Synthesis of Nutrient and Sediment Data for Watersheds Within the Chesapeake Bay Drainage Basin

by Michael J. Langland, Patricia L. Lietman, and Scott Hoffman

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CONVERSION FACTORS AND ABBREVIATIONS

Multiply	By	To obtain
	Flow	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
	Mass	
pound (lb)	0.4536	kilogram
pound per acre (lb/acre)	1.121	kilogram per hectare
pound per day (lb/d)	0.4536	kilograms per day
	Area	
acre	0.4047	hectare
square mile (mi^2)	2.590	square kilometer

Other Abbreviations

Abbreviated water-quality units used in report:

- milligrams per liter (mg/L)
- micrograms per liter (µg/L)
- micrometers (µm)

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ABSTRACT

Nutrient and sediment data collected by Federal and state agencies from 1972 through 1992 at 1,058 surface-water sites in nontidal parts of the Chesapeake Bay Basin were compiled into a large database. Adequate nutrient, sediment, and streamflow data were not available to compute annual loads for all sites because water-quality monitoring at many of the sites was either short term or noncontinuous or because streamflow was not measured. Annual nutrient and sediment loads were calculated at a total of 127 sites. Annual loads of dissolved nitrate were calculated for 108 sites, but total nitrogen loads could be calculated for only 48 of these sites because ammonia plus organic nitrogen data were not available for many of these 108 sites. Annual loads of total phosphorus were calculated for 99 sites, and annual loads of suspended sediment were calculated for 33 sites. Loads could be calculated for only a very few sites in the Juniata River Basin (a tributary to the Susquehanna River), the York River Basin, the middle and lower reaches of the James River, and the nontidal parts of the eastern shore of the Bay.

Geographic Information System (GIS) spatial data sets of land use, physiographic province, rock type, and watershed delineation were compiled for the entire Chesapeake Bay Basin (approximately 64,000 square miles). The nutrient- and sediment-yield data were evaluated with respect to land use, physiographic province, rock type, and hydrologic characteristics. During years that the mean streamflow was about equal to the long-term mean streamflow, the Susquehanna River contributed about 50 percent of the freshwater, 66 percent of the total nitrogen, and 40 percent of the total phosphorus transported by tributaries to the Bay. Nutrient and sediment data were available for less than 18 percent of the predominantly agricultural areas underlain by siliciclastic rock and for less than 35 percent of the predominantly agricultural areas underlain by either carbonate rock or unconsolidated rock. Nutrient and sediment data were available for about 91 percent of the predominantly forested areas underlain by siliciclastic rock. Spatial and temporal gaps in the water-quality data and GIS data sets limited some data analysis. Correlations of annual yields of nutrients and sediment with respect to land use, physiographic province, and rock type indicated (1) basins with larger percentages of agricultural land had larger nutrient and sediment yields, (2) basins with larger percentages of forest land had smaller nutrient and sediment loads, (3) the largest total nitrogen yields were from agricultural basins underlain by carbonate rock, (4) yields of nutrients from urban basins were substantially less than yields from agricultural basins, and (5) basins with small amounts of agricultural and urban land had relatively small nutrient and sediment yields.

INTRODUCTION

The Chesapeake Bay is the largest estuary in the United States. Its thriving fisheries industry and complex ecosystems are vulnerable to changes in water quality. Excessive nutrients and sediment entering the Chesapeake Bay from agricultural, urban, and forested nonpoint sources within the Bay Basin have been shown to cause degradation of both water quality and living resources in the Bay. In 1987, with the signing of the Chesapeake Bay Agreement, Pennsylvania, Maryland, Virginia, and the District of Columbia agreed to reduce controllable nutrient loads to the Chesapeake Bay by 40 percent by the year 2000. Many studies conducted by the U.S. Geological Survey (USGS), other Federal and state organizations, utilities, and universities have determined concentrations of nutrients and sediment in streams draining watersheds throughout the

Chesapeake Bay Basin. A small number of these studies have used the concentration data to estimate nutrient and sediment loads; however, the concentration and load information has never been compiled into a single database or analyzed with respect to the primary factors affecting nutrient and sediment loading to the Chesapeake Bay. Factors such as land use, physiographic province, rock type, and hydrologic characteristics vary widely throughout the Chesapeake Bay drainage, but more needs to be known about the relative importance of these individual factors and how they interact synergistically to affect water quality. Compilation of nutrient- and sediment-load data and basin characteristics will provide water managers with the data needed to evaluate existing monitoring networks, estimate the effectiveness of water-quality management-strategies, and determine future monitoring needs.

Purpose and Scope

This report (1) documents the compilation of nontidal nutrient and sediment water-quality data collected from 1972 through 1992; nutrient- and sediment-load and -yield data; spatial Geographic Information System (GIS) data sets, including land use, physiographic province and rock type; and selected supplemental information for the Chesapeake Bay Basin for all available data sources that met the minimum requirements (detailed in Description of Database on page 6); (2) relates nutrient and sediment loads and yields to land use, physiographic province, rock type, and hydrologic characteristics; (3) identifies spatial and temporal deficiencies in nutrient- and sediment-load data collection within the Chesapeake Bay Basin; and (4) presents a discussion of potential applications of the database.

Approach

Extensive water-quality, water-discharge, spatial, and supplemental data (station name, latitude and longitude, drainage basin, etc.) were compiled into one database. Water-quality data were requested from all nontidal monitoring programs within the Chesapeake Bay Watershed. Hydrologic streamflow data collected by the USGS were used to determine and characterize the annual quantity of both total flow and base flow and to identify annual streamflow according to flow condition. By use of an unbiased log-linear regression model (Cohn and others, 1989), annual nutrient and suspended-sediment loads were estimated for total flow and base flow for some sites within the Bay Basin. Spatial data sets for land use, physiographic province, rock type, and watershed delineations were compiled in a GIS for the entire Bay Basin. Drainage basins, upstream from water-quality sites where loads were estimated, were delineated and characterized by percentage land use, physiographic province, rock type, and hydrologic condition. Estimated nutrient and sediment loads were correlated with land use, physiographic province, and rock type to identify any linear relations that existed in the data. Spatial gaps in the database were evaluated with respect to the areal distribution of sites with water-quality-load data and the range of spatial (GIS) data. Temporal gaps were evaluated with respect to minimum requirements for loads computations and requirements for trend analysis for this and future studies.

Description of Study Area

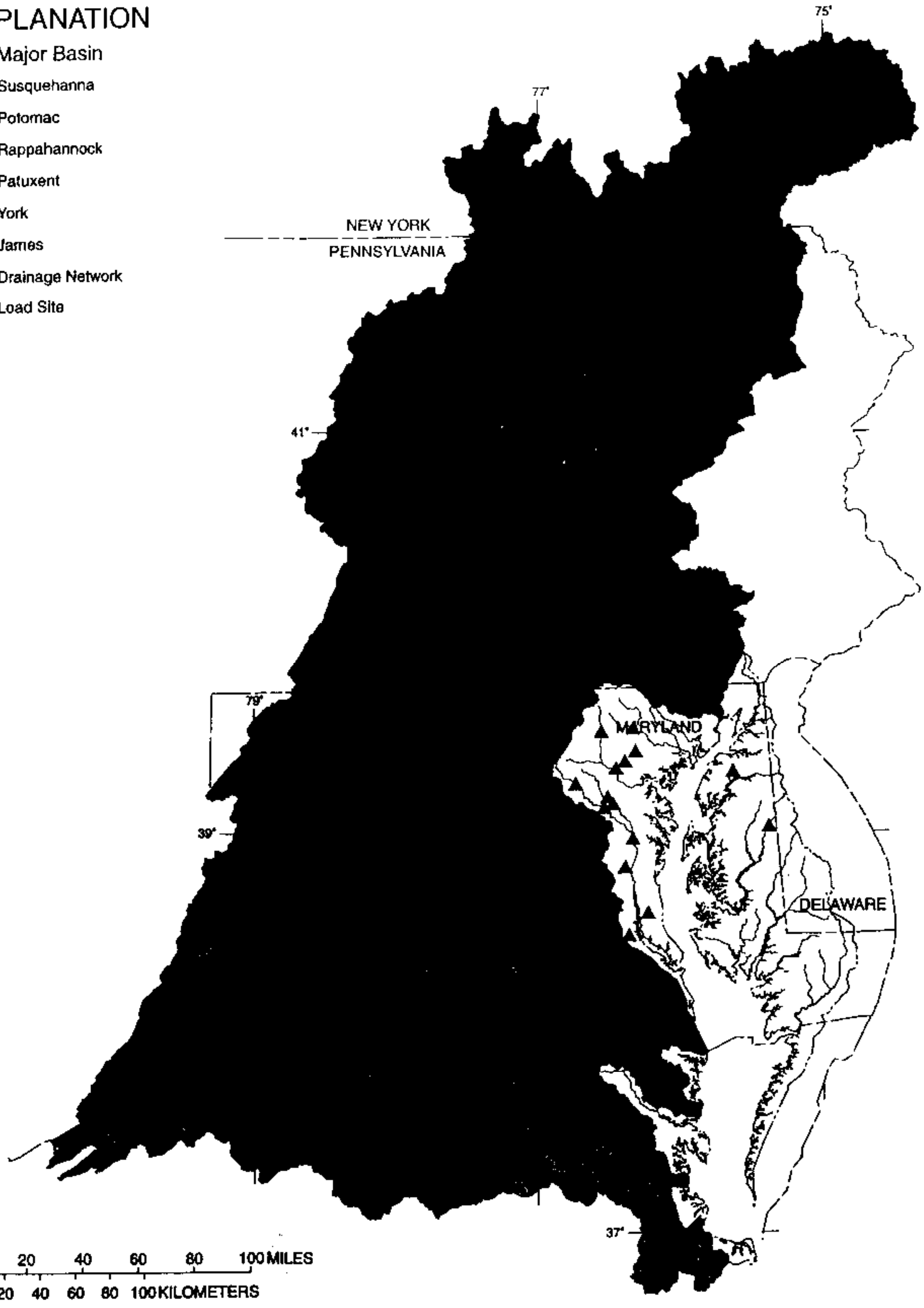
The Chesapeake Bay is one of the largest and most productive estuarine systems in the world. The Chesapeake Bay "mainstem," defined by tidal zones, is approximately 195 mi long and 3.5 to 35 mi wide and has a surface area of nearly 4,400 mi^2. The mainstem is located entirely within the states of Maryland and Virginia. Nearly 50 rivers, with thousands of tributary streams and creeks, drain the approximately 64,000 mi^2 forming the Chesapeake Bay Basin. The Bay Basin contains more than 150,000 stream miles in the District of Columbia and parts of six states: New York, Pennsylvania, Maryland, Virginia, West Virginia, and Delaware (fig. 1). Six rivers, the Susquehanna, Patuxent, Potomac, Rappahannock, York, and James (fig. 1), contribute nearly 90 percent of the Bay's mean annual freshwater inflow of 69,800 ft^3/s (U.S. Army Corps of Engineers, 1977). The Susquehanna River, the largest river entering the Bay, drains nearly 43 percent of the 64,000-mi^2 basin and normally contributes about 50 percent of the freshwater reaching the Bay. Most of the Susquehanna River Basin is in Pennsylvania.

The climate in the Chesapeake Bay Basin is characterized as humid continental with generally moderate temperatures. Precipitation in the Bay Basin averaged 44 in/yr at selected National Atmospheric and Oceanic Administration (NOAA) stations from 1930 to 1961 (U.S. Army Corps of Engineers, 1977). However, significant long- and

EXPLANATION

Major Basin

- Susquehanna
- Potomac
- Rappahannock
- Patuxent
- York
- James
- Drainage Network
- ▲ Load Site



0 20 40 60 80 100 MILES
0 20 40 60 80 100 KILOMETERS

Figure 1. Stream network in the six major river basins of the Chesapeake Bay Basin.

short-term variations in precipitation occur in the Bay Basin primarily because of the large areal extent and local influence of thunderstorms. For example, in the northern part of the basin, average precipitation is about 30 in/yr, while in sections of the southern part of the basin, precipitation averages nearly 50 in/yr. Surface runoff (precipitation) within the Chesapeake Bay watershed is a significant contributor of nutrient loads (Maryland Department of Environment, 1992).

Data Sources

Water-quality and -discharge data were requested, retrieved, and compiled from Federal and state agencies, universities, and private companies or organizations that had collected nutrient and sediment data at multiple and single land-use sites from nontidal stream reaches within the Chesapeake Bay Basin. Databases used as sources of nutrient and sediment data include U.S. Environmental Protection Agency's (USEPA) STORET, USGS's WATSTORE, and Maryland Department of the Environment's (MDE) VAX system. Agencies supplying water-quality data include the USGS, the Pennsylvania Department of Environmental Protection (PaDEP) [formerly the Pennsylvania Department of Environmental Resources (PaDER)], MDE, the Virginia Department of Environmental Quality (VaDEQ), the Virginia Surface Water Quality Board (VaSWCB), the Susquehanna River Basin Commission (SRBC), the Occoquan Watershed Monitoring Laboratory (OWML) and the Occoquan Laboratory (OCCOQ) in Virginia, the D.C. Bureau of Air and Water Quality (DCBAWQ), Montgomery County in Maryland (MONTCO), Prince George County Health Department in Maryland (PGHD), Fairfax County (FAIRFAX) and Fairfax County Water Authority (FCWA) in Virginia, and the Loudoun County Sanitation Authority in Virginia. All water-quality data from PaDEP and VaDBQ were retrieved from STORET. The majority of the samples contained in the water-quality database were collected as part of three Federal and state programs: River Input (Fall Line) Nutrient Monitoring, CORE and TREND Monitoring, and Ambient Water-Quality Monitoring. All continuous streamflow records were retrieved from the USGS ADAPS database.

