L; Denver, 1986) can be found in the unconfined portions of the Englishtown-Mt. Laurel aquifer system and the Rancocas aquifer. Further investigation is required to determine whether these elevated levels are due to salt-water intrusion (Ed51-10) or application of potassium chloride (Ec51-16, Fc12-23, Fc42-09 and Fb41-11).

RECOMMENDATIONS

We recommend continuation of the southern New Castle County ground-water monitoring network as outlined in Appendix A. In order to conduct time-series analyses of ground-water quality, more than just a "snapshot" of the ground water is needed. Sampling during all seasons of the year over several years will provide the data necessary for a comprehensive understanding of the ground-water quality and will help in determining the sources of contamination. We recommend continued sampling of shallow, water-table wells and public wells on a quarterly basis and a yearly schedule for wells screened in the deeper, confined aquifers.

Flexibility is built into the sampling schedule to allow for modifications in the number of analyses as well as the number of wells sampled. The number of parameters tested should be reevaluated on a yearly basis by members of New Castle County Department of Public Works, Water Resources Agency for New Castle County, Delaware Department of Agriculture, Delaware Division of Public Health, Delaware Department of Natural Resources and Environmental Control, and the Delaware Geological Survey.

New wells may be added or existing wells removed from the network to obtain the most efficient coverage of southern New Castle County. For more complete coverage of the southern portion of the network, the installation of several shallow monitor wells in the Cypress Branch, Blackbird Creek, Sassafras

River, and Cedar Swamp watersheds should be seriously considered. The installation of several wells in the deeper confined aquifers in the lower portion of the county are warranted to delineate the position of the salt-fresh water interface.

The process of systematically assessing water quality in southern New Castle County began in Phase III and Phase IV, and has provided the baseline from which future results can be compared to determine the impacts of specific land uses. The database will enable use of consistent and reliable data to examine temporal variability on short- and long-term time frames. Continued testing will provide a tool that will enable New Castle County, State and local officials to manage ground-water development and use effectively.

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APPENDIX A

Sampling Schedule Summary

		pH (field)	pH (lab)	Temp	Spec. Cond.	Ca	Mg	Na	Alk	SO_4	Cl	SiO_2	Fe	Mn	K	Cu	Pb	Zn	Fl	Radon	DO	TOC	TDS	Total Phos.	Ortho-Phos.
	Ea45-04	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	DPH	NCC	NCC
	Eb43-04	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	DPH	NCC	NCC
	Eb51-11	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	DPH	NCC	NCC
	Ec51-16	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	DPH	NCC	NCC
	Ec52-09	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	DPH	NCC	NCC
	Fa15-08	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	DPH	NCC	NCC
	Fb11-07	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	DPH	NCC	NCC
	Fb14-11	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	DPH	NCC	NCC
Public	Fb33-12	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	DPH	NCC	NCC
Wells	Fb33-24	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	DPH	NCC	NCC
(deep)	Fb24-11	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	DPH	NCC	NCC
	Fb43-03	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	DPH	NCC	NCC
	Fb54-01	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	DPH	NCC	NCC
	Fc12-23	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	DPH	NCC	NCC
	Fc15-04	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	DPH	NCC	NCC
	Fc31-11	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	DPH	NCC	NCC
	Fc42-13	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	DPH	NCC	NCC
	Gb24-05	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	DPH	NCC	NCC
	Hc13-02	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	DPH	NCC	NCC
	Hc14-03	DGS	DPH	DGS	DGS	ART	ART	NCC	DPH	NCC	DPH	ART	DPH	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	DPH	NCC	NCC
	Eb33-41	DGS	NCC	DGS	DGS	ART	ART	Current	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	Current	NCC
	Eb33-42	DGS	NCC	DGS	DGS	ART	ART	Current	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	NCC	Current	NCC
Monitor	Fb12-05	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
Wells	Fb12-06	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
(shallow)	Fb25-07	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	Current	NCC	NCC	NCC
	Fc42-09	DGS	NCC	DGS	DGS	ART	Current	Current	NCC	Current	NCC	Current	NCC	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	NCC	Current	NCC
	Fc42-24	DGS	NCC	DGS	DGS	ART	Current	Current	NCC	Current	NCC	Current	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	Current	NCC
	Fc42-25	DGS	NCC	DGS	DGS	ART	Current	Current	NCC	Current	NCC	Current	NCC	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	NCC	Current	NCC
	Fb54-05	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	NCC	NCC	NCC
ppoquinimi	Fb54-07	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	NCC	NCC	NCC
Study Wells	Fb54-08	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
	Gb14-03	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	NCC	NCC	NCC
	Eb43-11	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	NCC	NCC	NCC
DGS/USGS	Eb54-05	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
eep & shallo	Ec35-05	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
	Ed21-20	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	-	DGS	ART	NCC	NCC	NCC
	Ed51-10	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
	Fb22-10	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
	Ea44-13	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
	Eb35-23	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
	Fa45-07	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
	Fb22-15	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
	Fb41-11	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
	Fc11-23	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
New	Fc12-26	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
onitor Well	Gb11-07	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
(shallow)	Gb14-05	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
	Gb21-10	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
	Gb53-02	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
	Gc44-07	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
	Hc11-11	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC
	Hc14-15	DGS	NCC	DGS	DGS	ART	ART	NCC	NCC	NCC	NCC	ART	NCC	NCC	NCC	NCC	NCC	NCC	NCC	USGS	DGS	ART	NCC	NCC	NCC

Key:

(shaded) Quarterly sampling

(boxed) Yearly sampling

DDA = Delaware Department of Agriculture

DGS = Delaware Geological Survey

DPH = Delaware Division of Public Health

NCC = New Castle County Department of Public Works

ART = Artesian Laboratories, Inc.

USGS = U.S. Geological Survey, National Water-Quality Laboratory, Arvada, CO

Current= Required or currently being tested by owner/operator of facility

APPENDIX A
Sampling Schedule Summary

		Ammonia Nitrogen	Nitrate Nitrogen	Nitrite Nitrogen	Pest.
	Ea45-04	NCC	DPH	NCC	-
	Eb43-04	NCC	DPH	NCC	-
	Eb51-11	NCC	DPH	NCC	-
	Ec51-16	NCC	DPH	NCC	-
	Ec52-09	NCC	DPH	NCC	-
	Fa15-08	NCC	DPH	NCC	-
	Fb11-07	NCC	DPH	NCC	-
	Fb14-11	NCC	DPH	NCC	-
Public	Fb33-12	NCC	DPH	NCC	-
Wells	Fb33-24	NCC	DPH	NCC	-
(deep)	Fb24-11	NCC	DPH	NCC	-
	Fb43-03	NCC	DPH	NCC	-
	Fb54-01	NCC	DPH	NCC	-
	Fc12-23	NCC	DPH	NCC	-
	Fc15-04	NCC	DPH	NCC	-
	Fc31-11	NCC	DPH	NCC	-
	Fc42-13	NCC	DPH	NCC	-
	Gb24-05	NCC	DPH	NCC	-
	Hc13-02	NCC	DPH	NCC	-
	Hc14-03	NCC	DPH	NCC	-
	Eb33-41	Current	NCC	NCC	DDA
	Eb33-42	Current	NCC	NCC	-
Monitor	Fb12-05	NCC	NCC	NCC	DDA
Wells	Fb12-06	NCC	NCC	NCC	DDA
(shallow)	Fb25-07	NCC	NCC	NCC	DDA
	Fc42-09	Current	NCC	Current	-
	Fc42-24	Current	NCC	Current	DDA
	Fc42-25	Current	NCC	Current	-
	Fb54-05	NCC	NCC	NCC	DDA
ppoquinimi	Fb54-07	NCC	NCC	NCC	DDA
Study Wells	Fb54-08	NCC	NCC	NCC	DDA
	Gb14-03	NCC	NCC	NCC	-
	Eb43-11	NCC	NCC	NCC	DDA
DGS/USGS	Eb54-05	NCC	NCC	NCC	DDA
eep & shallo	Ec35-05	NCC	NCC	NCC	
	Ed21-20	NCC	NCC	NCC	-
	Ed51-10	NCC	NCC	NCC	DDA
	Fb22-10	NCC	NCC	NCC	-
	Ea44-13	NCC	NCC	NCC	DDA
	Eb35-23	NCC	NCC	NCC	DDA
	Fa45-07	NCC	NCC	NCC	DDA
	Fb22-15	NCC	NCC	NCC	DDA
	Fb41-11	NCC	NCC	NCC	DDA
	Fc11-23	NCC	NCC	NCC	DDA
New	Fc12-26	NCC	NCC	NCC	DDA
onitor Well	Gb11-07	NCC	NCC	NCC	DDA
(shallow)	Gb14-05	NCC	NCC	NCC	DDA
	Gb21-10	NCC	NCC	NCC	DDA
	Gb53-02	NCC	NCC	NCC	DDA
	Gc44-07	NCC	NCC	NCC	DDA
	Hc11-11	NCC	NCC	NCC	DDA
	Hc14-15	NCC	NCC	NCC	DDA

APPENDIX B
Results of Quality Assurance and Quality Control

DGSID	Date	Analysis Result Duplicate 1	Analysis Result Duplicate 2	Average Value	Difference in given units
			pH (standard units)		
Ed21-20	9/17/96	6.98	7.3	7.14	0.32
Fb22-10	9/24/96	7.76	7.82	7.79	0.06
Fc11-23	9/16/96	6.02	6.33	6.175	0.31
Fc31-11	9/10/96	7.23	7.6	7.415	0.37
Gb14-05	9/9/96	6.74	6.79	6.765	0.05
Hc13-02	9/10/96	7.68	7.66	7.67	0.02
Eb54-05	4/11/97	6.02	6.01	6.015	0.01
Fb25-07	5/7/97	5.43	5.53	5.48	0.1
Fb12-05	5/27/97	5.15	5.15	5.15	0
Fb22-15	2/19/97	6.25	6.24	6.245	0.01
			Total Organic Carbon (TOC) mg/L		
Ed21-20	9/17/96	1	1	1	0
Fb22-10	9/24/96	1	1	1	0
Fc11-23	9/16/96	1.9	1	1.45	0.9
Gb14-05	9/9/96	1	1	1	0
Hc13-02	9/10/96	1	1	1	0
			Calcium (mg/L)		
Ed21-20	9/17/96	12.4	12	12.2	0.4
Fb22-10	9/24/96	0.103	0.08	0.0915	0.023
Fc11-23	9/16/96	12.1	12.2	12.15	0.1
Gb14-05	9/9/96	22.3	19.8	21.05	2.5
Hc13-02	9/10/96	36.6	36.6	36.6	0
			Magnesium (mg/L)		
Ed21-20	9/17/96	2.91	2.83	2.87	0.08
Fb22-10	9/24/96	0.049	0.004	0.0265	0.045
Fc11-23	9/16/96	10.4	10.4	10.4	0
Gb14-05	9/9/96	6.49	5.87	6.18	0.62
Hc13-02	9/10/96	11.8	11.9	11.85	0.1
			Silica (mg/L)		
Ed21-20	9/17/96	3.74	3.6	3.67	0.14
Fb22-10	9/24/96	13.9	13.9	13.9	0
Fc11-23	9/16/96	6.26	6.28	6.27	0.02
Gb14-05	9/9/96	4.76	5.21	4.985	0.45
Hc13-02	9/10/96	6.19	6.21	6.2	0.02
			Sodium (mg/L)		
Ed21-20	9/17/96	39.6	38.8	39.2	0.8
Fb22-10	9/24/96	58.6	58.2	58.4	0.4
Fc11-23	9/16/96	4.53	4.61	4.57	0.08
Gb14-05	9/9/96	83.7	77.2	80.45	6.5
Hc13-02	9/10/96	6.25	6.29	6.27	0.04