GIS spatial data sets of land use, physiographic province, rock type, watershed delineations, and site classification were obtained from Federal or state agencies and compiled or developed for the entire Chesapeake Bay Basin. All data sets, feature types, attribute data, resolution, and original sources are summarized in table 1. Specific descriptive information is contained in the documentation for each GIS data set.

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Table 1. Type of feature, attribute data, broad definition, projection, and original data sources used for GIS data sets

[UTM, Universal Tranverse Mercator; USEPA, U.S. Environmental Protection Agency; USGS, U.S. Geological Survey; N/A; not applicable]

Data set	Feature type	Attribute data	Broad definition	Projection (scale in meters)	Original source
[redacted]					
Physiographic province	Polygon	Appalachian Plateau Appalachian Mountain Great Valley Section Blue Ridge Reading Prong Section Mesozoic Lowlands Section Piedmont Lowlands Section Piedmont Uplands Section Coastal Plain		UTM18 (1:500,000)	USGS
[redacted]					
Watershed delineation	Line	Load basins Other basins	N/A	UTM18 (1:24,000) UTM18 (1:250,000)	USGS
[redacted]					

DESCRIPTION OF DATABASE

The following sections of this report document the criteria used for selection of water-quality data to include in the database, describe the databases compiled for this project, discuss the regression model used to estimate nutrient and sediment loads, and describe the GIS data sets.

Water-Quality Data Set

A water-quality database was constructed for nontidal sampling sites where major forms of nitrogen, phosphorus, and sediment concentrations, dissolved oxygen, and phytoplankton were sampled. The selection of water-quality data from nontidal sites for inclusion in the database was based on the following minimum criteria[1]:

- Nutrient- and sediment-concentration data collected between October 1, 1971, through September 30, 1992.
- A minimum of 12 nutrient- or sediment-concentration samples representing fall, winter, spring, and summer conditions collected throughout any consecutive 3-year time span.
- Nutrient- and sediment-concentration data available in digital format.

The water-quality database contains the results from 129,990 water-quality samples from 1,154 surface-water sites within the Chesapeake Bay Basin. If available, instantaneous discharge, the stream discharge at the time of sampling, was retrieved and associated with each individual water-quality sample. Remark codes, pertaining to specific sample qualifiers, are stored with the water-quality sample data. The Statistical Analysis System (SAS) (SAS Institute, Inc., 1990), a statistical data analysis computer package, was used to detect and identify suspect dates, times, and water-quality data. The number of water-quality sites sampled in each of the five states is listed in table 2. Virginia contains the greatest number of water-quality sites (table 2). The water-quality database is presently stored in a SAS data set at the Chesapeake Bay Program Office, Annapolis, Md. The database format and list of constituents are presented in table 3. A complete list of the 1,154 stations numbers, locations, and names contained in the water-quality database is provided in appendix 1. Water-quality data were collected by more than one agency at 96 sites within the Bay Basin; therefore, water-quality and streamflow data were collected at 1,058 unique locations. Further references in this report to the water-quality sites will refer to the 1,058 unique site locations (table 2).

[1] Minimum criteria were established because the original data retrieval from STORET contained thousands of additional site locations for which only 1 or 2 samples were collected. These samples did not represent programs designed to continuously monitor water quality but represented short-term point source sampling or synoptic sampling programs.

Supplemental program and site-information data, including quality assurance and quality control, analyzing and sample-collection agencies, and sample-collection protocols, are available in letter form for all 1,154 stations from which water-quality data were compiled and stored in the database. A sample supplemental information sheet used to collect the data is shown in appendix 2.

Hydrologic Condition Data Set

Fluctuations in annual streamflow, primarily caused by climatic variability, directly influence annual nutrient and sediment concentrations and loads. These fluctuations may mask changes in water quality caused by changes in factors such as land use or implementation of agricultural best-management practices. Because the load is calculated as the product of a concentration and a discharge, annual fluctuations in streamflow will have a major effect on resulting loads. In an attempt to minimize this effect in data analysis and interpretation, annual variations in hydrologic conditions were accounted for by characterizing annual mean streamflows as high, normal, or low on the basis of water-discharge ratios. Ratios were determined by dividing the annual-mean discharge by the long-term mean discharge of the sampled stream at stations with 5 or more years of continuous water-discharge record. Normal flow was defined as within 10 percent of the long-term mean. For example, water-discharge ratios less than 0.90 are low flow, ratios between 0.90 and 1.10 are normal flow, and ratios greater than 1.10 are high flow. Normalization of annual mean streamflows by use of the water-discharge ratios allowed the analysis of nutrient and sediment loads and yields with similar streamflow conditions with respect to land use, physiographic province, and rock type.

Table 2. *Total number of stations listed by state, multi-agency sites (sites where more than one agency collected data), water-quality sites, load stations, multi-agency load sites (loads computed from data supplied by more than one agency), unique load sites, and base-flow load sites*

State	Total number of stations	Number of multi-agency sites	Number of unique water-quality sites	Total number of load stations	Number of multi-agency load sites	Number of unique load sites	Number of base flow load sites
New York	19	0	19	5	1	4	4
Pennsylvania	246	48	198	73	17	54	48
Maryland	375	21	354	43	5	38	29
West Virginia	14	0	14	1	0	1	0
Virginia	500	27	473	34	4	30	11
Total	1,154	96	1,058	154	27	127	92

Table 3. *Water-quality database format including variable name, type, length, position, and format*

[ft^3/s, cubic foot per second; CD, remark code; P, parameter code; N, nitrogen; mg/L, milligram per liter; P, phosphorus; °C, degrees Celsius; µg/L, microgram per liter]

Data type	Variable name	Variable type	Length	Position	Format
Agency code	AGENCY	Character	8	0	8
Station number	STAID	Character	15	8	15
Hydrologic unit code	HUC	Character	8	23	8
Latitude	LAT	Character	6	31	6
Longitude	LONG	Character	7	37	7
Station name	SNAME	Character	48	44	48
Date	DATE	Character	6	92	6
Time	TIME	Character	4	98	4
[redacted]					
Total nitrogen as N, mg/L	CD600	Character	1	111	1
	P00600	Number	8	112	
[redacted]					
Dissolved ammonia as N, mg/L	CD608	Character	1	129	1
	P00608	Number	8	130	
[redacted]					
Dissolved Kjeldahl nitrogen as N, mg/L	CD623	Character	1	147	1
	P00623	Number	8	148	
[redacted]					
Dissolved nitrite + nitrate as N, mg/L	CD631	Character	1	165	1
	P00631	Number	8	166	
[redacted]					
Dissolved phosphorus as P, mg/L	CD666	Character	1	183	1
	P00666	Number	8	184	
[redacted]					
Suspended sediment, mg/L	CD80154	Character	1	201	1
	P80154	Number	8	202	
[redacted]					
Total nitrate as N, mg/L	CD620	Character	1	219	1
	P00620	Number	8	220	
[redacted]					
Total nitrite as N, mg/L	CD615	Character	1	237	1
	P00615	Number	8	238	
[redacted]					
Dissolved oxygen, mg/L	CD300	Character	1	255	1
	P00300	Number	8	256	
[redacted]					

Load Data Set

Load-Estimator Model

Annual nutrient and suspended-sediment loads (tons per year) in stormflow and base flow were computed by a 7-parameter log-linear multiple regression model and stored in both GIS and SAS databases. This model, developed by Cohn and others (1989) to describe nutrient and sediment loads, was validated by Cohn and others (1992) with repeated split-sample studies. This model was developed and used at 9 monitoring stations for the Chesapeake Bay River-Input (Fall Line) Nutrient Monitoring Program (Maryland Department of Environment, 1992) and at 14 stations in the Susquehanna River Basin (L.A. Reed, U.S. Geological Survey, written commun., 1995). The model requires two input ASCII files, both in fixed formats, in order to calculate a load for a given constituent. The first file contains the water-quality data (format shown in table 3), and the second file contains the continuous daily-mean water-discharge data retrieved from USGS ADAPS databases. The model is a multiple regression equation of the form

$$\ln[C] = \beta_o + \beta_1 \ln[Q/\bar{Q}] + \beta_2\{\ln[Q/\bar{Q}]\}^2 + \beta_3[T-\bar{T}] + \beta_4[T-\bar{T}]^2 + \beta_5 \sin[2\pi T] + \beta_6 \cos[2\pi T] + \varepsilon \ ,$$

where ln is the natural logarithm function;

- C is measured concentration, in milligrams per liter;
- Q is measured discharge, in cubic feet per second;
- T is time, measured in decimal years;
- $\bar{Q}$ and $\bar{T}$ are centering variables for discharge and time;
- β_x are parameters estimated by ordinary least squares; and
- ε is combined independent random error, assumed to be normally distributed with zero mean and variance σ_ε^2.

Loads were then calculated with the following equation:

$$L_T = \sum_{t=1}^{T} \{C_{i,t} \times Q_t \times K\} \ ,$$

where L_T is calculated load over time interval T for constituent i;

- $C_{i,t}$ is predicted concentration of constituent i for day t, in milligrams per liter (calculated by the model); and
- Qt is measured mean daily discharge for day t, in cubic feet per second;
- K is conversion factor $2.699 \times 10^{-3} \dfrac{s \times L \times ton}{ft^3 \times mg \times d}$, where s is seconds, L is liters, ton is tons, ft^3 is cubic feet, mg is milligrams, and d is days.

(The model usually reports estimated loads in kilograms per day; for this study, the K listed above converts kilograms per day to tons per day.)

Annual nutrient and sediment loads are calculated for the period October 1 through September 30, the USGS water year. An example of the model output is shown in appendix 3. Regression diagnostics and residual plots were used to determine the validity of the regression model, identify outliers in the water-quality sample data, and detect serial correlation and seasonality. If regression diagnostics indicated poor relations between concentration and model variables resulting in high model errors, one attempt was made to eliminate extreme outliers and rerun the model. If regression diagnostics still indicated a poor relation, model results were not reported.

Annual loads were computed on the following 13 nutrient and sediment constituents. Numerical codes are identifiers for each constituent in the databases:

- total nitrogen (00600)
- total and dissolved ammonia (00610, 00608)
- total and dissolved nitrate (00620, 00618)
- total and dissolved ammonia plus organic nitrogen (00625, 00623)
- total and dissolved nitrite plus nitrate (00630, 00631)
- total and dissolved phosphorus (00665, 00666)
- dissolved orthophosphorus (00671)
- suspended sediment (80154)

On the basis of analytical procedures, samples analyzed for total ammonia, total nitrate, and total nitrite plus nitrate at the USGS National Water Quality Laboratory were considered to be dissolved, regardless of how they were reported in the database.

Nutrient and Sediment Loads

At most sites, water-quality samples were collected on the basis of one of two different sampling programs: flow-driven or fixed-interval sampling. In flow-driven (or total-streamflow) sampling programs, samples are collected on the basis of streamflow conditions. This sampling protocol generally results in frequent sampling over a wide range of streamflows but with an emphasis on stormflow, producing a well-defined relation between concentration and streamflow. Fixed-interval (fixed) sampling programs collect samples on a regular schedule, usually monthly or quarterly. Samples collected at fixed intervals may not represent the entire range of streamflow and have been shown to underestimate the constituent load, particularly if the sampling misses high-flow events. Because of financial and personnel considerations, more frequent and representative streamflow sampling is not always possible at many sites. The effects of the flow-driven and fixed-interval sampling strategies on loads were examined at several sites with multiple-agency sample collection. Figure 2 illustrates typical differences in the number of samples collected over the range of flows and the resultant differences in annual loads for total nitrate and total phosphorus from both fixed-interval and flow-driven sampling at the same site. Flow-driven collection strategies almost always resulted in higher estimated nutrient and sediment loads at the 27 sites where data were collected by more than one agency. Therefore, loads were classified on the basis of sampled streamflow conditions and type of sampling program. Sites where sampling conditions were representative of flow-driven were characterized as total load, and sites sampled at fixed-time intervals (most state programs) were characterized as fixed load.

Adequate data were available to estimate nutrient and suspended-sediment loads at 127 nontidal stream sites within the Chesapeake Bay Basin for at least 1 to a maximum of 13 individual water-quality constituents at each site. The 127 nontidal stream sites represent basins designated by the downstream station number nearest the mouth of the basin. The number of load sites are listed, by state, in table 2. Pennsylvania contains the greatest number of load sites, primarily because of the 48 PaDEP water-quality sites located at or near USGS streamflow-gaging stations (Pennsylvania Department of Environmental Resources, 1991).

Base-flow loads, which result primarily from ground-water inputs to streams, were calculated for dissolved nitrate at 92 of the load sites. Ground water is a significant source of nitrate to rivers, and base-flow loads can be a significant part of the total-nitrogen load. Streamflow hydrographs were separated into two components, surface runoff (stormflow) and base flow, by use of the local minima streamflow separation technique as described by Pettyjohn and Henning (1979). For this study, 30 percent was added to the base flow and subtracted from total flow, and if the difference was greater than zero, that day was considered to be a non-base-flow day. For calculation of base-flow loads, the water-quality files were purged of data from non-base-flow days and used as input to the load-estimator model.

A complete list of the 127 load sites, the corresponding flow sites, the 92 base-flow sites, and a matrix corresponding to the estimated load constituents is presented in appendix 4. A total of 8,020 individual annual loads corresponding to the 13 constituents were estimated for 127 load sites. An additional 978 individual annual base-flow loads of dissolved nitrate were estimated from 92 sites. Less than 1 percent of the estimated annual loads were considered invalid because of high model error and were not included in the load database. An example of the nutrient- and sediment-load database is included in appendix 5.

Geographic Information System Data Sets

GIS data sets of site classification (load or nonload), land use, physiographic province, rock type, and watershed delineations were obtained, compiled, or developed for the entire Chesapeake Bay Basin. Each separate data set is discussed in this section. Land use, physiographic province, and rock type exert major controls on loads by influencing the sources of and transport of nutrients and sediments. Applications of manure and commercial fertilizers to agricultural and urban lands and the tillage and cultivation of agricul-

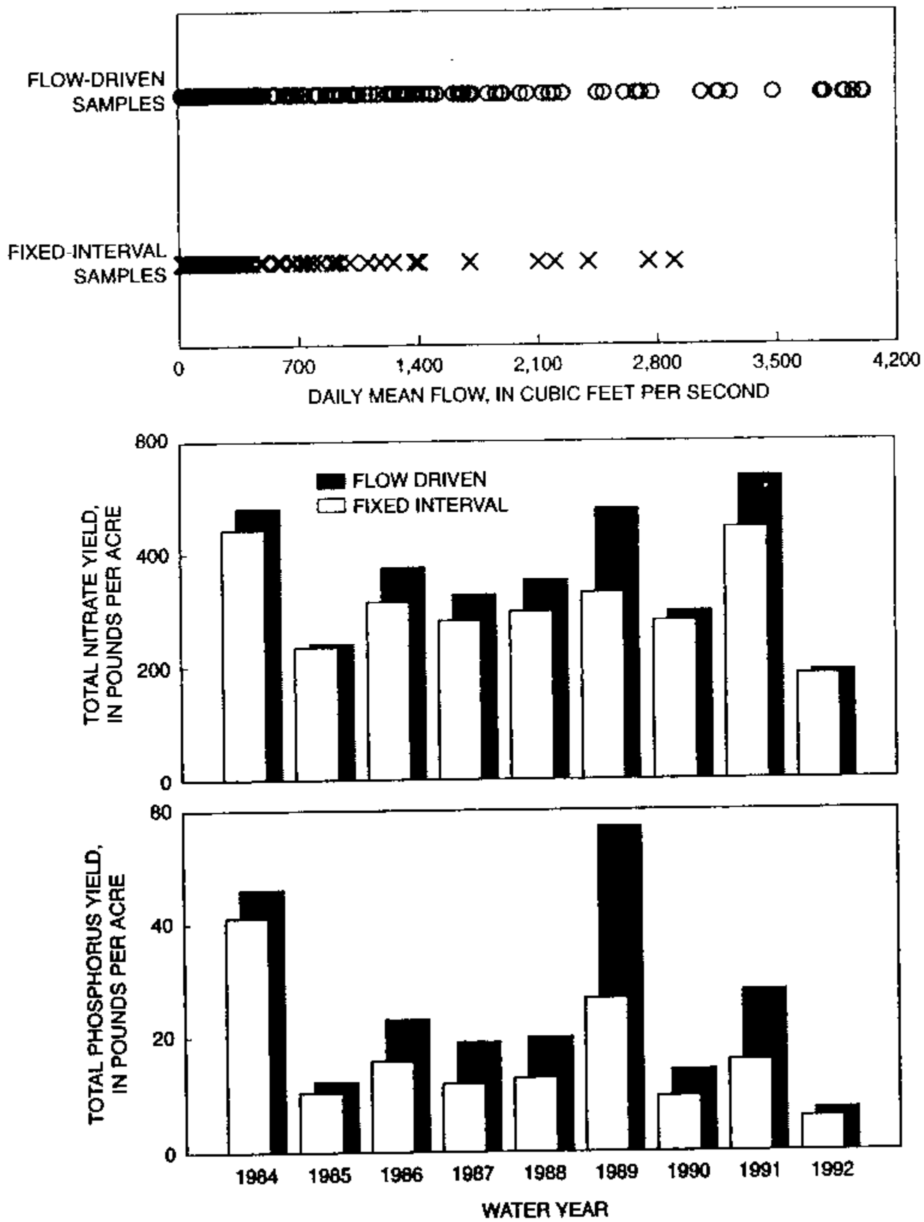

Figure 2. Comparisons of sampled daily mean flows and resultant differences in estimated annual yields for total nitrate and total phosphorus at Shermans Creek near Shermansdale, Pa., with flow-driven and fixed-interval sampling protocols.

tural soils provide large sources of nutrients and sediments. Private septic systems and atmospheric deposition also may provide a substantial, nonpoint source of nitrogen in the form of soluble nitrate or nitrite. Nutrient transport from the watershed to the Chesapeake Bay or its tributaries occurs through direct surface runoff or infiltration to ground water that is ultimately discharged to surface water. Varying physiographic controls, such as elevation and surface slopes, affect climate, types of vegetation, and amount of ground cover, thereby affecting nutrient pathways and the transport rate (Williams and Reed, 1972). Bedrock chemistry, bedrock configuration, and hydrologic characteristics can affect amounts and rates of nutrient transport to the ground-water system. Soils derived from the bedrock have specific characteristics, such as permeability, percentage organic content, and cation exchange capacity, that also affect nutrient transport. As an example of the synergistic effects associated with nutrient transport, some intensively farmed, carbonate areas in the Piedmont Physiographic Province contain large sources of nutrients from manure and commercial fertilizer and have rapid water infiltration because of highly porous and weathered limestone. Nitrate contamination of ground water is widespread in these areas (Fishel and others, 1992; Lietman and others, 1983; L.A. Reed, U.S. Geological Survey, written commun., 1995).

Site Location

The location of each of the 1,058 unique water-quality stations was plotted on a map of the Chesapeake Bay drainage, and the area was divided into 13 subbasins. Most of the subbasins are parts of large tributaries to the Bay; the Susquehanna River Basin was divided into four subbasins, and the Potomac River Basin was subdivided into three subbasins. The Choptank, Patuxent, Rappahannock, York, and James River Basins were not subdivided. An area that contains many small tributaries and drains to the northwestern part of the Bay was identified as the Western Shore. Areas that drain to the eastern side of the Bay, except for the Choptank River Basin, and small areas that drain to the western side of the Bay were not included in any of the subbasins. The 13 subbasins are included on each Bay Basin illustration. The locations of all 1,058 sites in the water-quality database were classified as nonload sites (designated as Bay 1 and 2) or load sites (designated as Bay 3) according to the following requirements:

- Bay 1- All 1,058 sites with at least 12 nutrient or sediment samples collected over at least 3 years, regardless of the availability of continuous streamflow data. All 1,058 sites are shown in figure 3.
- Bay 2 - A subset of Bay 1 with 613 sites containing at least 50 nutrient or sediment samples collected over at least 3 years, regardless of the availability of continuous streamflow data.[2]
- Bay 3 - A subset of Bay 2 containing the locations of the 127 load sites with at least 50 nutrient or sediment samples and continuous streamflow record of at least 3 years. If water-quality data were collected within 1,500 yards of a continuous streamflow station, both sites were examined on topographic maps to determine if the streamflow data were suitable to estimate loads for the water-quality site. All 127 load sites are shown in fig. 4.

Land Use

The Environmental Monitoring and Assessment Program (EMAP) data set for land use was obtained from the USEPA for inclusion in the database (table 1). Approximately 54 percent of the Bay Basin is forested (table 4). The majority of the forested (woody) areas are in the northern and western parts of the Bay Basin (fig. 5). Approximately 63 percent of Pennsylvania is forest. Agricultural (herbaceous) areas comprise about 30 percent of the entire Chesapeake Bay Basin with about the same percentage of land classified as agricultural in Pennsylvania, Maryland, and Virginia. The majority of the land used for agriculture in the Bay Basin is located in three distinct areas: (1) the valleys running generally southwest to northeast, (2) the fertile soils in the Lower Susquehanna River Basin, and (3) the eastern shore area of Maryland. The most urbanized areas of the basin are in the "corridor"

[2] Many sites, especially those in ambient monitoring networks, are sampled on a monthly basis. After 3 years, this would result in about 36 samples— less than the 50 required by this study for model calibration. These stations were included in Bay 2 and Bay 3 if sampling over a longer period of time resulted in the minimum number of samples. For example, stations sampled for 4 or more years usually contained 50 or more samples, and, if possible, annual loads were computed.

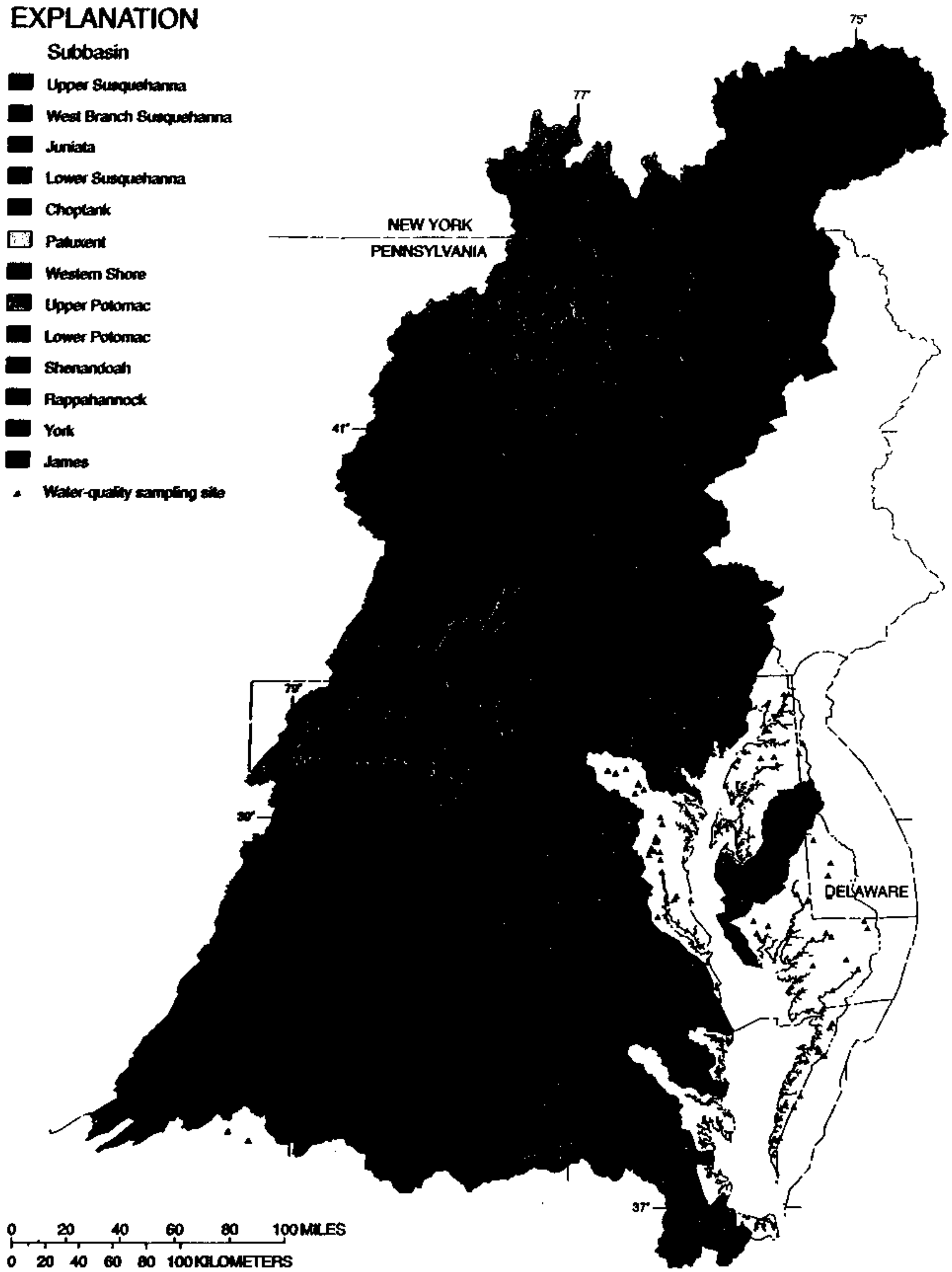

Figure 3. Locations of 1,058 water-quality sampling sites in the Chesapeake Bay Basin.