APPENDIX B
Results of Quality Assurance and Quality Control

DGSID	Date	Analysis Result Duplicate 1	Analysis Result Duplicate 2	Average Value	Difference in given units
			Copper (mg/L)		
Ed21-20	9/17/96	0.01	0.01	0.01	0
Fb22-10	9/24/96	0.01	0.01	0.01	0
Fc11-23	9/16/96	0.01	0.01	0.01	0
Gb14-05	9/9/96	0.01	0.01	0.01	0
Hc13-02	9/10/96	0.01	0.01	0.01	0
			Lead (mg/L)		
Ed21-20	9/17/96	0.004	0.002	0.003	0.002
Fb22-10	9/24/96	0.003	0.002	0.0025	0.001
Fc11-23	9/16/96	0.002	0.002	0.002	0
Gb14-05	9/9/96	0.003	0.002	0.0025	0.001
Hc13-02	9/10/96	0.004	0.002	0.003	0.002
			Zinc (mg/L)		
Ed21-20	9/17/96	0.22	0.22	0.22	0
Fb22-10	9/24/96	0.02	0.02	0.02	0
Fc11-23	9/16/96	0.03	0.05	0.04	0.02
Gb14-05	9/9/96	0.06	0.06	0.06	0
Hc13-02	9/10/96	0.02	0.02	0.02	0
			Flouride (mg/L)		
Ed21-20	9/17/96	0.23	0.13	0.18	0.1
Fb22-10	9/24/96	0.13	0.13	0.13	0
Fc11-23	9/16/96	0.18	0.14	0.16	0.04
Gb14-05	9/9/96	0.12	0.12	0.12	0
Hc13-02	9/10/96	0.49	0.47	0.48	0.02
			Alkalinity (mg/L)		
Hc13-02	9/10/96	115	115	115	0
Gb14-05	9/91996	29.45	28.5	28.975	0.95
Fc11-23	9/16/96	3.8	3.8	3.8	0
Ed21-20	9/17/96	76	76	76	0
Fb22-10	9/25/96	43.7	43.7	43.7	0
Fc31-11	9/10/96	87	120	103.5	33
Eb54-05	4/11/97	3.4	3.4	3.4	0
Fb25-07	5/7/97	2.2	2.3	2.25	0.1
Fb12-05	5/27/97	6.12	6.12	6.12	0
Fb22-15	2/19/97	12.65	12.65	12.65	0

APPENDIX B
Results of Quality Assurance and Quality Control

DGSID	Date	Analysis Result Duplicate 1	Analysis Result Duplicate 2	Average Value	Difference in given units
			Sulfate (mg/L)		
Ed21-20	9/17/96	0.05	0.05	0.05	0
Fb22-10	9/24/96	0.05	0.05	0.05	0
Fc11-23	9/16/96	0.05	0.05	0.05	0
Gb14-05	9/9/96	0.05	0.05	0.05	0
Hc13-02	9/10/96	0.05	0.05	0.05	0
Eb54-05	4/11/97	7.8	7.8	7.8	0
Fb12-05	5/27/97	25	25	25	0
Fb22-15	2/19/97	23	24	23.5	1
			Chloride (mg/L)		
Ed21-20	9/17/96	1.4	1.45	1.425	0.05
Fb22-10	9/24/96	0.2	0.15	0.175	0.05
Fc11-23	9/16/96	0.38	0.4	0.39	0.02
Gb14-05	9/9/96	0.4	0.35	0.375	0.05
Hc13-02	9/10/96	0.68	0.9	0.79	0.22
Eb54-05	4/11/97	0.86	0.86	0.86	0
Fb25-07	5/7/97	0.89	0.89	0.89	0
Fb12-05	5/27/97	0.44	0.89	0.665	0.45
Fb22-15	2/19/97	1.7	1.7	1.7	0
			Iron (mg/L)		
Ed21-20	9/17/96	2.54	2.91	2.725	0.37
Fb22-10	9/24/96	0.25	0.18	0.215	0.07
Fc11-23	9/16/96	0.02	0.02	0.02	0
Gb14-05	9/9/96	1	1	1	0
Hc13-02	9/10/96	0.22	0.22	0.22	0
Fb25-07	5/7/97	2.89	2.91	2.9	0.02
Fb12-05	5/27/97	0.02	0.02	0.02	0
Fb22-15	2/19/97	0.07	0.07	0.07	0
			Manganese (mg/L)		
Ed21-20	9/17/96	0.05	0.05	0.05	0
Fb22-10	9/24/96	0.02	0.02	0.02	0
Fc11-23	9/16/96	0.06	0.02	0.04	0.04
Gb14-05	9/9/96	0.02	0.02	0.02	0
Hc13-02	9/10/96	0.03	0.02	0.025	0.01
			Potassium (mg/L)		
Ed21-20	9/17/96	1.78	1.78	1.78	0
Fb22-10	9/24/96	0.07	0.07	0.07	0
Fc11-23	9/16/96	0.74	0.71	0.725	0.03
Gb14-05	9/9/96	0.91	0.9	0.905	0.01
Hc13-02	9/10/96	12.8	12.8	12.8	0

APPENDIX B
Results of Quality Assurance and Quality Control

DGSID	Date	Analysis Result Duplicate 1	Analysis Result Duplicate 2	Average Value	Difference in given units
			Ammonia (mg/L)		
Ed21-20	9/17/96	0.02	0.04	0.03	0.02
Fb22-10	9/24/96	0.02	0.01	0.015	0.01
Fc11-23	9/16/96	0.03	0.04	0.035	0.01
Gb14-05	9/9/96	0.03	0.03	0.03	0
Hc13-02	9/10/96	0.13	0.15	0.14	0.02
			Nitrite (mg/L)		
Ed21-20	9/17/96	0.04	0.03	0.035	0.01
Fb22-10	9/24/96	0.04	0.04	0.04	0
Fc11-23	9/16/96	0.03	0.02	0.025	0.01
Gb14-05	9/9/96	0.03	0.02	0.025	0.01
Hc13-02	9/10/96	0.03	0.03	0.03	0
			Nitrate(mg/L)		
Ed21-20	9/17/96	2.5	2.8	2.65	0.3
Fb22-10	9/24/96	3.2	2.6	2.9	0.6
Fc11-23	9/16/96	3.5	3.5	3.5	0
Gb14-05	9/9/96	0.67	0.87	0.77	0.2
Hc13-02	9/10/96	0.2	0.3	0.25	0.1
Eb54-05	4/11/97	1.4	1.4	1.4	0
Fb25-07	5/7/97	0.3	0.35	0.325	0.05
Fb12-05	5/27/97	4.5	4.5	4.5	0
Fb22-15	2/19/97	4.3	4.28	4.29	0.02
			Total Dissolved Solids (mg/L)		
Ed21-20	9/17/96	312	307	309.5	5
Fb22-10	9/24/96	66	69	67.5	3
Fc11-23	9/16/96	74	195	134.5	121
Gb14-05	9/9/96	88	67	77.5	21
Hc13-02	9/10/96	418	458	438	40
Eb54-05	4/11/97	220	228	224	8
Fb25-07	5/7/97	143	116	129.5	27
Fb12-05	5/27/97	100	98	99	2
Fb22-15	2/19/97	131	125	128	6

APPENDIX C

Pesticide Quality Control Sample Duplicates and Blanks

Pesticide	DGSID	Date	Analysis1 Results (ppb)	Analysis2 Result (ppb)
Alachlor				
	Eb43-11	9/12/96	0.1	0.1
	Fc43-11	9/16/96	0.27	0.17
	Gb14-05	9/9/96	ND	ND
	Field Blank	7/31/96	ND	0.14
	Field Blank	8/1/96	0.07	0.07
	Trip Blank	9/9/96	ND	ND
Cyanazine				
	Eb33-41	9/12/96	ND	ND
	Eb54-05	9/16/96	ND	ND
	Gb11-07	9/9/96	0.09	0.09
	Field Blank	7/31/96	ND	ND
	Field Blank	8/1/96	ND	ND
	Trip Blank	9/9/96	ND	ND
Metolachlor				
	Eb35-23	9/19/96	ND	ND
	Fb41-11	9/17/96	ND	0.08
	Field Blank	7/31/96	0.15	0.19
	Field Blank	8/1/96	0.15	0.09
	Field Blank	9/9/96	0.11	0.06
	Trip Blank	9/9/96	ND	0.06
Atrazine				
	Eb35-23	9/19/96	0.34	0.35
	Fb12-05	9/17/96	0.46	0.39
	Gb11-07	9/9/96	3.04	2.81
	Field Blank	7/31/96	0.06	0.1
	Field Blank	8/1/96	0.06	0.08
	Field Blank	9/9/96	0.1	0.11
Carbofuran				
	Ed51-10	9/16/96	ND	ND
	Fa45-07	9/12/96	ND	ND
	Fc11-23	9/16/96	ND	ND
	Gb14-05	9/9/96	ND	ND
	Field Blank	7/31/96	ND	ND
	Field Blank	8/1/96	ND	ND

Control Type	Date	Alachlor	Atrazine (ppb)	Carbofuran (ppb)	Cyanazine (ppb)	Metolachlor (ppb)	Simazine (ppb)	2,4-D (ppb)
Field Blanks								
	7/22/96	ND	ND	ND	ND	ND		
	7/29/96	ND	0.06	ND	ND	ND		
	7/31/96	ND	0.06	ND	ND	0.15		
	7/31/96	0.14	0.1	ND	ND	0.19		
	8/1/96	0.07	0.06	ND	ND	0.15		
	8/1/96	0.07	0.08	ND	ND	0.09		
	9/9/96	ND	0.1	ND	ND	0.11		
	9/9/96		0.11			0.06		
	9/12/96	ND	0.06	ND	ND	ND		
	9/19/96	ND	ND	ND	ND	ND		
	5/19/97	ND	0.24		ND	ND	0.1	ND
Trip Blanks								
	7/22/96	ND	ND	ND	ND	ND		
	7/29/96	ND	0.07	ND	ND	0.11		
	7/30/96	ND	0.07	ND	ND	ND		
	9/9/96	ND	0.11	ND	ND	ND		
	9/9/96	ND			ND	0.06		
	9/17/96	ND	ND	ND	ND	0.1		
	5/29/97	ND	ND		ND	ND	ND	ND

ND = NOT DETECTED
BLANK = NOT TESTED

APPENDIX D
Radon Quality Control

DGSID	Date	Duplicate 1 (pCi/L)	Duplicate 2 (pCi/L)	Average Value	Difference in given units
Eb35-23	*	2600	2200	2400	400
Eb54-05	9/19/96	420	400	410	20
Ed51-10	9/16/96	840	810	825	30
Fa45-07	9/12/96	180	200	190	20
Fb11-07	1/23/97	82	80	81	2
Fb12-05	9/17/96	340	360	350	20
Fb22-10	9/24/96	500	470	485	30
Fb33-12	1/16/97	81	73	77	8
Fb41-11	9/17/96	150	150	150	0
Fc11-23	9/16/96	250	240	245	10
Fc12-26	9/16/96	420	510	465	90
Gb11-0	9/9/96	280	270	275	10
Gb14-0	9/9/96	250	240	245	10
Hc13-02	9/10/96	450	480	465	30

*Eb35-23 was sampled on 7/30/96 and 9/19/96

APPENDIX E
Explanations for Water-Quality Results

AQUIFER KEY

clg	Columbia
m	Magothy
ml	Mt. Laurel
rng	Rancocas
ptg	Potomac
vt	Vincentown (Part of the Rancocas Aquifer)