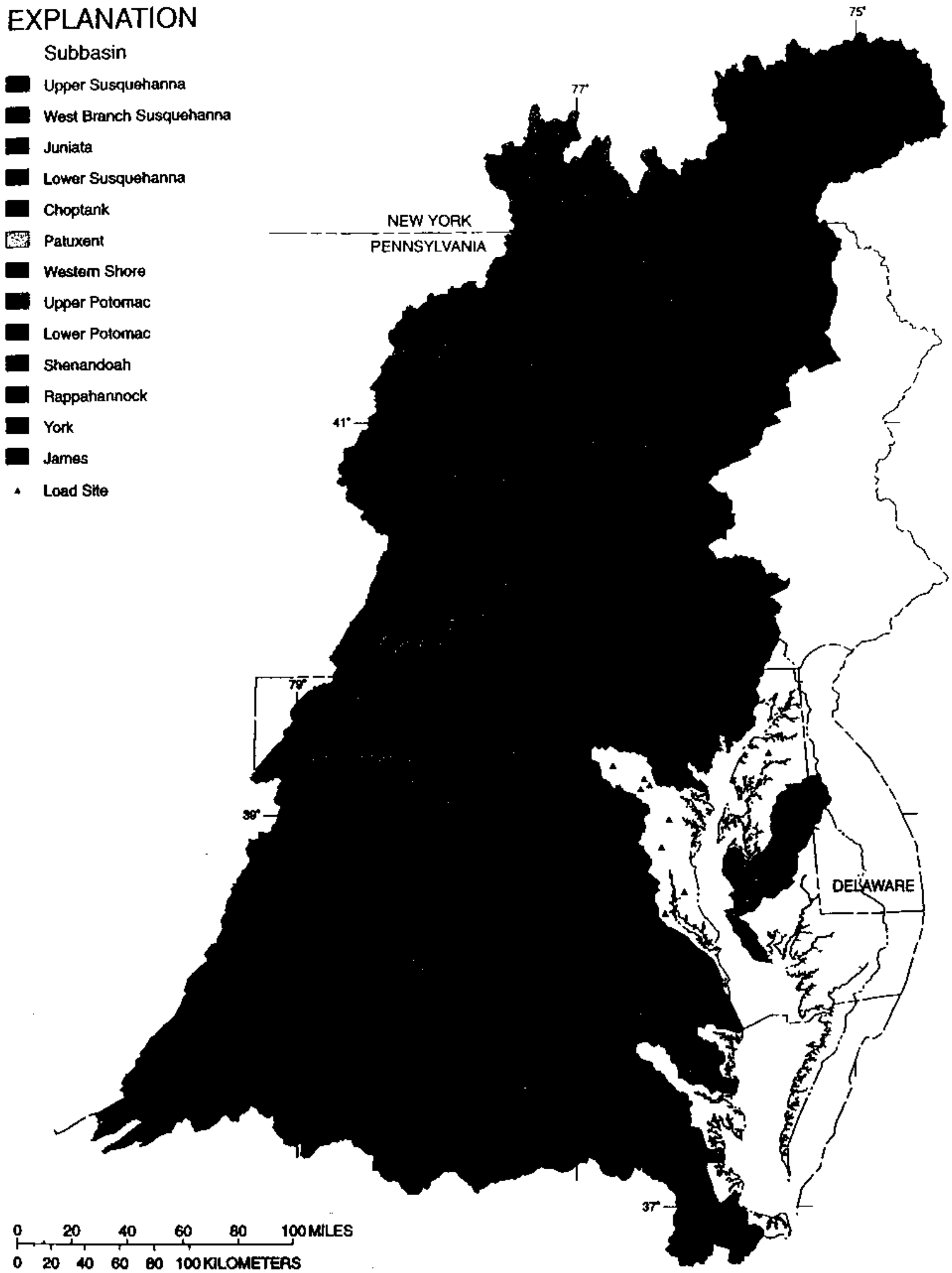

Figure 4. Locations of all 127 sites where loads were estimated in the Chesapeake Bay Basin.

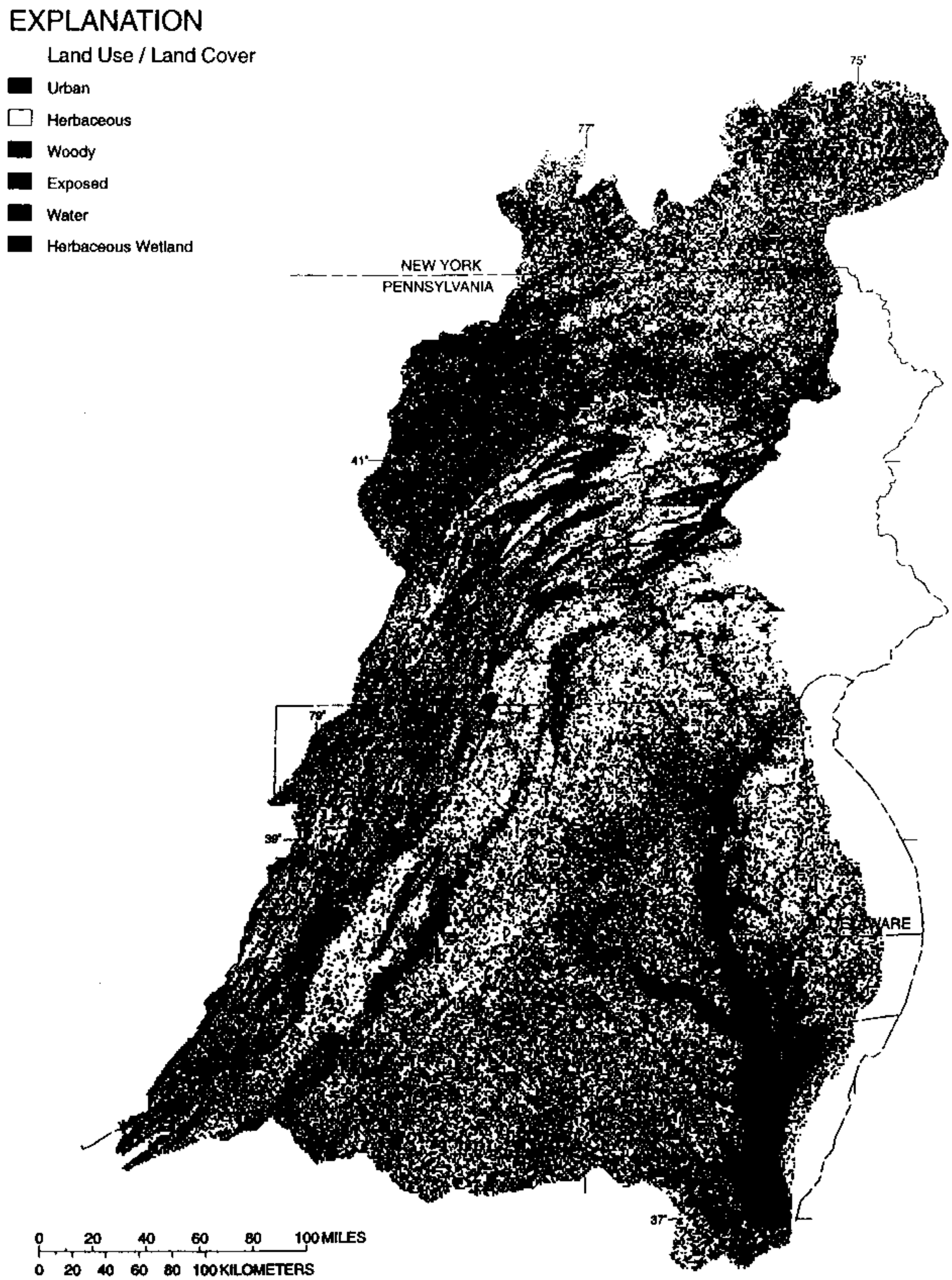

Figure 1. Distribution of six land-use classifications in the Chesapeake Bay Basin.

Table 4. Geographic Information System data set name, classification, and percentage area for the Chesapeake Bay Basin and states of Pennsylvania, Maryland, and Virginia

[<, less than]

Geographic Information System data set	Classification	Percent of Bay Basin	Percent of Bay Basin in:		
			Pennsylvania	Maryland	Virginia
Land use (percent)	Woody (forest)	53.8	62.5	32.6	52.4
	Herbaceous (agriculture)	30.6	31.1	31.3	28.3
	High Intensity Urban (urban)	.6	.3	1.2	.6
	Low Intensity Urban (urban)	4.0	2.9	6.4	4.5
	Woody Urban (urban)	1.1	.6	1.9	1.4
	Herbaceous Urban (urban)	1.6	.8	2.7	2.3
	Water	7.2	11.1	20.8	9.6
	Exposed	.3	.7	.2	.1
	Herbaceous Wetland	.8	0	2.9	.8
		100	100	100	100
Physiographic Province (percent)	Appalachian Plateau	23.5	39.4	5.8	0
	Ridge and Valley				
	Appalachian Mountain Section	24.2	41.9	6.7	14.7
	Great Valley Section	7.6	6.0	5.4	12.4
	Blue Ridge	4.4	1.3	4.9	9.5
	New England				
	Reading Prong Section	<.1	<.1	0	0
	Piedmont				
	Mesozoic Lowlands Section	4.2	4.1	5.4	6.3
	Piedmont Lowlands Section	1.8	2.8	0	0
	Piedmont Upland Section	16.6	4.4	23.9	32.2
	Coastal Plain	17.7	0	47.9	24.9
		100	100	100	100
Rock Type (percent)	Carbonate	12.0	10.2	8.9	14.7
	Siliciclastic	48.9	83.4	14.1	19.9
	Crystalline	20.4	6.4	26.6	39.6
	Unconsolidated	18.7	0	50.4	25.8
		100	100	100	100
Water (percent)	Water	6.6	<.1	20.2	9.1
Total (square miles)	Chesapeake Bay Basin	64,742	22,621	11,573	23,906

between Baltimore, Md., and Washington, D.C. (fig. 5). Approximately 4.6 percent of the basin is considered urban (high- and low-intensity urban); the highest percentage by state is in Maryland (7.6 percent). Water bodies, including the Chesapeake Bay, major rivers, and hundreds of tributaries, occupy about 7.2 percent of the basin. Approximately 20 percent of Maryland is classified as water.

Physiographic Provinces

Six major physiographic provinces have been identified in the Chesapeake Bay Basin—the Appalachian Plateau, Ridge and Valley, Blue Ridge, New England (Reading Prong Section only), Piedmont, and Coastal Plain Physiographic Provinces (fig. 6). Additionally, two physiographic provinces (Ridge and Valley and Piedmont) were subdivided into sections (table 4). The Appalachian Plateau Physiographic Province, the western-most province, occupies about 24 percent of the entire Bay Basin. This province is dominated by moderately warped and tilted layers of sandstone and shale producing rugged, hilly areas with intricately dissected plateaus and broad ridges (U.S. Geological Survey, 1984). The Ridge and Valley Physiographic Province, containing the Appalachian Mountain and Great Valley Sections, is to the east, contiguous to the Appala-

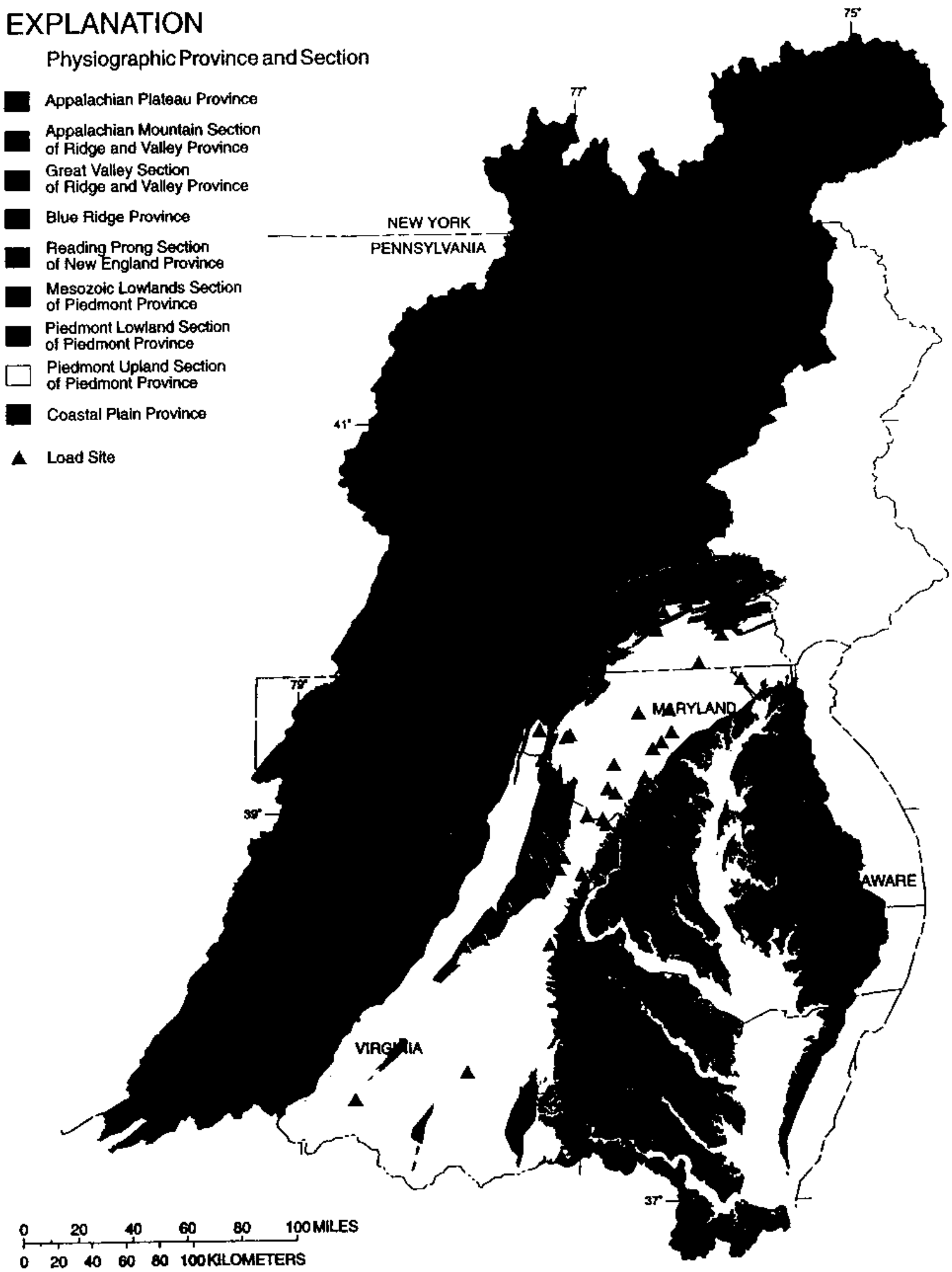

Figure 6. Distribution of physiographic provinces and their sections in the Chesapeake Bay Basin.

chian Plateau, and occupies about 32 percent of the basin. The Appalachian Mountain Section consists primarily of sedimentary rocks, with resistant layers forming long narrow ridges separated by long valleys generally underlain by limestone and shale (Berg and others, 1989). The Great Valley Section is a broad, moderately dissected valley with shale and sandstone on the western side and limestone and dolomite in the center and on the eastern side. Approximately 48 percent of Pennsylvania is in the Appalachian Mountain and Great Valley Sections.

The Blue Ridge Physiographic Province, consisting of complexly folded and faulted metamorphic and metavolcanic rocks, lies between the Piedmont and the Ridge and Valley Provinces and occupies less than 5 percent of the basin. Approximately 82 percent of the Blue Ridge Physiographic Province is located in Virginia. The Reading Prong Section of the New England Province is located completely in Pennsylvania and comprises less than 1 percent of the Bay Basin. The fifth physiographic province, the Piedmont, borders the western edge of the Coastal Plain and comprises about 23 percent of the Bay Basin. The Piedmont is divided into three sections—Mesozoic Lowlands, Piedmont Lowlands, and Piedmont Uplands—because of distinct differences in topography and rock type. Topography includes rolling lowlands with isolated highlands in the Mesozoic Lowlands, broad valleys separated by broad low hills in the Piedmont Lowlands, and broad, gently-rolling hills and valleys in the Piedmont Uplands (Berg and others, 1989). The Piedmont Lowlands Section, located completely in the Lower Susquehanna River Basin, contains some of the most nutrient-rich soils and intensively farmed land in the country. The Coastal Plain Physiographic Province is the eastern most province and borders the Chesapeake Bay. The Coastal Plain comprises about 18 percent of the Bay Basin and is located completely in Maryland, Virginia, and Delaware. The Coastal Plain consists of gently dipping, unconsolidated layers of gravel, sand, and clay underlying flat lowlands.

Rock Type

A GIS data set called "rock type" was compiled on the basis of bedrock geology. The rocks in the Bay Basin can be grouped into four broad "rock types" on the basis of similar lithologic and geologic characteristics. These four rock types are carbonate rocks, crystalline rocks, siliciclastic rocks, and unconsolidated sediments (fig. 7). Carbonate rocks consist primarily of limestone, dolomite, and marble and occupy large areas of the Great Valley and Piedmont Lowlands. Approximately 12 percent of the Bay Basin is underlain by carbonate rock (table 4); 45 percent of that area is located in Virginia. About 50 percent of the Bay Basin is underlain by siliciclastic rock. Siliciclastic rocks include sandstone, siltstone, shale, and conglomerates. About 84 percent of Pennsylvania is classified as siliciclastic rock, and the majority of the siliciclastic rock in the Bay Basin (60 percent) is located in Pennsylvania. The majority of the crystalline rock is schist, granite, quartzite, and gneiss, and it comprises approximately 20 percent of the Bay Basin; the majority (40 percent) is located in Virginia. Unconsolidated sediments underlie about 19 percent of the Bay Basin and include sands, gravels, and clays. Unconsolidated rock underlies about 50 percent of Maryland and comprises about 48 percent of the Bay Basin.

Watershed Delineations

The boundaries of watersheds, upstream of the USGS streamflow-gaging stations, were delineated for all 127 basins having load estimations. All 127 load basins were delineated to the streamflow-gaging site at a scale of 1:24,000.

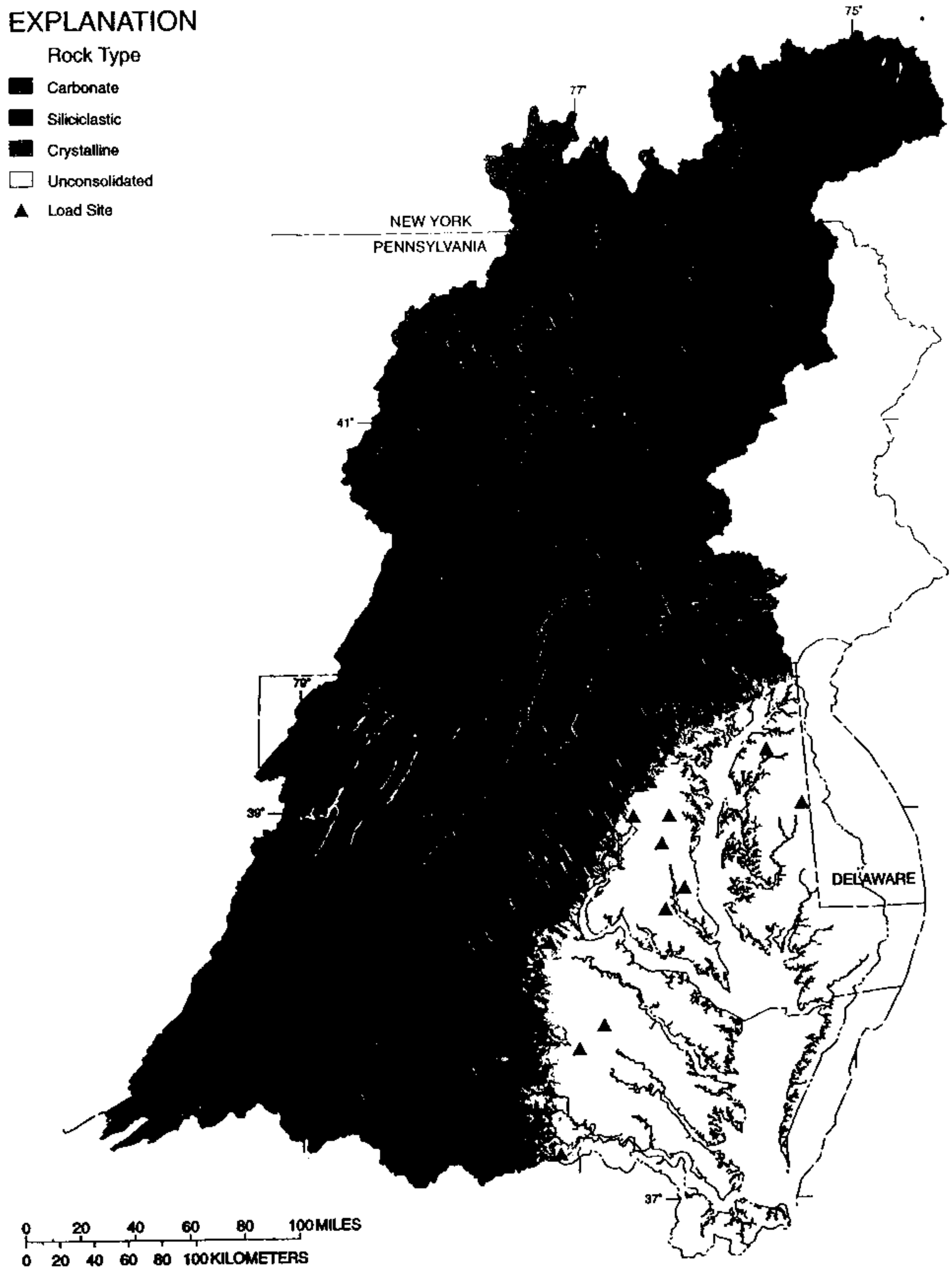

Figure 7. Distribution of four major rock types in the Chesapeake Bay Basin.

SYNTHESIS OF NUTRIENT AND SEDIMENT DATA AND GEOGRAPHIC DATA

Ranges and means of data from nutrient and suspended-sediment samples collected from nontidal streams in the Chesapeake Bay drainage basin are reported in the following sections of the report. Ranges in calculated yields of nutrients and suspended sediment also are discussed, and the yields are related to land use, physiographic province, and rock type.

Water-quality-concentration data were collected for 18 constituents at 1,058 nontidal sites in the Chesapeake Bay Basin (table 3). While data synthesis was performed on 14 nutrient and sediment constituents, this report focuses on the major forms of nitrogen (total nitrogen and dissolved nitrate nitrogen), total phosphorus, and suspended sediments. Additional data analysis on the remaining constituents are presented in appendixes included in the report.

Distribution of Nutrient and Sediment Concentrations

A summary of concentration data for total nitrogen, total phosphorus, dissolved nitrate, and suspended sediment for all 127 load sites is presented in appendix 6. The distribution of concentrations measured in samples collected within each of the 13 major subbasins of the Chesapeake Bay drainage is shown on figure 8. The greatest range and largest maximum concentrations of total nitrogen, dissolved nitrate, total phosphorus, and suspended sediment were in samples collected from streams within the lower Susquehanna River subbasin. In addition, the largest median concentrations of total nitrogen (4.2 mg/L) and total phosphorus (0.23 mg/L) were in samples collected from tributaries within the lower Susquehanna River subbasin. The largest median concentration of dissolved nitrate (1.9 mg/L) was in streams sampled in the Western Shore subbasin. The largest median concentration of suspended sediment (124 mg/L) was in samples collected from tributaries in the upper Potomac River subbasin.

The largest concentrations of total nitrogen and total phosphorus were generally in samples collected from smaller streams draining areas where agriculture is the predominant land use. In many of these basins, farming practices are so intensive that the recommended maximum number of animal units (AU) per acre is generally exceeded (one animal unit is equal to 1,000 lb of animal, regardless of type). The U.S. Department of Agriculture (1982) recommended 1.5 AU/acre in a plan developed for the Conestoga River watershed, an intensively farmed area in the Piedmont Physiographic Province that is underlain by carbonate rocks. Preliminary findings of Correll and others (1993) also indicate higher concentrations of total nitrogen and nitrate in the Piedmont Province. Conversely, the York River subbasin (fig. 1), which is predominantly forested (greater than 70 percent), has the smallest median concentrations for all four constituents.

Distribution of Nutrient and Sediment Loads

The most downstream site from each of eight major (fall line[3]) river basins was selected to examine the total nutrient and sediment loads delivered to the Bay. The major rivers are the Susquehanna, Patuxent, Potomac, Rappahannock, York, and James (fig. 1), which contribute almost 90 percent of the freshwater to the Bay. Additionally, the Choptank River Basin (fig. 4) represents the only fall line load basin located on the eastern shore of the Chesapeake Bay. The York River Basin is represented by two fall line sites: one on the Pamunkey River and one on the Mattaponi River. Loading information is available at these stations from 1990 to 1992. Prior to 1990, annual loads were not calculated for some years at all eight fall line sites (fig. 9). Rather than totaling loads by year, mean annual loads to the Bay were totaled on the basis of hydrologic condition. Estimated loads for the period 1972-92 were used to compute the average load in high, normal, and low flow years, thereby approximating total nitrogen and total phosphorus loads to the Bay (table 5). The mean annual loads for high, normal, and low flow years (table 5) indicate the Susquehanna River Basin, which discharges about 50 percent of the freshwater to the Bay, delivers substantially larger nutrient loads than the other major basins, regardless of streamflow condition. During normal flow years, the Susquehanna River contributes about 66 percent of the nitrogen and 40 percent of the

[3] The "fall line" is a colloquial term used to refer to a distinct change in slope that generally occurs in a line running southwest to northeast through the basin. It generally represents the limit of the tidal areas and tends to coincide where the harder crystalline rocks of the Piedmont Physiographic Province and the unconsolidated rocks of the Coastal Plain Physiographic Province overlap.