ANALYSIS KEY

Blank space	Not Tested/Sampled
ND	Not Detected

WATERSHED KEY

Q	Chesapeake and Delaware Canal
R	Augustine Creek/Silver Run
S	Drawyer Creek
T	Appoquinimink River
U	Blackbird Creek
V	Cedar Swamp
W	Smyrna River
X	Cypress Branch
Y	Sassafras River
Z	Sandy Branch/Great Bohemia Creek
AA	Back Creek

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Aquifer	Watershed	Temperature (Celsius)	pH (lab)	pH (field)	eH	Specific Conductance in µS/cm	Oxygen, dissolved mg/L	Depth to Water (feet)
Ea44-13	7/29/96	clg	Q	17.1	5.34	5.15	219	173	0.0	7.43
Ea44-13	11/12/96	clg	Q	15.8	5.17	4.45	221	636	9.4	7.75
Ea44-13	2/10/97	clg	Q	11.4	5.54	6.00	192	197	8.6	5.9
Ea44-13	5/7/97	clg	Q	11.2	6.27	6.04	237	160	11.5	6.75
Ea45-04	8/6/96	m	Q	14.0	6.20	6.43	-51	103	0.0	
Ea45-04	1/10/97	m	Q	13.7	6.9	6.47	-8	86	0	
Ea45-04	4/2/97	m	Q	13.7	6.70	6.45	-57	101	0	
Ea45-04	6/12/97	m	Q	13.3	6.6	6.37	-52	99	0	
Eb33-41	9/12/96	clg	Q	13.3	7.78	6.00		180		
Eb33-41	3/10/97	clg	Q	15.1	6.01	6.78	276	98	9.3	29.81
Eb33-41	5/29/97	clg	Q	13.5	5.27	6.6	192	57	10.4	30.87
Eb33-42	8/15/96	clg	Q	13.3	6.54	5.39	213	79	0.0	20.38
Eb33-42	3/10/97	clg	Q	14	5.69	6.56	325	78	8.8	18.41
Eb33-42	5/29/97	clg	Q	12.8	5.14	7.49	180	62	10.4	20.45
Eb35-23	7/30/96	clg	Q	18.0	6.12	6.15	162	667		2.26
Eb35-23	9/19/96	clg	Q	18.9	6.85	6.03	174	652	5.1	2.08
Eb35-23	11/12/96	clg	Q	15.4	6.17	5.8	242	1104	12.1	2.1
Eb35-23	2/10/97	clg	Q	8.3	6.33	6.00	105	424	2.1	1.46
Eb35-23	5/19/97	clg	Q	16.1	6.33	7.43	136	457	0	1.68
Eb43-04	8/6/96	m	Q	14.0	6.80	6.90	-53	137	0.0	
Eb43-04	1/8/97	m	Q	14	7.3	6.85	-29	139	0	
Eb43-04	4/9/97	m	Q	14.1	7.10	7.23	-88	219	0	
Eb43-04	6/10/97	m	Q	14.3	7.2	7	-83	183	0	
Eb43-11	9/12/96	ml	Q	17.2	6.96	6.14	147	137	8.4	
Eb43-11	1/16/97	ml	Q	12.5	6.52	7.68	75	147	0	
Eb43-11	3/17/97	ml	Q	12.8	6.58	8.67	181	144	6.4	
Eb51-11	8/6/96	m	AA	13.6	6.50	6.74	-73	140	3.9	
Eb51-11	1/8/97	m	AA	13.4	7	7	-71	133	0	
Eb51-11	4/16/97	m	AA	13.7	7.00	6.78	-46	163	0	
Eb51-11	6/12/97	m	AA	13.6	7	6.64	-23	128	0	
Eb54-05	9/19/96	ml	S	18.2	6.71	6.05	173	228	4.9	
Eb54-05	1/16/97	ml	S	8.6	6.21	7.17	129	182	2.7	
Eb54-05	4/11/97	ml	S	11.1	6.02	6.00	218	237	5.9	
Ec35-05	1/22/97	ml	Q		7.41		-12	296	0	
Ec35-05	3/17/97	ml	Q	12.4	7.41	8.96	-79	314	0	
Ec51-16	8/7/96	ml	R	13.0	6.80	6.86	115	166	0.0	
Ec51-16	1/10/97	ml	R	12.8	7	7.39	101	136	5.9	
Ec51-16	4/11/97	ml	R	12.9	6.80	6.27	187	156	3.9	
Ec51-16	6/10/97	ml	R	13.2	7.2	7.19	33	155	7.2	
Ec52-09	8/7/96	ml	R	13.4	7.40	7.48	-114	200	0.0	
Ec52-09	1/10/97	ml	R	13.4	7.6	7.58	-68	151	2.9	
Ec52-09	6/25/97	ml	R	13.7	7.8	7.54	-49	151	3.5	
Ed21-20	9/17/96	m	Q	16.9	6.98	7.63	-172	236	0.0	
Ed21-20	1/16/97	m	Q	11.1	7.21	7.86	-139	200	0	
Ed21-20	3/17/97	m	Q	11.5	7.49	7.80	-152	20.3	0	
Ed51-10	9/16/96	rng	Q	13.9	5.41	4.78	167	294	6.3	
Ed51-10	1/22/97	rng	Q	12.4	5.13	8.36	208	279	4.2	
Ed51-10	3/17/97	rng	Q	12.5	5.22	9.42	297	278	0	
Fa15-08	8/6/96	m	Z	13.9	6.40	6.63	-64	128	3.9	
Fa15-08	1/8/97	m	Z	13.8	6.9	6.8	-54	107	4.5	
Fa15-08	4/16/97	m	Z	13.8	6.60	6.68	-43	120	0	
Fa15-08	6/25/97	m	Z	14.2	6.8	6.49	-45	106	0	
Fa45-07	9/12/96	clg	Z	16.5	7.33	6.39	141	602	3.7	14.15
Fa45-07	11/13/96	clg	Z	12.6	5.37	6.47	80	890	5.6	14
Fa45-07	2/4/97	clg	Z	13.7	6.63	7.15	143	780	5.5	12.4
Fa45-07	5/21/97	clg	Z	14.9	6.44	7.19	183	1025	7.8	11.52

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Aquifer	Watershed	Temperature (Celsius)	pH (lab)	pH (field)	eH	Specific Conductance in µS/cm	Oxygen, dissolved mg/L	Depth to Water (feet)
Fb11-07	1/23/97	ptg	AA		7.22		-115	157	0	
Fb11-07	4/16/97	ptg	AA	14.3		6.98	-44	163	0	
Fb11-07	6/17/97	ptg	AA	14.5	7	6.68	-81	163	0	
Fb12-05	9/17/96	clg	AA	16.2	5.61	4.90	237	128	9.0	9.47
Fb12-05	11/19/96	clg	AA	15.8	5.14	4.93	218	153	8.5	10.4
Fb12-05	2/21/97	clg	AA	13.6	5.75	6.27	200	139	10.2	7.7
Fb12-05	5/27/97	clg	AA	13.9	5.15	6.14	203	106	10.9	9.8
Fb12-06	1/22/97	clg	AA	13	5.69	6.75	174	203	8.8	9.15
Fb12-06	1/27/97	clg	AA	13		6.36	180	173	7.6	9.32
Fb12-06	2/21/97	clg	AA	12.7	5.75	6.00	179	272	10.7	10
Fb12-06	5/27/97	clg	AA	12.9	5.71	6.42	218	200	11.6	10.17
Fb14-11	8/14/96	ptg	S	15.3	6.50	6.77	-76	134	0.0	
Fb14-11	1/9/97	ptg	S	15.5	7.1	6.89	-79	103	0	
Fb14-11	4/4/97	ptg	S	15.3	6.90	6.66	-71	125	0	
Fb14-11	6/17/97	ptg	S	15.4	6.9	6.73	-84	115	0	
Fb22-10	9/24/96	ml	S	15.9	7.76	7.58	111	216	2.0	
Fb22-15	7/29/96	clg	S	14.2	5.25	4.93	260	168	8.2	5.24
Fb22-15	11/12/96	clg	S	15.3	5.05	5.42	91.2	592	8.9	5.09
Fb22-15	2/19/97	clg	S	14	6.25	6.54	213	220	10	2.3
Fb22-15	5/7/97	clg	S	13.3	6.11	7.21	215	156	11.1	4.88
Fb24-11	8/8/96	ml	S	13.8	7.40	7.47	2	195	5.8	
Fb24-11	1/14/97	ml	S	8.1	7.6	7.63	29	166	0	
Fb24-11	4/2/97	ml	S	10.2	7.60	8.59	-20	173	1.3	
Fb24-11	6/12/97	ml	S	14.5	7.7	8.87	-107	149	0	
Fb25-07	7/25/96	rng	S	14.5	5.16	4.83	269	146	9.3	11.20
Fb25-07	11/19/96	rng	S	15.1	5.17	4.71	178	158	9	12.34
Fb25-07	1/14/97	rng	S	13.4	5.21	6.7	212	142	8.4	12.22
Fb25-07	2/21/97	rng	S	13.9	5.33	5.28	225	187	9.7	11.87
Fb25-07	5/7/97	rng	S	13.7	5.43	6.08	241	146	10.1	12.1
Fb33-12	1/16/97	ptg	S	15.2	7.15	8.15	-58	143	0	
Fb33-12	4/3/97	m	S	15.3	7.30	7.64	-82	167	0	
Fb33-12	6/10/97	m	S	15.5	7.3	7.12	-54	185	0	
Fb33-24	1/16/97	ptg	T	15.8	6.95	7.67	-37	135	0	
Fb33-24	4/3/97	ptg	T	16.2	7.20	7.63	-69	115	0	
Fb33-24	6/10/97	ptg	T	16.3	7.2	6.91	-25	150	0	
Fb41-11	9/17/96	clg	T	16.8	6.49	6.39	173	3530	6.3	11.26
Fb41-11	11/15/96	clg	T	15.8	6.2	6.22	162	1008	10.8	11
Fb41-11	2/4/97	clg	T	14.4	6.40	6.84	167	355	10.6	9.47
Fb41-11	5/21/97	clg	T	13.9	6.67	6.6	209	177	16.4	9.02
Fb43-03	1/16/97	m	T	15.3	7.24	8.21	-45	166	0	
Fb43-03	4/3/97	m	T	15.3	7.60	7.49	-107	166	4.5	
Fb43-03	6/10/97	m	T	15.4	7.7	7.68	-104	174	0	
Fb54-01	8/13/96	ptg	T	17.5	7.20	7.51	-142	179	0.0	
Fb54-01	1/17/97	ptg	T	17.6	7.6	7.86	-99	177	0	
Fb54-01	4/3/97	ptg	T	17.6	7.70	7.51	-127	139	2.2	
Fb54-01	6/12/97	ptg	T	17.5	7.8	7.83	-160	177	3	