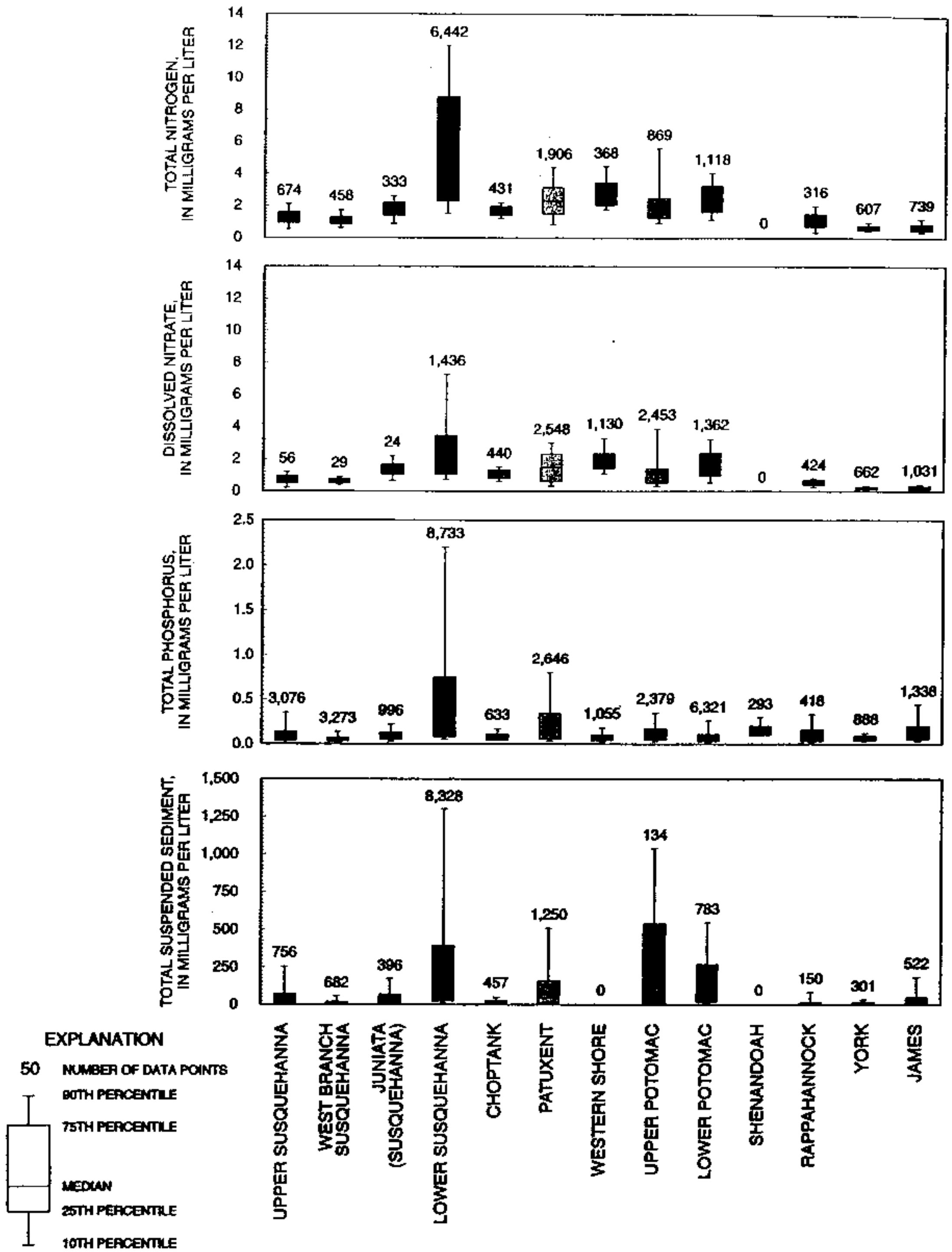

Figure 8. Nutrient and sediment concentrations for 13 major subbasins for the 127 load sites in the Chesapeake Bay Basin.

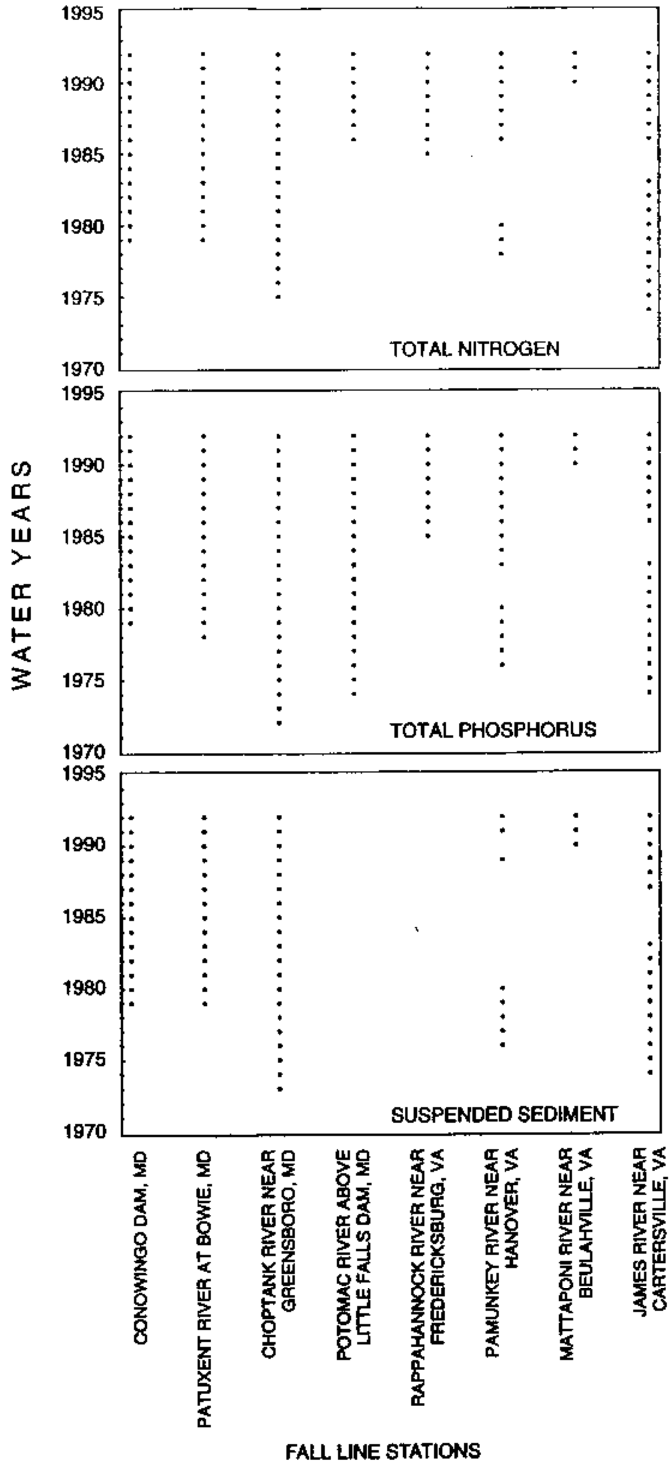

Figure 9. Years for which annual load data are available for total nitrogen, total phosphorus, and suspended sediment at eight fall line sites in the Chesapeake Bay Basin.

Table 5. *Mean annual loads and annual yields for high, normal, and low flow water years for eight major subbasins in the Chesapeake Bay for the period 1972-92*

[All load values are in tons per year; all yield data are in pounds per acre; --, data not available; N/A, insufficient data]

Basin name	Mean annual load									Mean annual yield								
	Total nitrogen			Total phosphorus			Suspended sediment			Total nitrogen			Total phosphorus			Suspended sediment		
	High	Normal	Low	High	Normal	Low	High	Normal	Low	High	Normal	Low	High	Normal	Low	High	Normal	Low
Susquehanna	88,700	75,300	58,500	4,550	2,580	1,910	2,870,000	1,040,000	687,000	3.27	2.78	2.16	0.17	0.09	0.07	106	38	25
Choptank	307	217	134	23	11	5	6,810	2,500	1,040	2.72	1.92	1.18	.20	.10	.04	60	22	9.20
Patuxent	1,380	1,060	840	242	77	67	64,900	29,900	14,600	3.96	3.04	2.41	.69	.22	.19	186	86	42
Potomac	36,600	25,000	15,900	2,960	1,380	998	--	--	--	3.17	2.16	1.38	.26	.11	.09	--	--	--
Rappahannock	--	2,240	1,760	--	394	266	--	--	--	--	1.40	1.10	--	.25	.17	--	--	--
York																		
Pamunkey	970	883	464	138	112	58	292,000	53,400	37,000	.89	.82	.42	.13	.10	.05	270	49	34
Mattaponi	420	--	170	38	--	19	11,800	--	3,640	.70	--	.28	.06	--	.03	20	--	6.0
James	9,500	8,830	4,180	3,900	1,950	733	1,610,000	1,270,000	394,000	1.52	1.41	.67	.62	.31	.12	257	203	63
Total	N/A	[1]114,000	81,900	N/A	[1]6,500	4,060	N/A	N/A	N/A	N/A	[1]1.77	1.28	N/A	[1].10	.06	N/A	N/A	N/A

[1] This total does not include loads from the Mattaponi River; however, on the basis of available data from high and low years, loads from the Mattaponi River would be expected to be less than 1 percent of the total load from the other basins. Numbers may not equal total because of rounding.

phosphorus transported by the major river basins to the Bay. Summing mean loads from each of the river basins for normal flow years, 114,000 ton/year of total nitrogen and 6,500 ton/year of total phosphorus are discharged to the Bay from basins above the fall line. Although the nitrogen loads from the James River were substantially less than those from the Susquehanna River, loads of total phosphorus and suspended sediment were similar. Most of the nitrogen transported by the Susquehanna River is soluble nitrogen. In contrast, however, phosphorus transport is primarily associated with sediment. Three large reservoirs behind dams on the Lower Susquehanna River currently trap an average of 2.4 million tons of sediment and 2,000 tons of phosphorus per year (Lloyd Reed, U.S. Geological Survey, written commun., 1994).

Distribution of Nutrient and Sediment Yields

The Susquehanna River is the major contributor of nitrogen and phosphorus to the Chesapeake Bay (table 5). However, mean yields (in pounds per acre) were lower in the Susquehanna River because of the large amount of forest land. This indicates a disproportionate area of the Susquehanna River Basin is contributing a higher amount of the total load. Mean annual yields for total nitrogen were greatest in the Patuxent River Basin for high, normal, and low flow. Mean annual yields for total phosphorus were greatest in the Patuxent River Basin during high flow years and the James River Basin for normal flow years.

Further data analysis in this report are limited to data for annual yields during normal flow years because flow conditions effectively control mean annual nutrient and sediment yields regardless of basin size or location. Most sites with 5 or more years of water-quality data had coverage over a range of hydrologic conditions, ranging from wet (high flow) years to dry (low flow) years. Mean annual yields for the 127 load sites by hydrologic condition are presented in appendix 7. All mean annual yields are reported as pounds per acre. Because of lack of data, 14 of the 127 load sites did not have loads estimated for normal flow years.

The range and variability for annual nutrient and sediment yields as a function of annual flow condition (high, normal, or low) was examined at 15 sites (table 5). These 15 sites were distributed throughout the major subbasins of the Chesapeake Bay (fig. 10). Eight of the 15 sites are fall line sites located near the downstream limit of the nontidal basin. The remaining 7 sites were selected so that, as a group, the 15 sites would represent a mix of varying land uses, physiographic provinces, rock types, and drainage-basin areas. For all 15 sites, mean annual yields of total nitrogen, dissolved nitrate, and suspended sediment during high-flow years were larger by a factor of two or three compared to normal- and low-flow mean annual yields.

Kendall's *tau* correlation procedure was used in SAS (SAS Institute, Inc., 1990) (alpha = 0.10) to determine if a simple linear correlation existed between nutrient and sediment yields and the percentage of land use, physiographic province, or rock type in each load basin. The Kendall's *tau* (*t*) is a measure of the strength of a monotonic relationship (from -1 to 1), is resistant to outliers, and produces accurate values of the p-statistic (a measure of the level of significance) for small sample sizes (Helsel and Hirsh, 1992). The summary statistics from the correlation table are presented in appendix 8. A complete list of the percentage land use, physiographic province, and rock type that were used in correlation for all 127 load basins is presented in appendix 9. Table 6 is an abbreviated correlation table showing the most significant correlations.