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Aquifer	Watershed	Temperature (Celsius)	pH (lab)	pH (field)	eH	Specific Conductance in µS/cm	Oxygen, dissolved mg/L	Depth to Water (feet)
Fb54-05	7/22/96	clg	T	15.6	5.61	5.86		183	0.0	32.43
Fb54-05	11/27/96	clg	T	13.1	5.83	5.39		240	11.3	34.81
Fb54-05	2/24/97	clg	T	12.4	6.18	6.76	190	176	9.5	32.9
Fb54-05	5/27/97	clg	T	13.9	5.65	6.94	203	100		32.75
Fb54-07	11/27/96	clg	T	13.1	5.04	4.82		100	10.9	25
Fb54-07	2/26/97	clg	T	12.4	5.11	6.10	268	100	9.3	24.23
Fb54-07	5/28/97	ptg	T	12.7	6.1	6.39	209	71	10.2	24.3
Fb54-08	7/22/96	clg	T	14.6	5.16	4.74		22	0.0	23.02
Fb54-08	11/20/96	clg	T	14.8	4.82	3.8	168.8		12.5	25.74
Fb54-08	5/28/97	clg	T	13.8	5.42	5.77	236	4	6.2	23.2
Fc11-23	9/16/96	clg	R	14.1	6.02	5.27	232	160	12.0	26.95
Fc11-23	11/15/96	clg	R	14.5	5.71	5.42	221	146	9.4	26.9
Fc11-23	2/4/97	clg	R	15.6	6.09	6.70	175	169	6.7	24.93
Fc11-23	5/7/97	clg	R	15	6.41	6.2	234	165	9.5	23.23
Fc12-23	8/7/96	ml	R	13.5	6.50	6.52	69	197	0.0	
Fc12-23	1/10/97	ml	R	13.5	6.9	6.49	686	145	4.8	
Fc12-23	4/2/97	ml	R	13.5	6.90	6.56	36	187	9	
Fc12-23	6/10/97	ml	R	13.4	6.5	6.48	122	133	4.5	
Fc12-23	6/25/97	ml	R	13.8	6.8	6.71	45	139	2.9	
Fc12-26	9/16/96	clg	R	15.3	6.26	5.38	190	263	7.1	22.96
Fc12-26	11/12/96	clg	R		5.57					22.85
Fc12-26	2/19/97	clg	R	15.2	5.21	8.47	147	459	9.2	22.15
Fc12-26	5/22/97	clg	R	14.8	6.11	8.26	208	327	9.1	21.72
Fc15-04	8/14/96	ml	R	14.2	7.60	7.60	-76	222	0.0	
Fc15-04	1/9/97	ml	R	13.5	7.9	7.85	-30	216	0	
Fc15-04	4/4/97	ml	R	14.1	7.70	6.00	-134	219	0	
Fc15-04	6/17/97	ml	R	14.5	7.7	8.76	-89	185	0	
Fc31-11	9/10/96	ml	T	14.1	7.60	7.63	-88	204	5.4	
Fc31-11	1/29/97	ml	T	14.3	7.6	7.68	20	167	0	
Fc31-11	4/9/97	ml	T	14.4	7.80	7.79	-113	210	6.8	
Fc31-11	6/12/97	ml	T	14.4	7.8	7.93	-132	180	3.3	
Fc42-09	7/24/96	vt	T	17.2	4.38	4.08	296	186	9.2	31.12
Fc42-09	11/18/96	vt	T	14.3	4.35	4.24		172	8.2	30.6
Fc42-09	2/28/97	vt	T	14.5	4.29	6.27	226	182	8.8	32.6
Fc42-09	5/23/97	vt	T	14.6	5.88	5.75	263	153	10.3	32.41
Fc42-13	8/7/96	ml	T	14.1	7.60	7.78	-112	184	0.0	
Fc42-13	1/14/97	ml	T	13.8	7.8	7.47	-56	166	0	
Fc42-13	4/9/97	ml	T	13.5	8.00	7.82	-121	176	0	
Fc42-13	6/10/97	ml	T	14.3	8	8.01	-80	169	2.5	
Fc42-24	7/24/96	vt	T	13.5	5.14	4.92	254	188	13.7	25.88
Fc42-24	11/18/96	vt	T	14.7	5.25	4.95	104.8	193	9.5	24.06
Fc42-24	2/28/97	vt	T	14.5	5.06	6.43	179	184	9	25.95
Fc42-24	5/5/97	vt	T	14.4	4.997	6.01	207	184	13.8	24.83
Fc42-25	7/24/96	clg	T	18.4	5.19	4.92	262	161	9.3	7.48
Fc42-25	11/18/96	clg	T	16.9	5.21	4.64	230	150	9.1	5.97
Fc42-25	2/28/97	clg	T	11.9	5.06	6.87	178	135	12.2	8.51
Fc42-25	5/23/97	clg	T	14.6	5.63	6.55	193	151	9.9	8.4
Gb11-07	9/9/96	clg	Y	15.7	6.27	5.35	264	274		12.09
Gb11-07	11/12/96	clg	Y	15.6	5.96	5.56	187	318	8	12.2
Gb11-07	2/4/97	clg	Y	13.9	6.14	6.45	182	328	9.9	10.75
Gb11-07	5/21/97	clg	Y	14.1	5.73	6	233	325	10.1	10.15
Gb11-07	5/28/97	clg	Y	13.9	5.85	7.86	184	309	12.8	10.34
Gb14-03	7/18/96	clg	T	13.4	7.29	7.23	97	233	0.0	14.30
Gb14-03	11/20/96	clg	T	12.4	7.36	6.11	-33	299	6.2	14.64
Gb14-03	2/26/97	clg	T	12.7	7.11	6.00	127	283	6	14.15
Gb14-03	5/28/97	clg	T	12	5.91	8.29	167	187	6.2	14.66

APPENDIX E

Results of Water-Quality Analyses

DGSID	Date	Aquifer	Watershed	Temperature (Celsius)	pH (lab)	pH (field)	eH	Specific Conductance in µS/cm	Oxygen, dissolved mg/L	Depth to Water (feet)
Gb14-05	9/9/96	clg	T	20.1	6.74	5.29	309	575	7.5	5.62
Gb14-05	11/7/96	clg	T	19.5	6.17	6.3	151	610	7.3	5.47
Gb14-05	2/6/97	clg	T	12.5	6.46	6.00	136	755	7.2	2.15
Gb14-05	5/22/97	clg	T	14.3	6.25	7.03	147	1190	11.1	4.8
Gb21-10	8/1/96	clg	Y	15.4	5.57	5.59	249	138	0.0	2.20
Gb21-10	11/7/96	clg	Y	18	5.38	5.42	195	147	10.3	3.66
Gb21-10	2/10/97	clg	Y	11.5	5.59	6.00	197	123	6.6	0.8
Gb21-10	5/21/97	clg	Y	13	5.57	6	233	131	8.3	2.84
Gb24-05	8/14/96	rng	U	14.6	7.30	7.76	-140	202	0.0	
Gb24-05	1/9/97	rng	U	13.9	7.8	7.71	-122	179	0	
Gb24-05	4/4/97	rng	U	14.3	7.70	7.66	-133	197	0	
Gb24-05	6/17/97	rng	U	14.6	7.7	8.25	-128	155	0	
Gb53-02	8/1/96	clg	U	13.1	6.07	5.95	205	150	6.1	3.28
Gb53-02	11/6/96	clg	U	14.4	6.05	6.06	163	153	10.5	5
Gb53-02	2/6/97	clg	U	13	6.25	7.49	144	252	5.2	2.45
Gb53-02	5/22/97	clg	U	12.4	5.71	7.33	189	199	15.9	2.21
Gc44-07	7/31/96	clg	W	18.5	6.41	6.60	-130	268	0.0	2.42
Gc44-07	11/7/96	clg	W	18.2	6.64	6.8	-80	298	0	2.49
Gc44-07	2/5/97	clg	W	11.5	6.71	8.52	-69	220	0	2.6
Gc44-07	5/21/97	clg	W	13.9	6.81	6	-91	258	0	2.82
Hc11-11	8/1/96	clg	W	20.6	5.12	4.92	251	415	0.0	1.00
Hc11-11	11/6/96	clg	W	18.9	5.08	4.77	204	293	2.4	3.16
Hc11-11	2/6/97	clg	W	10	5.33	7.61	232	181	4.7	0.17
Hc11-11	5/5/97	clg	W	13	6.35	6.35	240	238	4.6	1.85
Hc11-11	5/22/97	clg	W	14.9	5.04	6.04	234	210	5.7	3.21
Hc13-02	9/10/96	rng	W	15.0	7.60	7.63	-88	204	5.4	
Hc13-02	1/29/97	rng	W	14.7	7.5	8.81	-98	244	0	
Hc13-02	4/16/97	rng	W	15.7	7.90	6.00	-43	248	3.4	
Hc13-02	6/19/97	rng	W	16.2	7.9	7.48	-95	225	0	
Hc14-03	8/13/96	rng	W	14.7	7.50	7.55	-77	239	6.1	
Hc14-03	1/9/97	rng	W	14.5	7.9	7.62	-65	158	10.5	66.08
Hc14-03	4/9/97	rng	W	14.9	7.80	8.01	-119	278	0	
Hc14-03	6/19/97	rng	W	15.2	7.9	8.86	-110	220	0	
Hc14-15	7/31/96	clg	W	20.4	6.24	5.85	224	153	14.2	4.19
Hc14-15	11/7/96	clg	W	17.2	5.59	5.55	195	161	6.7	5.54
Hc14-15	2/5/97	clg	W	8.5	5.47	8.47	140	131	10.1	4.95
Hc14-15	5/5/97	clg	W	12.6	5.95	5.93	214	127	8.6	4.55
Hc14-15	5/22/97	clg	W	15.9	6.02	7.27	216	155	18.6	4.85

APPENDIX E

Results of Water-Quality Analyses

DGSID	Date	Total Organic Carbon (mg/L)	Calcium, dissolved mg/L as Ca	Magnesium, dissolved mg/L as Mg	Sodium, dissolved mg/L as Na	Silica dissolved mg/L as SiO_2	Alkalinity as $CaCO_3$ mg/L	Sulfate dissolved mg/L as SO_4^{-2}
Ea44-13	7/29/96	ND	15.4	4.83	17.7	3.41	3.8	<0.05
Ea44-13	11/12/96						1.9	
Ea44-13	2/10/97						12.5	29
Ea44-13	5/7/97						2.5	
Ea45-04	8/6/96	ND	10.7	4.17	4.5	10	52	<0.05
Ea45-04	1/10/97				3		45	
Ea45-04	4/2/97				3		50	
Ea45-04	6/12/97				8		55	
Eb33-41	9/12/96	2.0	13.2	3.84	10.9	5.45	14.3	<0.05
Eb33-41	3/10/97						25.6	23
Eb33-41	5/29/97						9.63	21
Eb33-42	8/15/96	3.2	9.25	2.84	5.98	5.97	10.45	<0.05
Eb33-42	3/10/97						7.6	14
Eb33-42	5/29/97						4.04	44
Eb35-23	7/30/96	ND	53.1	15.1	70.3	3.53	55.1	<0.05
Eb35-23	9/19/96	ND	39.1	7.48	9.15	10.2	49.4	<0.05
Eb35-23	11/12/96						77.9	
Eb35-23	2/10/97						91	18
Eb35-23	5/19/97						7.12	
Eb43-04	8/6/96	ND	36.3	6.4	4.01	4.14	108	<0.05
Eb43-04	1/8/97				4		110	
Eb43-04	4/9/97				3		110	5
Eb43-04	6/10/97				8.3		103	
Eb43-11	9/12/96	1.5	26.4	2.01	4.22	8.24	25.6	<0.05
Eb43-11	1/16/97						48.5	
Eb43-11	3/17/97						21.5	<0.5
Eb51-11	8/6/96	ND	26.3	4.6	3.36	6.69	76	<0.05
Eb51-11	1/8/97				3		80	
Eb51-11	4/16/97				2		82	6
Eb51-11	6/12/97				8		75	
Eb54-05	9/19/96	ND	53.4	15.8	74.8	5.3	31.4	<0.05
Eb54-05	1/16/97						50.4	
Eb54-05	4/11/97						3.4	7.8
Ec35-05	1/22/97						122	
Ec35-05	3/17/97						28	12.3
Ec51-16	8/7/96	ND	40.6	2.34	4.45	8.09	80	<0.05
Ec51-16	1/10/97				3		83	
Ec51-16	4/11/97				3		75	
Ec51-16	6/10/97				8		77	
Ec52-09	8/7/96	ND	52	3.01	4.43	9.14	125	<0.05
Ec52-09	1/10/97				3		120	
Ec52-09	6/25/97				5		120	
Ed21-20	9/17/96	ND	12.4	2.91	39.6	3.74	76	<0.05
Ed21-20	1/16/97						87.4	
Ed21-20	3/17/97						39	19
Ed51-10	9/16/96	ND	16.1	10.3	34.3	13.8	2.85	<0.05
Ed51-10	1/22/97						67.5	
Ed51-10	3/17/97						3.1	<0.5
Fa15-08	8/6/96	ND	21.2	4.66	3.62	7.16	65	<0.05
Fa15-08	1/8/97				2		67	
Fa15-08	4/16/97				2		61	6.1
Fa15-08	6/25/97				5		61	
Fa45-07	9/12/96	ND	47.1	24.8	62.9	2.79	131	<0.05
Fa45-07	11/13/96						9.9	
Fa45-07	2/4/97						109	24
Fa45-07	5/21/97						8.54	

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Total Organic Carbon (mg/L)	Calcium, dissolved mg/L as Ca	Magnesium, dissolved mg/L as Mg	Sodium, dissolved mg/L as Na	Silica dissolved mg/L as SiO_2	Alkalinity as $CaCO_3$ mg/L	Sulfate dissolved mg/L as SO_4^{-2}
Fb11-07	1/23/97						91.5	
Fb11-07	4/16/97							5.7
Fb11-07	6/17/97				69		91	
Fb12-05	9/17/96	ND	10.8	8.73	6.66	6.76	2.85	<0.05
Fb12-05	11/19/96						1.8	
Fb12-05	2/21/97						3.2	23
Fb12-05	5/27/97						6.12	25
Fb12-06	1/22/97						81.1	
Fb12-06	1/27/97							
Fb12-06	2/21/97						3.15	29
Fb12-06	5/27/97						9.43	18
Fb14-11	8/14/96	ND	15	3.54	11	4.22	69	<0.05
Fb14-11	1/9/97				10		72	
Fb14-11	4/4/97				10		67	<0.5
Fb14-11	6/17/97				14		66	
Fb22-10	9/24/96	ND	0.103	0.049	58.6	13.9	43.7	<0.05
Fb22-15	7/29/96	ND	13.9	11.4	3.28	6.53	3.8	<0.05
Fb22-15	11/12/96						2.85	
Fb22-15	2/19/97						12.65	23
Fb22-15	5/7/97						6.05	
Fb24-11	8/8/96	2.4	43	2.7	4	11.4	100	<0.05
Fb24-11	1/14/97				3		106	
Fb24-11	4/2/97				2		85	
Fb24-11	6/12/97				8		104	
Fb25-07	7/25/96	ND	15.8	5.23	5.05	6.7	1.9	<0.05
Fb25-07	11/19/96						1.7	
Fb25-07	1/14/97						4.8	
Fb25-07	2/21/97						2.08	<1
Fb25-07	5/7/97						2.2	
Fb33-12	1/16/97						80.8	
Fb33-12	4/3/97				22		106	<0.5
Fb33-12	6/10/97				26		105	
Fb33-24	1/16/97						57.9	
Fb33-24	4/3/97				14		80	4.1
Fb33-24	6/10/97				19		76	
Fb41-11	9/17/96	ND	168	51.5	545	2.71	96.9	<0.05
Fb41-11	11/15/96						9.5	
Fb41-11	2/4/97						12.35	40
Fb41-11	5/21/97						10.09	
Fb43-03	1/16/97						82.7	
Fb43-03	4/3/97				59		110	0.51
Fb43-03	6/10/97				42		112	
Fb54-01	8/13/96	ND	1.88	0.4324	39	4.43	95	<0.05
Fb54-01	1/17/97				43		96	
Fb54-01	4/3/97				46		96	0.52
Fb54-01	6/12/97				47		95	

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Total Organic Carbon (mg/L)	Calcium, dissolved mg/L as Ca	Magnesium, dissolved mg/L as Mg	Sodium, dissolved mg/L as Na	Silica dissolved mg/L as SiO_2	Alkalinity as $CaCO_3$ mg/L	Sulfate dissolved mg/L as SO_4^{-2}
Fb54-05	7/22/96	2.0	9.89	6.41	4.29	4.86	13.3	<0.05
Fb54-05	11/27/96						6.65	
Fb54-05	2/24/97						1.9	
Fb54-05	5/27/97						9.05	30
Fb54-07	11/27/96						2.85	
Fb54-07	2/26/97						1.9	
Fb54-07	5/28/97						8.93	19
Fb54-08	7/22/96	2.1	1.4	0.658	1.9	8.42	9.5	<0.05
Fb54-08	11/20/96						6.7	
Fb54-08	5/28/97						2.4	28
Fc11-23	9/16/96	1.9	12.1	10.4	4.53	6.26	3.8	<0.05
Fc11-23	11/15/96						4.2	
Fc11-23	2/4/97						5.7	14
Fc11-23	5/7/97						3.3	
Fc12-23	8/7/96	ND	38.8	5.25	5	11.2	75	<0.05
Fc12-23	1/10/97				6		74	
Fc12-23	4/2/97				5		75	
Fc12-23	6/10/97				10		45	
Fc12-23	6/25/97				8		59	
Fc12-26	9/16/96	ND	31.5	21	7.89	8.21	21.8	<0.05
Fc12-26	11/12/96						13.2	
Fc12-26	2/19/97						3.3	18
Fc12-26	5/22/97						8.89	36
Fc15-04	8/14/96	ND	43.5	7.1	8	9.53	138	<0.05
Fc15-04	1/9/97				8		135	
Fc15-04	4/4/97				8		110	<0.5
Fc15-04	6/17/97				12		132	
Fc31-11	9/10/96	1.5	40.1	5.73	4	6.48	120	<0.05
Fc31-11	1/29/97				3		120	
Fc31-11	4/9/97				2		115	4.4
Fc31-11	6/12/97				9		115	
Fc42-09	7/24/96	1.2	11.6	6.52	7.04	7.48	1.9	<0.05
Fc42-09	11/18/96						1.5	
Fc42-09	2/28/97						0.9	18.5
Fc42-09	5/23/97						2.13	10
Fc42-13	8/7/96	ND	29.6	5.41	13	7.55	115	<0.05
Fc42-13	1/14/97				12		111	
Fc42-13	4/9/97				12		115	4.2
Fc42-13	6/10/97				24		108	
Fc42-24	7/24/96	ND	16.6	12.6	4.3	5.36	1.9	<0.05
Fc42-24	11/18/96						9.2	
Fc42-24	2/28/97						1.9	21
Fc42-24	5/5/97						1.9	40
Fc42-25	7/24/96	ND	10.4	9.72	3.76	4.89	3.8	<0.05
Fc42-25	11/18/96						8.45	
Fc42-25	2/28/97						13.3	15
Fc42-25	5/23/97						2.08	12
Gb11-07	9/9/96	ND	24.4	13.7	10.6	5.91	10.45	<0.05
Gb11-07	11/12/96						26.6	
Gb11-07	2/4/97						4.75	36
Gb11-07	5/21/97						3.98	
Gb11-07	5/28/97						3.77	30
Gb14-03	7/18/96	1.0	102	2.52	1.46	8.66	18.4	<0.05
Gb14-03	11/20/96						159	
Gb14-03	2/26/97						0.9	
Gb14-03	5/28/97						4.06	10

APPENDIX E

Results of Water-Quality Analyses

DGSID	Date	Total Organic Carbon (mg/L)	Calcium, dissolved mg/L as Ca	Magnesium, dissolved mg/L as Mg	Sodium, dissolved mg/L as Na	Silica dissolved mg/L as SiO_2	Alkalinity as $CaCO_3$ mg/L	Sulfate dissolved mg/L as SO_4^{-2}
Gb14-05	9/9/96	ND	22.3	6.49	83.7	4.76	29.45	0.07
Gb14-05	11/7/96						56.1	
Gb14-05	2/6/97						64.6	32
Gb14-05	5/22/97						10.11	14
Gb21-10	8/1/96	ND	11.6	6.06	8.39	8.4	7.6	<0.05
Gb21-10	11/7/96						10.9	
Gb21-10	2/10/97						47.4	41
Gb21-10	5/21/97						3.42	
Gb24-05	8/14/96	ND	48.5	3.61	4	12.8	117	<0.05
Gb24-05	1/9/97				4		120	
Gb24-05	4/4/97				2		122	<0.5
Gb24-05	6/17/97				8		116	
Gb53-02	8/1/96	ND	13.4	5.45	9.12	5.67	28.5	<0.05
Gb53-02	11/6/96						39.9	
Gb53-02	2/6/97						53.2	15
Gb53-02	5/22/97						7.36	20
Gc44-07	7/31/96	4.0	43.7	12.5	8.36	27.4	19	<0.05
Gc44-07	11/7/96						145	
Gc44-07	2/5/97						107	23
Gc44-07	5/21/97							
Hc11-11	8/1/96	ND	17.2	8.05	46.6	11.4	1.9	<0.05
Hc11-11	11/6/96						7.6	
Hc11-11	2/6/97						4.75	35
Hc11-11	5/5/97						2.7	
Hc11-11	5/22/97						5.95	22
Hc13-02	9/10/96	ND	36.6	11.8	7	6.19	152	<0.05
Hc13-02	1/29/97				7		150	
Hc13-02	4/16/97				6		150	5
Hc13-02	6/19/97				7		156	
Hc14-03	8/13/96	ND	35.9	12.7	7	6.62	150	<0.05
Hc14-03	1/9/97				7		150	
Hc14-03	4/9/97				8		147	5.1
Hc14-03	6/19/97				10		147	
Hc14-15	7/31/96	ND	10.7	3.44	14.1	2.58	5.7	<0.05
Hc14-15	11/7/96						13.3	
Hc14-15	2/5/97						10.45	19
Hc14-15	5/5/97						3.1	
Hc14-15	5/22/97						4.86	19