It appears likely that land use, rather than rock type or physiographic province, is the most important variable for predicting nutrient and sediment yields from a basin. Significant correlations between rock type and yield or between physiographic province and yield may be caused by a predominant land use within that rock type or province. Results of the correlation analysis showed the strongest, significant (smallest p-values), and most consistent correlations between nutrient and sediment yields and agricultural land use. Basins with higher percentages of agricultural land discharged larger amounts of nutrients and sediment (fig. 11). Conversely, basins with higher percentages of forest land discharged smaller amounts of nutrients and sediment (table 6). Although correlations were not significant between carbonate rock type and agricultural land use, or between carbonate rock type and nutrient or sediment yields (table 6),

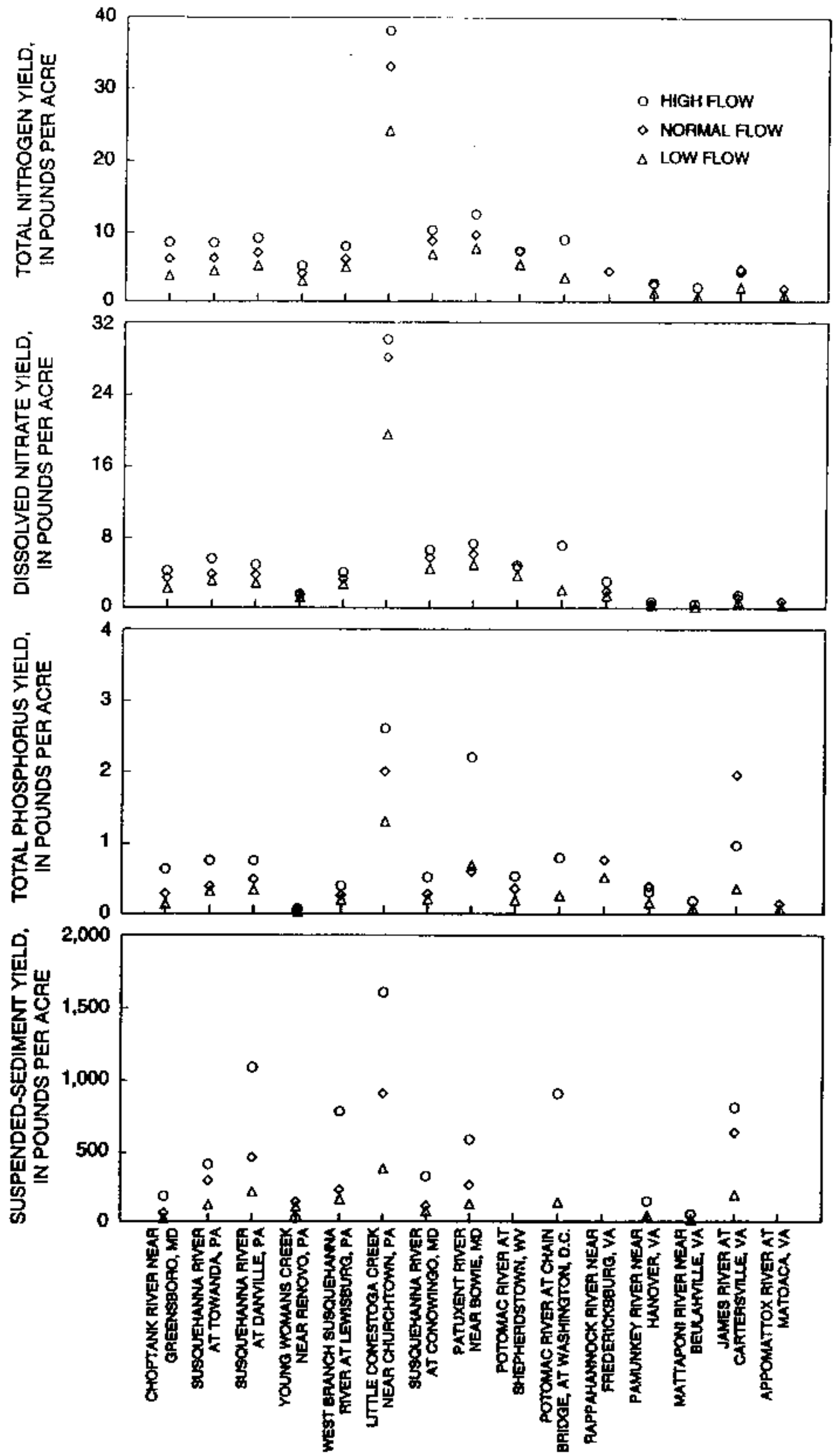

Figure 10. Relation between annual flow condition and mean annual yields of selected constituents at 15 sites in the Chesapeake Bay Basin.

***Table 6.** Results of Kendall's tau correlation test relating mean annual yields for selected constituents to selected land uses, rock types, and physiographic provinces*

[p, measure of significance (less than 0.10 considered significant); n, degrees of freedom; shaded areas represent significant correlations]

1.00000	Correlation coefficient
.0	Probability of obtaining correlation coefficient by random chance
41	Number of observations

	Total nitrogen	Dissolved nitrate	Dissolved ammonia	Total phosphorus	Ortho-phosphorus	Suspended sediment
Agriculture	0.51443	0.43591	0.37439	0.25655	0.19145	0.29644
p-value	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
n	40	98	54	100	54	23
Forest	-.47619	-.42744	-.25228	-.34578	-.19629	-.28675
p-value	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
n	41	99	55	101	54	24
Urban	.16294	.17977	.05990	.23902	.04708	.11089
p-value	.1463	[redacted]	.5290	[redacted]	.6170	.4595
n	39	96	53	99	54	23
Wetlands	.00000	.12599	.04219	-.24968	-.14564	-.81650
p-value	1.0000	.7237	.8046	.3098	.5536	[redacted]
n	4	7	19	13	13	3
Carbonate	.18156	.06302	-.03275	.11153	.30608	.21281
p-value	.1996	.4731	.8022	.2234	[redacted]	.2576
n	26	62	30	55	33	16
Siliciclastic	-.17908	-.20378	.03772	-.26898	-.20887	-.16058
p-value	.1687	[redacted]	.7281	[redacted]	[redacted]	.3604
n	30	83	42	87	42	18
Piedmont Lowlands	.33333	.44444	.42857	.50000	.40000	.66667
p-value	.3476	[redacted]	.1765	[redacted]	.3272	.1742
n	6	9	7	9	5	4
Great Valley	.11111	-.00585	-.12727	.19298	-.00952	.46667
p-value	.6547	.9721	.5858	.2483	.9605	.1885
n	10	19	11	19	15	6
Blue Ridge	-.20513	-.20000	-.24242	.00000	-.05882	.33333
p-value	.3290	.2047	.2726	.1000	.7417	.4969
n	13	21	12	20	17	4
Appalachian Plateau	-.63576	.53781	.04219	-.44176	-.27273	-.09759
p-value	[redacted]	[redacted]	.8046	[redacted]	.2429	.7613
n	11	48	19	49	11	7

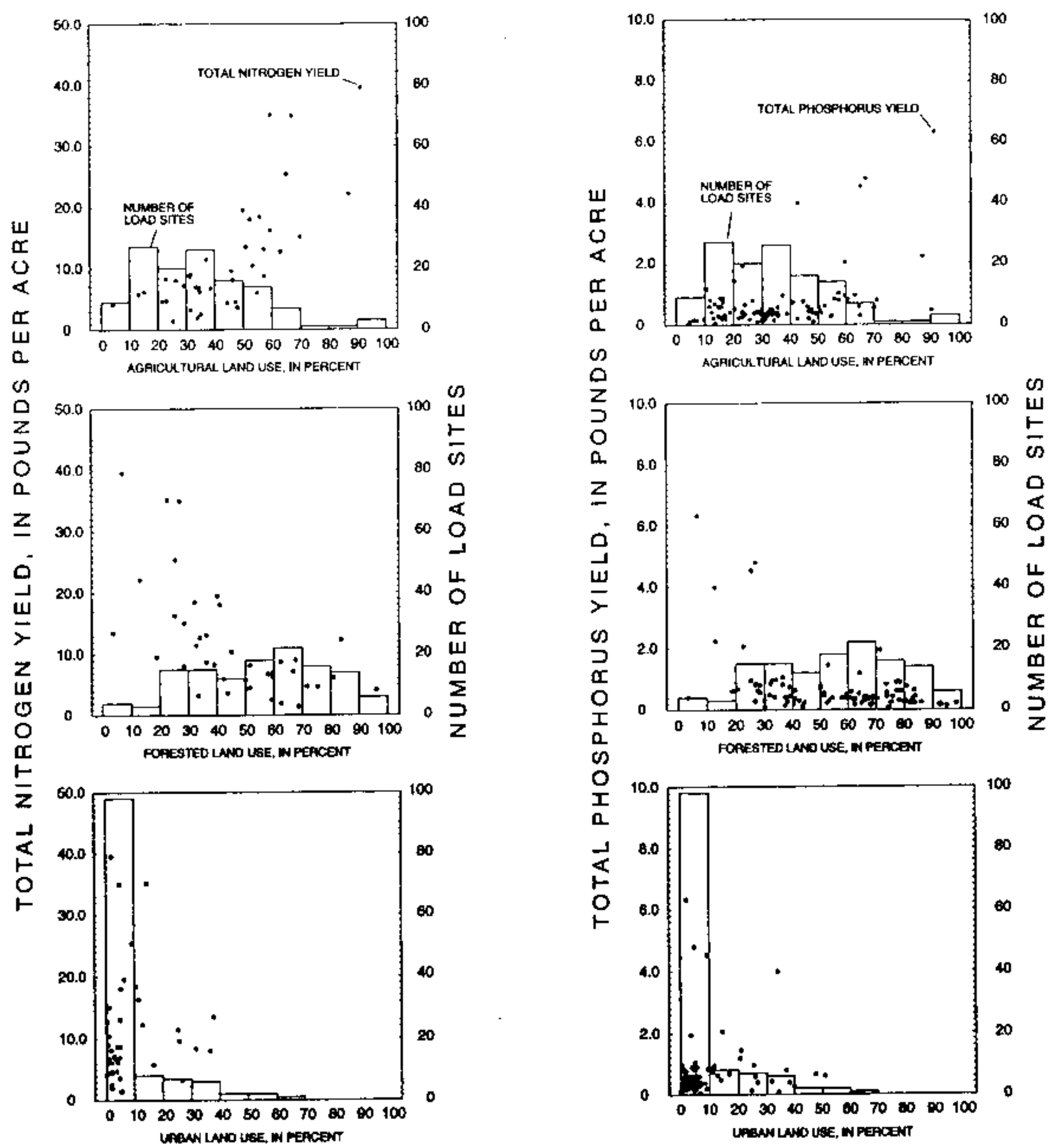

Figure 11. Relation between mean annual yields of total nitrogen and total phosphorus from normal flow years and percent of specific land use from that basin.

qualitatively, there appears to be a synergistic effect between agricultural land use and carbonate rock type on nutrient yields. When nitrogen yields are grouped according to the level of agricultural land use (greater or less than 50 percent) and plotted in relation to the percentage of carbonate rock (fig. 12), the highest yields of total nitrogen originate in basins that are greater than 50 percent agricultural and have greater than 15 percent carbonate rock. Even where agricultural land use represents less than 50 percent of the land use in a basin, agricultural practices can have a significant effect on the magnitude of nutrient loads (fig. 12).

Urban land use also showed a positive correlation with yields of total nitrogen, total phosphorus, and dissolved nitrate. The correlations, however, may be misleading because many of the basins used in the correlation analysis were dominated by forest or agricultural land use; urban effects represent only a small percentage of total basin area (fig. 11). Therefore, to examine the effects of urban land use, the mean annual yields for the entire Bay Basin were compared to small, predominantly urban basins. Fifteen basins in the database have greater than 25 percent urban land use; however, only 7 of those basins have sufficient yield data for analysis (table 7). Almost all of the mean annual yields from the predominantly urban basins are less than the mean annual yields for all 127 load basins. Two load basins were identified with high percentages of both urban and agriculture land: 01616000 and 01586000 (table 7). Nutrient yields from these two basins were larger than yields from all 127 load basins. Nutrient yields for predominantly agricultural basins (greater than 50 percent) (table 7) were substantially higher than mean yields from all the load basins. Therefore, the two mixed agricultural, urban basins probably had yields greater than mean yields from all the load basins because of the agricultural influence.

The only significant correlations between rock type and yields of nutrients or sediment were for siliciclastic rock. Mean annual yields of dissolved nitrate, total phosphorus, and dissolved orthophosphorus decreased as the percentage of the basin underlain by siliciclastic rock increased. Siliciclastic rocks are more resistant to weathering than carbonate rock, resulting in thin, commonly rocky soils, and areas underlain by siliciclastic rocks are dominated by steep slopes, which makes agriculture difficult. Although most of the basins containing a large percentage of siliciclastic rocks are forested, broad ridges in siliciclastic areas support some agricultural activity. No other significant correlations were found between nutrient or sediment mean annual yields and rock type.

The temperate climate and broad valleys of the Piedmont Lowlands and the Great Valley are conducive to productive agriculture. The Piedmont Lowlands (fig. 6) are mostly underlain by carbonate rock (82 percent) and the land is predominantly agricultural (70 percent). Previous studies (Fishel and others, 1992; Lietman and others, 1983) noted elevated nutrient loads in

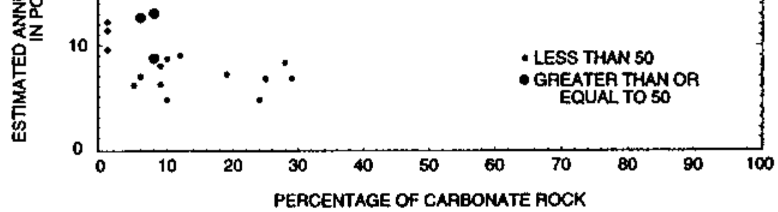

Figure 12. Differences in mean annual yields of total nitrogen from normal flow years as a function of percentage carbonate rock and percentage agriculture.