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Chloride dissolved mg/L as Cl-	Iron dissolved mg/L as Fe	Manganese dissolved mg/L as Mn	Potassium dissolved mg/L as K	Copper dissolved mg/L as Cu	Lead dissolved mg/L as Pb	Zinc dissolved mg/L as Zn	Flouride dissolved mg/L as F-
Ea44-13	7/29/96	1.06	<0.02	<0.02	0.75	<0.01	<0.002	<0.02	1.40
Ea44-13	11/12/96	0.9	0.6						
Ea44-13	2/10/97	1.7	0.02						
Ea44-13	5/7/97	0.44	0.12						
Ea45-04	8/6/96	<2	9.20	0.21	0.82	<0.01	0.003	0.03	0.11
Ea45-04	1/10/97	7	9.5						
Ea45-04	4/2/97	3	8.8						
Ea45-04	6/12/97	3	8.3						
Eb33-41	9/12/96	1.1	0.05	<0.02	12.20	<0.01	<0.002	<0.02	0.22
Eb33-41	3/10/97	2.07	0.06						
Eb33-41	5/29/97	0.89	0.04						
Eb33-42	8/15/96	0.58	0.19	<0.02	0.90	<0.01	<0.002	<0.02	0.52
Eb33-42	3/10/97	1.35	0.09						
Eb33-42	5/29/97	0.89	0.02						
Eb35-23	7/30/96	0.62	0.09	0.07	1.23	<0.01	<0.002	0.05	0.13
Eb35-23	9/19/96	0.8	0.19	0.26	9.90	<0.01	<0.002	0.05	0.14
Eb35-23	11/12/96	0.9	0.3						
Eb35-23	2/10/97	0.89	0.67						
Eb35-23	5/19/97	0.9	0.61						
Eb43-04	8/6/96	<2	2.40	0.04	1.46	0.02	<0.002	<0.02	0.25
Eb43-04	1/8/97	3	2.6						
Eb43-04	4/9/97	5	2.2						
Eb43-04	6/10/97	2	2.13						
Eb43-11	9/12/96	0.5	0.05	<0.02	0.53	<0.01	<0.002	0.08	0.24
Eb43-11	1/16/97	1.77	0.08						
Eb43-11	3/17/97	1.64	0.35						
Eb51-11	8/6/96	<2	3.50	<0.02	0.35	<0.01	<0.002	<0.02	0.22
Eb51-11	1/8/97	2	4.2						
Eb51-11	4/16/97	1	4.4						
Eb51-11	6/12/97	2	4.3						
Eb54-05	9/19/96	3.7	0.08	0.24	18.20	<0.01	<0.002	0.12	0.14
Eb54-05	1/16/97	6.2	0.15						
Eb54-05	4/11/97	0.86							
Ec35-05	1/22/97	3.55	0.86						
Ec35-05	3/17/97	3.9	2.4						
Ec51-16	8/7/96	4	<0.05	<0.02	0.78	<0.01	<0.002	<0.02	0.16
Ec51-16	1/10/97	10	0.07						
Ec51-16	4/11/97	5	<0.05						
Ec51-16	6/10/97	7	<0.05						
Ec52-09	8/7/96	<2	0.51	0.06	0.77	<0.01	<0.002	<0.02	0.14
Ec52-09	1/10/97	3	0.51						
Ec52-09	6/25/97	4	0.39						
Ed21-20	9/17/96	1.4	2.54	0.05	1.78	<0.01	0.004	0.22	0.23
Ed21-20	1/16/97	8.86	3.1						
Ed21-20	3/17/97	6	5						
Ed51-10	9/16/96	1.15	0.03	<0.02	1.91	0.14	<0.002	0.09	0.12
Ed51-10	1/22/97	48.7	0.25						
Ed51-10	3/17/97	2.02	0.27						
Fa15-08	8/6/96	<2	5.40	0.14	0.77	<0.01	0.003	0.06	0.17
Fa15-08	1/8/97	2	6.9						
Fa15-08	4/16/97	1	5.8						
Fa15-08	6/25/97	<2	5.3						
Fa45-07	9/12/96	0.65	0.08	<0.02	1.94	<0.01	<0.002	<0.02	0.27
Fa45-07	11/13/96	1.7	0.2						
Fa45-07	2/4/97	0.89	0.05						
Fa45-07	5/21/97	1.7	0.03						

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Chloride	Iron	Manganese	Potassium	Copper	Lead	Zinc	Flouride
		dissolved	dissolved	dissolved	dissolved	dissolved	dissolved	dissolved	dissolved
		mg/L as Cl-	mg/L as Fe	mg/L as Mn	mg/L as K	mg/L as Cu	mg/L as Pb	mg/L as Zn	mg/L as F-
Fb11-07	1/23/97	2.67	3.2						
Fb11-07	4/16/97	2.34							
Fb11-07	6/17/97	2	3.4						
Fb12-05	9/17/96	1.2	0.09	<0.02	1.11	<0.01	<0.002	<0.02	0.12
Fb12-05	11/19/96	1.7	0.21						
Fb12-05	2/21/97	<0.44	0.02						
Fb12-05	5/27/97	0.44	0.02						
Fb12-06	1/22/97	9.75	0.08						
Fb12-06	1/27/97								
Fb12-06	2/21/97	<0.44	0.11						
Fb12-06	5/27/97	0.89	0.06						
Fb14-11	8/14/96	<2	4.60	<0.02	1.66	<0.01	0.003	0.14	0.27
Fb14-11	1/9/97	<2	3.9						
Fb14-11	4/4/97	2	3.7						
Fb14-11	6/17/97	0	3.7						
Fb22-10	9/24/96	0.2	0.25	<0.02	0.07	<0.01	0.003	<0.02	0.13
Fb22-15	7/29/96	0.71	0.04	<0.02	0.93	<0.01	<0.002	0.07	0.16
Fb22-15	11/12/96	0.9	0.4						
Fb22-15	2/19/97	1.7	0.07						
Fb22-15	5/7/97	0.44	0.22						
Fb24-11	8/8/96	<2	0.35	0.11	1.31	<0.01	<0.002	<0.02	0.43
Fb24-11	1/14/97	2	0.36						
Fb24-11	4/2/97	3	0.36						
Fb24-11	6/12/97	2	0.25						
Fb25-07	7/25/96	1.15	0.11	<0.02	0.98	<0.01	<0.002	0.06	0.18
Fb25-07	11/19/96	2.6	0.02						
Fb25-07	1/14/97	2.66	<0.05						
Fb25-07	2/21/97	<0.44	0.12						
Fb25-07	5/7/97	0.89	2.89						
Fb33-12	1/16/97	2.66	1						
Fb33-12	4/3/97	1	0.8						
Fb33-12	6/10/97	<2	0.76						
Fb33-24	1/16/97	4.43	2.4						
Fb33-24	4/3/97	3	2.2						
Fb33-24	6/10/97	<2	2.6						
Fb41-11	9/17/96	4.3	0.15	<0.02	20.20	<0.01	<0.002	0.07	0.16
Fb41-11	11/15/96	363	0.02						
Fb41-11	2/4/97	8.86	0.07						
Fb41-11	5/21/97	0.89	0.11						
Fb43-03	1/16/97	4.43	0.5						
Fb43-03	4/3/97	2	0.32						
Fb43-03	6/10/97	<2	0.23						
Fb54-01	8/13/96	<2	0.39	<0.02	1.26	<0.01	<0.002	<0.02	0.29
Fb54-01	1/17/97	2	0.34						
Fb54-01	4/3/97	2	0.36						
Fb54-01	6/12/97	1	0.39						

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Chloride dissolved mg/L as Cl-	Iron dissolved mg/L as Fe	Manganese dissolved mg/L as Mn	Potassium dissolved mg/L as K	Copper dissolved mg/L as Cu	Lead dissolved mg/L as Pb	Zinc dissolved mg/L as Zn	Flouride dissolved mg/L as F-
Fb54-05	7/22/96	0.89	0.09	<0.02	0.94	0.21	<0.002	<0.02	0.21
Fb54-05	11/27/96	8.9	1.21						
Fb54-05	2/24/97	0.89	0.31						
Fb54-05	5/27/97	0.44	6.21						
Fb54-07	11/27/96	4.4	15.1						
Fb54-07	2/26/97	0.89	0.26						
Fb54-07	5/28/97	0.89	0.91						
Fb54-08	7/22/96	0.7	0.18	<0.02	0.53	<0.01	<0.002	<0.02	0.22
Fb54-08	11/20/96	5.5	7.31						
Fb54-08	5/28/97	0.89	0.06						
Fc11-23	9/16/96	0.38	<0.02	0.06	0.74	<0.01	<0.002	0.03	0.18
Fc11-23	11/15/96	0.9	2.83						
Fc11-23	2/4/97	0.89	0.12						
Fc11-23	5/7/97	0.44	0.33						
Fc12-23	8/7/96	19	2.20	<0.02	1.54	<0.01	<0.002	0.18	0.22
Fc12-23	1/10/97	21	1.8						
Fc12-23	4/2/97	20	0.95						
Fc12-23	6/10/97	20	23						
Fc12-23	6/25/97	20	4.2						
Fc12-26	9/16/96	0.55	0.06	0.52	1.08	<0.01	<0.002	<0.02	0.17
Fc12-26	11/12/96	1.7	0.5						
Fc12-26	2/19/97	0.89	0.08						
Fc12-26	5/22/97	0.89	0.09						
Fc15-04	8/14/96	<2	0.43	<0.02	11.00	<0.01	0.004	<0.02	0.39
Fc15-04	1/9/97	2	0.44						
Fc15-04	4/4/97	3	0.41						
Fc15-04	6/17/97	1	0.41						
Fc31-11	9/10/96	<2	0.25	0.04	1.73	<0.01	<0.002	<0.02	0.42
Fc31-11	1/29/97	3	0.31						
Fc31-11	4/9/97	2	0.3						
Fc31-11	6/12/97	3	0.23						
Fc42-09	7/24/96	18.5	0.06	0.11	1.12	<0.01	<0.002	0.05	0.27
Fc42-09	11/18/96	10.6	0.23						
Fc42-09	2/28/97	<0.05	0.18						
Fc42-09	5/23/97	1.7	0.21						
Fc42-13	8/7/96	<2	0.21	<0.02	1.77	<0.01	0.003	<0.02	0.15
Fc42-13	1/14/97	2	0.22						
Fc42-13	4/9/97	1	0.2						
Fc42-13	6/10/97	<2	0.11						
Fc42-24	7/24/96	1.94	0.42	<0.02	0.54	<0.01	<0.002	<0.02	0.32
Fc42-24	11/18/96	2.66	0.45						
Fc42-24	2/28/97	<0.05	<0.02						
Fc42-24	5/5/97	0.44	0.03						
Fc42-25	7/24/96	0.44	0.06	<0.02	0.76	<0.01	<0.002	<0.02	0.20
Fc42-25	11/18/96	7.09	0.06						
Fc42-25	2/28/97	<0.05	<0.02						
Fc42-25	5/23/97	1.7	0.04						
Gb11-07	9/9/96	0.75	0.07	0.11	0.84	<0.01	<0.002	0.04	0.11
Gb11-07	11/12/96	1.7	0.1						
Gb11-07	2/4/97	0.89	0.06						
Gb11-07	5/21/97	1.7	0.05						
Gb11-07	5/28/97	0.44	0.05						
Gb14-03	7/18/96	2.8	1.00	0.20	0.43	<0.01	<0.002	<0.02	0.33
Gb14-03	11/20/96	1.2	0.81						
Gb14-03	2/26/97	<0.45	<0.02						
Gb14-03	5/28/97	1.7	1.48						

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Chloride dissolved mg/L as Cl-	Iron dissolved mg/L as Fe	Manganese dissolved mg/L as Mn	Potassium dissolved mg/L as K	Copper dissolved mg/L as Cu	Lead dissolved mg/L as Pb	Zinc dissolved mg/L as Zn	Flouride dissolved mg/L as F-
Gb14-05	9/9/96	0.4	1.00	<0.02	0.91	<0.01	0.003	0.06	0.12
Gb14-05	11/7/96	4.3	0.3						
Gb14-05	2/6/97	0.89	0.06						
Gb14-05	5/22/97	0.89	0.03						
Gb21-10	8/1/96	2.6	0.18	0.05	0.72	<0.01	<0.002	0.04	0.13
Gb21-10	11/7/96	0.89	0.7						
Gb21-10	2/10/97	0.89	0.06						
Gb21-10	5/21/97	1.7	0.04						
Gb24-05	8/14/96	<2	0.44	<0.02	0.79	<0.01	<0.002	<0.02	0.23
Gb24-05	1/9/97	2	0.51						
Gb24-05	4/4/97	3	0.49						
Gb24-05	6/17/97	1	0.47						
Gb53-02	8/1/96	0.7	0.06	<0.02	8.70	<0.01	<0.002	<0.02	0.14
Gb53-02	11/6/96	1.7	0.5						
Gb53-02	2/6/97	0.89	0.08						
Gb53-02	5/22/97	0.89	0.11						
Gc44-07	7/31/96	0.7	15.10	1.41	1.34	<0.01	<0.002	<0.02	0.21
Gc44-07	11/7/96	3.4	7.6						
Gc44-07	2/5/97	1.7	6.93						
Gc44-07	5/21/97								
Hc11-11	8/1/96	6.4	0.18	<0.02	0.46	<0.01	<0.002	<0.02	0.15
Hc11-11	11/6/96	1.7	0.5						
Hc11-11	2/6/97	1.7	0.03						
Hc11-11	5/5/97	1.7	0.07						
Hc11-11	5/22/97	0.44	0.1						
Hc13-02	9/10/96	<2	0.14	0.03	12.80	<0.01	0.004	<0.02	0.49
Hc13-02	1/29/97	2	0.36						
Hc13-02	4/16/97	0	0.18						
Hc13-02	6/19/97	1	0.28						
Hc14-03	8/13/96	<2	0.18	<0.02	11.80	<0.01	<0.002	<0.02	0.59
Hc14-03	1/9/97	2	0.23						
Hc14-03	4/9/97	1	0.19						
Hc14-03	6/19/97	<2	0.19						
Hc14-15	7/31/96	0.7	0.05	<0.02	0.92	<0.01	<0.002	<0.02	0.14
Hc14-15	11/7/96	0.9	0.2						
Hc14-15	2/5/97	1.7	0.09						
Hc14-15	5/5/97	0.89	0.16						
Hc14-15	5/22/97	0.89	0.32						

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Total Phosphate	Ortho Phosphate	Ammonia	Nitrite	Nitrate	Radon	Total Dissolved
		dissolved	dissolved	dissolved	dissolved	dissolved	pCi/L	Solids
		mg/L as P	mg/L as P	mg/L as NH_4	mg/L as N	mg/L as N		mg/L
Ea44-13	7/29/96	<0.05	<0.05	0.08	0.015	5.80	320	302
Ea44-13	11/12/96					1.10		119
Ea44-13	2/10/97					10		41
Ea44-13	5/7/97					0.5		423
Ea45-04	8/6/96			0.12	0.02	<0.40		80
Ea45-04	1/10/97					<0.40		64
Ea45-04	4/2/97					<0.40		56
Ea45-04	6/12/97					<0.40		75
Eb33-41	9/12/96	<0.05	<0.05	0.04	0.04	2.30		179
Eb33-41	3/10/97					0.64		185
Eb33-41	5/29/97					0.93		107
Eb33-42	8/15/96	<0.05	<0.05	0.19	0.03	0.20		275
Eb33-42	3/10/97					0.44		300
Eb33-42	5/29/97					0.5		37
Eb35-23	7/30/96	<0.05	<0.05	0.10	<0.01	3.60	2600	498
Eb35-23	9/19/96	<0.05	<0.05	0.02	0.03	3.80	2200	88
Eb35-23	11/12/96					4.10		378
Eb35-23	2/10/97					3.5		141
Eb35-23	5/19/97					1.95		161
Eb43-04	8/6/96			0.21	0.02	<0.40		121
Eb43-04	1/8/97					<0.40	146	85
Eb43-04	4/9/97					<0.40		113
Eb43-04	6/10/97					<0.40		97
Eb43-11	9/12/96	<0.05	<0.05	0.02	0.02	2.10		88
Eb43-11	1/16/97					<0.01		148
Eb43-11	3/17/97					3.36		112
Eb51-11	8/6/96			0.18	<0.01	<0.40		96
Eb51-11	1/8/97					<0.40		97
Eb51-11	4/16/97					<0.40		112
Eb51-11	6/12/97					<0.40		86
Eb54-05	9/19/96	<0.05	<0.05	0.02	0.03	3.50	410	96
Eb54-05	1/16/97					0.16		178
Eb54-05	4/11/97					1.4		220
Ec35-05	1/22/97					0.35		238
Ec35-05	3/17/97					11.2		121
Ec51-16	8/7/96	<0.05	<0.05	0.15	<0.01	<2.10	1100	122
Ec51-16	1/10/97					2.20		63
Ec51-16	4/11/97					2.5		88
Ec51-16	6/10/97					2.3		95
Ec52-09	8/7/96	<0.05	<0.05	0.09	<0.01	<0.4	500	114
Ec52-09	1/10/97					<0.4		87
Ec52-09	6/25/97					<0.4		117
Ed21-20	9/17/96	<0.05	<0.05	0.02	0.04	2.50		312
Ed21-20	1/16/97					<0.01		150
Ed21-20	3/17/97					15.1		277
Ed51-10	9/16/96	<0.05	<0.05	0.06	0.03	0.80	825	82
Ed51-10	1/22/97					1.30		214
Ed51-10	3/17/97					5.8		135
Fa15-08	8/6/96			0.08	<0.01	<0.40	120	96
Fa15-08	1/8/97					<0.40		64
Fa15-08	4/16/97					<0.40		89
Fa15-08	6/25/97					<0.40		89
Fa45-07	9/12/96	<0.05	<0.05	0.02	0.02	3.60	190	112
Fa45-07	11/13/96					3.50		403
Fa45-07	2/4/97					6.6		56
Fa45-07	5/21/97					3.71		70

APPENDIX E

Results of Water-Quality Analyses

DGSID	Date	Total Phosphate dissolved mg/L as P	Ortho Phosphate dissolved mg/L as P	Ammonia dissolved mg/L as NH_4	Nitrite dissolved mg/L as N	Nitrate dissolved mg/L as N	Radon pCi/L	Total Dissolved Solids mg/L
Fb11-07	1/23/97					0.29	82	113
Fb11-07	4/16/97							
Fb11-07	6/17/97					<0.40		92
Fb12-05	9/17/96	<0.05	<0.05	0.02	0.02	3.70	350	65
Fb12-05	11/19/96					2.15		51
Fb12-05	2/21/97					1.7		29
Fb12-05	5/27/97					4.5		100
Fb12-06	1/22/97					16.00		232
Fb12-06	1/27/97						1542	
Fb12-06	2/21/97					2.85		28
Fb12-06	5/27/97					13		200
Fb14-11	8/14/96	<0.05	<0.05	0.02	0.05	<0.40	200	85
Fb14-11	1/9/97					<0.40		64
Fb14-11	4/4/97					<0.40		57
Fb14-11	6/17/97					<0.40		79
Fb22-10	9/24/96	<0.05	<0.05	0.02	0.04	3.20	500	66
Fb22-15	7/29/96	<0.05	<0.05	0.09	<0.01	10.00	400	198
Fb22-15	11/12/96					4.80		105
Fb22-15	2/19/97					4.3		131
Fb22-15	5/7/97					0.4		147
Fb24-11	8/8/96	<0.05	<0.05	0.04	0.03	<0.4	150	157
Fb24-11	1/14/97					<0.4	392	109
Fb24-11	4/2/97					<0.4		111
Fb24-11	6/12/97					<0.4		118
Fb25-07	7/25/96	<0.05	<0.05	0.11	<0.01	9.90		89
Fb25-07	11/19/96					1.90		85
Fb25-07	1/14/97					0.14	709	147
Fb25-07	2/21/97					6.55		45
Fb25-07	5/7/97					0.3		143
Fb33-12	1/16/97					<0.40	81	127
Fb33-12	4/3/97					<0.40		146
Fb33-12	6/10/97					<0.40		123
Fb33-24	1/16/97					<0.01	238	106
Fb33-24	4/3/97					<0.40		91
Fb33-24	6/10/97					<0.40		91
Fb41-11	9/17/96	<0.05	<0.05	0.03	0.02	2.30	150	110
Fb41-11	11/15/96					2.10		520
Fb41-11	2/4/97					7.2		80
Fb41-11	5/21/97					2.9		37
Fb43-03	1/16/97					<0.01	172	197
Fb43-03	4/3/97					<0.40		160
Fb43-03	6/10/97					<0.40		138
Fb54-01	8/13/96	<0.05	<0.05	0.02	0.02	<0.40		119
Fb54-01	1/17/97					<0.40		115
Fb54-01	4/3/97					<0.40		144
Fb54-01	6/12/97					<0.40		120

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Total Phosphate dissolved mg/L as P	Ortho Phosphate dissolved mg/L as P	Ammonia dissolved mg/L as NH_4	Nitrite dissolved mg/L as N	Nitrate dissolved mg/L as N	Radon pCi/L	Total Dissolved Solids mg/L
Fb54-05	7/22/96	0.05	<0.05	0.36	<0.01	12.00		3270
Fb54-05	11/27/96			0.2		4.25		201
Fb54-05	2/24/97					18		154
Fb54-05	5/27/97					14		140
Fb54-07	11/27/96			0.28		8.36		80
Fb54-07	2/26/97					6.1		569
Fb54-07	5/28/97					3.7		184
Fb54-08	7/22/96	0.06	<0.05	0.30	0.02	0.86		6671
Fb54-08	11/20/96					1.15		22
Fb54-08	5/28/97					5.5		158
Fc11-23	9/16/96	<0.05	<0.05	0.03	0.03	3.50	250	74
Fc11-23	11/15/96					3.40		56
Fc11-23	2/4/97					14		57
Fc11-23	5/7/97					0.76		1102
Fc12-23	8/7/96	<0.05	<0.05	0.10	0.02	<1.80	1200	158
Fc12-23	1/10/97					2.60		115
Fc12-23	4/2/97					1.8		48
Fc12-23	6/10/97					2.9		136
Fc12-23	6/25/97					3.1		133
Fc12-26	9/16/96	<0.05	<0.05	0.03	0.03	3.20	465	210
Fc12-26	11/12/96					1.90		260
Fc12-26	2/19/97					11.6		292
Fc12-26	5/22/97					7.4		233
Fc15-04	8/14/96	<0.05	<0.05	0.08	0.04	<0.4		128
Fc15-04	1/9/97					<0.4	490	122
Fc15-04	4/4/97					<0.4		135
Fc15-04	6/17/97					<0.4		123
Fc31-11	9/10/96	<0.05	<0.05	0.11	0.04	<0.4	610	121
Fc31-11	1/29/97					<0.4		136
Fc31-11	4/9/97					<0.4		103
Fc31-11	6/12/97					<0.4		131
Fc42-09	7/24/96	0.09	<0.05	0.19	<0.01	13.00		93
Fc42-09	11/18/96					1.15		106
Fc42-09	2/28/97					22		155
Fc42-09	5/23/97					2.7		7
Fc42-13	8/7/96	<0.05	<0.05	0.11	0.02	<0.4	490	129
Fc42-13	1/14/97					<0.4		117
Fc42-13	4/9/97					<0.4		123
Fc42-13	6/10/97					<0.4		130
Fc42-24	7/24/96	<0.05	<0.05	0.12	0.02	7.00	250	88
Fc42-24	11/18/96					3.20		106
Fc42-24	2/28/97					4.8		136
Fc42-24	5/5/97					0.92		97
Fc42-25	7/24/96	<0.05	<0.05	0.12	<0.01	7.00		62
Fc42-25	11/18/96					2.43		137
Fc42-25	2/28/97					11		90
Fc42-25	5/23/97					7.4		83
Gb11-07	9/9/96	<0.05	<0.05	0.02	0.03	2.90	275	92
Gb11-07	11/12/96					1.20		248
Gb11-07	2/4/97					26		105
Gb11-07	5/21/97					6.5		351
Gb11-07	5/28/97					27		370
Gb14-03	7/18/96	<0.05	<0.05	0.71	<0.01	0.42		416
Gb14-03	11/20/96			0.37		0.75		262
Gb14-03	2/26/97					0.1		6
Gb14-03	5/28/97					1.3		340

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Total Phosphate dissolved mg/L as P	Ortho Phosphate dissolved mg/L as P	Ammonia dissolved mg/L as NH_4	Nitrite dissolved mg/L as N	Nitrate dissolved mg/L as N	Radon pCi/L	Total Dissolved Solids mg/L
Gb14-05	9/9/96	<0.05	<0.05	0.03	0.03	0.67	250	88
Gb14-05	11/7/96					3.20		354
Gb14-05	2/6/97					2.2		62
Gb14-05	5/22/97					11		782
Gb21-10	8/1/96	<0.05	<0.05	0.09	<0.01	1.50	430	116
Gb21-10	11/7/96					5.30		32
Gb21-10	2/10/97					1.7		3
Gb21-10	5/21/97					1.13		85
Gb24-05	8/14/96	<0.05	<0.05	0.01	0.02	<0.40	230	141
Gb24-05	1/9/97					<0.40		117
Gb24-05	4/4/97					<0.40		142
Gb24-05	6/17/97					<0.40		130
Gb53-02	8/1/96	<0.05	<0.05	0.12	<0.01	0.65	240	71
Gb53-02	11/6/96					2.80		150
Gb53-02	2/6/97					1.2		35
Gb53-02	5/22/97					13		196
Gc44-07	7/31/96	<0.05	<0.05	0.97	0.03	0.42	380	228
Gc44-07	11/7/96					4.20		148
Gc44-07	2/5/97					0.47		171
Gc44-07	5/21/97							
Hc11-11	8/1/96	<0.05	<0.05	0.13	0.015	1.40	310	292
Hc11-11	11/6/96					4.20		128
Hc11-11	2/6/97					2		220
Hc11-11	5/5/97					0.25		240
Hc11-11	5/22/97					2.3		188
Hc13-02	9/10/96	<0.01	<0.05	0.13	0.030	<0.40	450	171
Hc13-02	1/29/97					<0.40		170
Hc13-02	4/16/97					<0.40		158
Hc13-02	6/19/97					<0.40		139
Hc14-03	8/13/96	<0.05	<0.05	0.06	0.02	<0.40	360	157
Hc14-03	1/9/97					<0.40		121
Hc14-03	4/9/97					<0.40		121
Hc14-03	6/19/97					<0.40		151
Hc14-15	7/31/96	<0.05	<0.05	0.13	<0.01	2.30	220	59
Hc14-15	11/7/96					9.70		68
Hc14-15	2/5/97					5		72
Hc14-15	5/5/97					0.65		178
Hc14-15	5/22/97					0.9		90

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Alachlor (ppb)	Cyanazine (ppb)	Metolachlor (ppb)	Atrazine (ppb)	Carbofuran (ppb)	Simazine (ppb)	2,4-D (ppb)
Ea44-13	7/29/96	ND	ND	ND	0.49	ND		
Ea44-13	11/12/96							
Ea44-13	2/10/97							
Ea44-13	5/7/97	ND	ND	ND	0.22		0.21	ND
Ea45-04	8/6/96							
Ea45-04	1/10/97							
Ea45-04	4/2/97							
Ea45-04	6/12/97							
Eb33-41	9/12/96	0.13	ND	ND	0.54	ND		
Eb33-41	3/10/97							
Eb33-41	5/29/97	ND	ND	ND	0.88		0.52	ND
Eb33-42	8/15/96							
Eb33-42	3/10/97							
Eb33-42	5/29/97							
Eb35-23	7/30/96	0.07	ND	ND	0.31	ND		
Eb35-23	9/19/96	ND	ND	ND	0.35	ND		
Eb35-23	11/12/96							
Eb35-23	2/10/97							
Eb35-23	5/19/97	0.1	ND	ND	0.27		ND	ND
Eb43-04	8/6/96							
Eb43-04	1/8/97							
Eb43-04	4/9/97							
Eb43-04	6/10/97							
Eb43-11	9/12/96	0.10	ND	ND	0.07	ND		
Eb43-11	1/16/97							
Eb43-11	3/17/97							
Eb51-11	8/6/96							
Eb51-11	1/8/97							
Eb51-11	4/16/97							
Eb51-11	6/12/97							
Eb54-05	9/19/96	0.09	ND	ND	0.72	ND		
Eb54-05	1/16/97							
Eb54-05	4/11/97							
Ec35-05	1/22/97							
Ec35-05	3/17/97							
Ec51-16	8/7/96							
Ec51-16	1/10/97							
Ec51-16	4/11/97							
Ec51-16	6/10/97							
Ec52-09	8/7/96							
Ec52-09	1/10/97							
Ec52-09	6/25/97							
Ed21-20	9/17/96							
Ed21-20	1/16/97							
Ed21-20	3/17/97							
Ed51-10	9/16/96	ND	ND	ND	ND	ND		
Ed51-10	1/22/97							
Ed51-10	3/17/97							
Fa15-08	8/6/96							
Fa15-08	1/8/97							
Fa15-08	4/16/97							
Fa15-08	6/25/97							
Fa45-07	9/12/96	ND	ND	0.06	1.1	ND		
Fa45-07	11/13/96							
Fa45-07	2/4/97							
Fa45-07	5/21/97	ND	0.04	ND	1.17		1.04	ND

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Alachlor (ppb)	Cyanazine (ppb)	Metolachlor (ppb)	Atrazine (ppb)	Carbofuran (ppb)	Simazine (ppb)	2,4-D (ppb)
Fb11-07	1/23/97							
Fb11-07	4/16/97							
Fb11-07	6/17/97							
Fb12-05	9/17/96	0.08	ND	ND	0.46	ND		
Fb12-05	11/19/96							
Fb12-05	2/21/97							
Fb12-05	5/27/97	ND	ND	ND	0.27		ND	ND
Fb12-06	1/22/97							
Fb12-06	1/27/97							
Fb12-06	2/21/97							
Fb12-06	5/27/97	ND	0.08	ND	2.42		2.05	ND
Fb14-11	8/14/96							
Fb14-11	1/9/97							
Fb14-11	4/4/97							
Fb14-11	6/17/97							
Fb22-10	9/24/96							
Fb22-15	7/29/96	0.36	0.06	ND	1.63	ND		
Fb22-15	11/12/96							
Fb22-15	2/19/97							
Fb22-15	5/7/97	0.09	0.06	0.13	1.81		1.61	ND
Fb24-11	8/8/96							
Fb24-11	1/14/97							
Fb24-11	4/2/97							
Fb24-11	6/12/97							
Fb25-07	7/25/96	ND	ND	ND	ND	ND		
Fb25-07	11/19/96							
Fb25-07	1/14/97							
Fb25-07	2/21/97							
Fb25-07	5/7/97	ND	ND	ND	ND		ND	ND
Fb33-12	1/16/97							
Fb33-12	4/3/97							
Fb33-12	6/10/97							
Fb33-24	1/16/97							
Fb33-24	4/3/97							
Fb33-24	6/10/97							
Fb41-11	9/17/96	ND	ND	ND	1.35	ND		
Fb41-11	11/15/96							
Fb41-11	2/4/97							
Fb41-11	5/21/97	ND	0.06	ND	2.38		1.87	ND
Fb43-03	1/16/97							
Fb43-03	4/3/97							
Fb43-03	6/10/97							
Fb54-01	8/13/96							
Fb54-01	1/17/97							
Fb54-01	4/3/97							
Fb54-01	6/12/97							

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Alachlor (ppb)	Cyanazine (ppb)	Metolachlor (ppb)	Atrazine (ppb)	Carbofuran (ppb)	Simazine (ppb)	2,4-D (ppb)
Fb54-05	7/22/96	0.06	ND	0.05	0.16	ND		
Fb54-05	11/27/96							
Fb54-05	2/24/97							
Fb54-05	5/27/97							
Fb54-07	11/27/96							
Fb54-07	2/26/97							
Fb54-07	5/28/97							
Fb54-08	7/22/96	ND	ND	0.07	0.06	ND		
Fb54-08	11/20/96							
Fb54-08	5/28/97							
Fc11-23	9/16/96	0.27	ND	0.03	0.4	ND		
Fc11-23	11/15/96							
Fc11-23	2/4/97							
Fc11-23	5/7/97	0.45	ND	ND	0.65		0.46	ND
Fc12-23	8/7/96							
Fc12-23	1/10/97							
Fc12-23	4/2/97							
Fc12-23	6/10/97							
Fc12-23	6/25/97							
Fc12-26	9/16/96	0.08	ND	0.05	0.82	ND		
Fc12-26	11/12/96							
Fc12-26	2/19/97							
Fc12-26	5/22/97	ND	ND	ND	0.21		0.11	ND
Fc15-04	8/14/96							
Fc15-04	1/9/97							
Fc15-04	4/4/97							
Fc15-04	6/17/97							
Fc31-11	9/10/96							
Fc31-11	1/29/97							
Fc31-11	4/9/97							
Fc31-11	6/12/97							
Fc42-09	7/24/96							
Fc42-09	11/18/96							
Fc42-09	2/28/97							
Fc42-09	5/23/97							
Fc42-13	8/7/96							
Fc42-13	1/14/97							
Fc42-13	4/9/97							
Fc42-13	6/10/97							
Fc42-24	7/24/96	ND	ND	ND	0.14	ND		
Fc42-24	11/18/96							
Fc42-24	2/28/97							
Fc42-24	5/5/97							
Fc42-25	7/24/96							
Fc42-25	11/18/96							
Fc42-25	2/28/97							
Fc42-25	5/23/97							
Gb11-07	9/9/96	0.47	0.09	0.1	3.04	ND		
Gb11-07	11/12/96							
Gb11-07	2/4/97							
Gb11-07	5/21/97	0.85	0.06	ND	2.01		2.13	ND
Gb11-07	5/28/97	0.99	0.08	ND	2.17		2.14	ND
Gb14-03	7/18/96							
Gb14-03	11/20/96							
Gb14-03	2/26/97							
Gb14-03	5/28/97							

APPENDIX E
Results of Water-Quality Analyses

DGSID	Date	Alachlor (ppb)	Cyanazine (ppb)	Metolachlor (ppb)	Atrazine (ppb)	Carbofuran (ppb)	Simazine (ppb)	2,4-D (ppb)
Gb14-05	9/9/96	ND	ND	ND	ND	ND		
Gb14-05	11/7/96							
Gb14-05	2/6/97							
Gb14-05	5/22/97	ND	ND	ND	ND		ND	ND
Gb21-10	8/1/96	ND	ND	ND	0.08	ND		
Gb21-10	11/7/96							
Gb21-10	2/10/97							
Gb21-10	5/21/97		ND	ND	0.2		ND	ND
Gb24-05	8/14/96							
Gb24-05	1/9/97							
Gb24-05	4/4/97							
Gb24-05	6/17/97							
Gb53-02	8/1/96	ND	ND	ND	ND	ND		
Gb53-02	11/6/96							
Gb53-02	2/6/97							
Gb53-02	5/22/97	ND	ND	ND	ND		ND	ND
Gc44-07	7/31/96	ND	ND	ND	ND	ND		
Gc44-07	11/7/96							
Gc44-07	2/5/97							
Gc44-07	5/21/97	ND	ND	ND	ND		ND	ND
Hc11-11	8/1/96	ND	ND	ND	ND	ND		
Hc11-11	11/6/96							
Hc11-11	2/6/97							
Hc11-11	5/5/97	ND	ND	ND	ND		ND	ND
Hc11-11	5/22/97							
Hc13-02	9/10/96							
Hc13-02	1/29/97							
Hc13-02	4/16/97							
Hc13-02	6/19/97							
Hc14-03	8/13/96							
Hc14-03	1/9/97							
Hc14-03	4/9/97							
Hc14-03	6/19/97							
Hc14-15	7/31/96	ND	ND	ND	0.09	ND		
Hc14-15	11/7/96							
Hc14-15	2/5/97							
Hc14-15	5/5/97	ND	ND	ND	0.17		0.3	ND
Hc14-15	5/22/97							