Table 7. Comparison of percentage land use, percentage rock type, and mean annual nutrient yields for predominantly urban and predominantly agricultural basins

[Yields are in pounds per acre; --, no data]

Basin	Area (square miles)	Percentage land use			Percentage rock type				Mean annual yields			
		Urban	Agriculture	Forest	Carbonate rock	Siliciclastic rock	Crystalline rock	Unconsolidated rock	Total nitrogen	Total ammonia plus organic nitrogen	Dissolved nitrate nitrogen	Total phosphorus
All 127 load basins									11.4	3.7	6.1	0.70
Predominantly urban basins												
01571000	11.2	46.0	26.8	28	9	91	0	0	8.0	4.5	3.7	.80
01589300	32.5	54.4	16.8	27	6	0	94	0	--	3.2	5.2	--
01593500	38.0	54.5	16.8	21	0	0	100	0	--	--	--	.67
01646000	57.9	50.9	11.4	28	0	2	98	0	--	2.8	3.1	.62
01649500	72.8	56.9	9.1	22	0	0	23	77	--	--	3.4	--
01657655	4.0	48.6	22.5	27	0	0	100	0	--	2.0	--	.28
Agricultural and urban basins												
01586000	56.6	42.4	51.0	3.4	0	0	100	0	13.3	--	11.3	.41
01616000	16.5	43.8	41.9	13	71	29	0	0	--	21.1	8.6	4.0
Predominantly agricultural basins												
01573810	.38	1.4	91.0	6.7	0	100	0	0	39.5	22.4	19.7	6.3
0157608335	1.42	1.1	63.4	26	50	50	0	0	25.4	12.0	14.4	4.5
01639500	102	1.1	69.9	29	1	28	71	0	15.1	2.8	11.8	--

areas of the Piedmont Lowlands. For the load subbasins, yields of dissolved nitrate and total phosphorus increased as the percentage of the basin in the Piedmont Lowlands increased (table 6). About 70 percent of the Piedmont Lowlands is in agricultural land use (fig. 6). Yields for total nitrogen and total phosphorus decreased and yields for dissolved nitrate increased as the percentage of the basin in the Appalachian Physiographic Plateau increased. About 70 percent of the Appalachian Plateau is forested, and 24 percent is agriculture. No other significant correlations existed between nutrient and sediment yields and physiographic province.

The spatial distribution of yields of total nitrogen, total phosphorus, and dissolved nitrate are shown in figures 13, 14, and 15. Symbols, representing the basins with yield data, identify the mean annual yield as 50 percent above, 50 percent below, or within 50 percent of the mean annual yields of all the sites. The yields are consistently higher in the Lower Susquehanna subbasin and central areas of the Potomac River subbasin, where 21 of the 27 subbasins with greater than 50 percent agricultural land use are located. As forested areas increase, as in northern Pennsylvania and western Virginia (fig. 5), the yields are consistently lower.

Mean annual yields of total nitrogen, total phosphorus, and dissolved nitrate were examined with respect to combinations of predominant rock types and land uses (table 8). A rock type was considered predominant if it underlies greater than 50 percent of the basin. Additionally, the predominant percentages for agriculture (50 percent) and urban (25 percent) land uses were used previously in this report (table 7). Although no load subbasins contained 100 percent of a single land use, assignment of a dominant land use aided in classifying small and medium size subbasins that generally represent the influences of individual land uses. For the purposes of this analysis, forest was considered dominant in a basin if the forested area was greater than 75 percent, agricultural if the area was greater than 50 percent, and urban if the area was greater than 25 percent. These percentages were selected to help eliminate the same basin from having multiple land uses. By use of these percentages, 68 sites that had a predominant land use were selected; the average drainage area was 279 mi^2. The mixed land-use classification (table 8) represents 45 percent of the basins that were less than the indicated percentage of land use; 14 of the 15 load basins greater than 5,000 mi^2 were mixed land-use basins. The largest nutrient yields are from the agricultural/carbonate basins, and the smallest yields are from the mixed land use/crystalline rock type combination (table 8). Loads of total nitrogen, dissolved nitrate, and total phosphorus were higher in predominantly agricultural areas than in predominantly forested areas. Because of limited data, a more detailed analysis of the combined influence of rock type and land use cannot be made. The variability in the means is less in the mixed land use and rock type than in the predominant land-use classifications. This suggests a mixing and dilution of extreme effects of single-land-use basins.

Annual base-flow loads of dissolved nitrate were estimated from 92 sites. Annual dissolved-nitrate loads were significantly higher in predominantly agricultural land use areas (greater than 50 percent) than in predominantly forested areas (greater than 75 percent) and predominantly urban land use areas (greater than 25 percent) (fig. 16). Annual loads of dissolved nitrate were significantly greater in predominantly carbonate rock (greater than 50 percent) than in predominantly siliciclastic, crystalline, and unconsolidated rock. The median load of dissolved nitrate was greatest (10.7 lb/acre) in the agricultural/carbonate combination and smallest (2.1 lb/acre) in the forest/siliciclastic combination. The median load of dissolved nitrate for basins in predominantly siliciclastic rock type was 3.0 lb/acre; however, the elevated median load of dissolved nitrate in the agricultural/siliciclastic land-use/rock-type combination (9.8 lb/acre) is probably related to the high percentage (42 percent, table 9) of agricultural land use in the siliciclastic rock.

For all basins for which total nitrogen and base flow dissolved-nitrate loads could be estimated, about 42 percent of the total nitrogen was dissolved nitrate in base flow. The percentage of dissolved-nitrate yield in base flow to total nitrogen yield was largest (58 percent) in the agricultural/carbonate combination and smallest (31 percent) in the forest/siliciclastic land-use/rock-type combination.

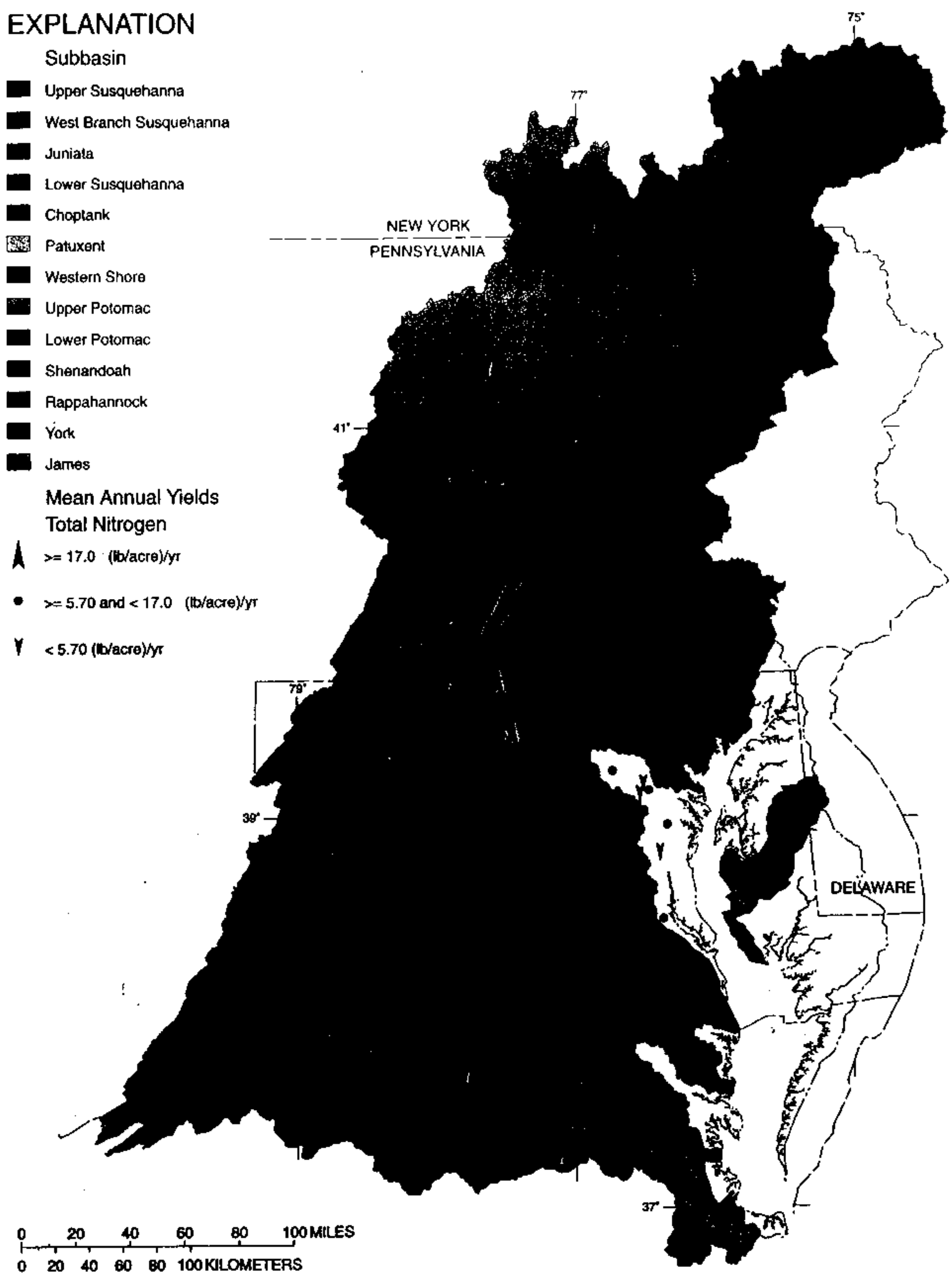

Figure 13. Locations of all total nitrogen sites and range in annual total nitrogen yields in the Chesapeake Bay Basin

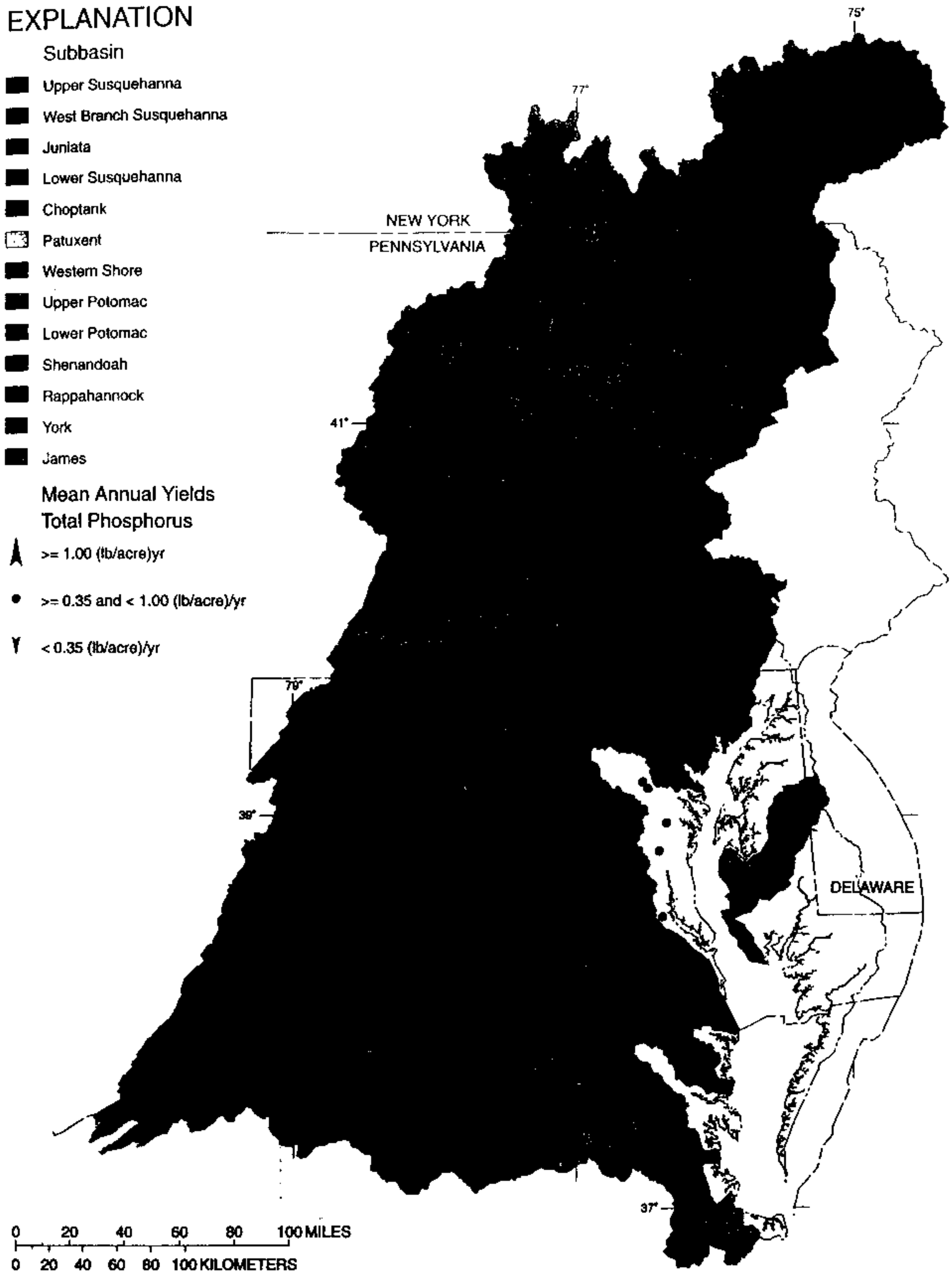

Figure 14. Locations of all total phosphorus sites and range in annual total phosphorus yields in the Chesapeake Bay Basin.

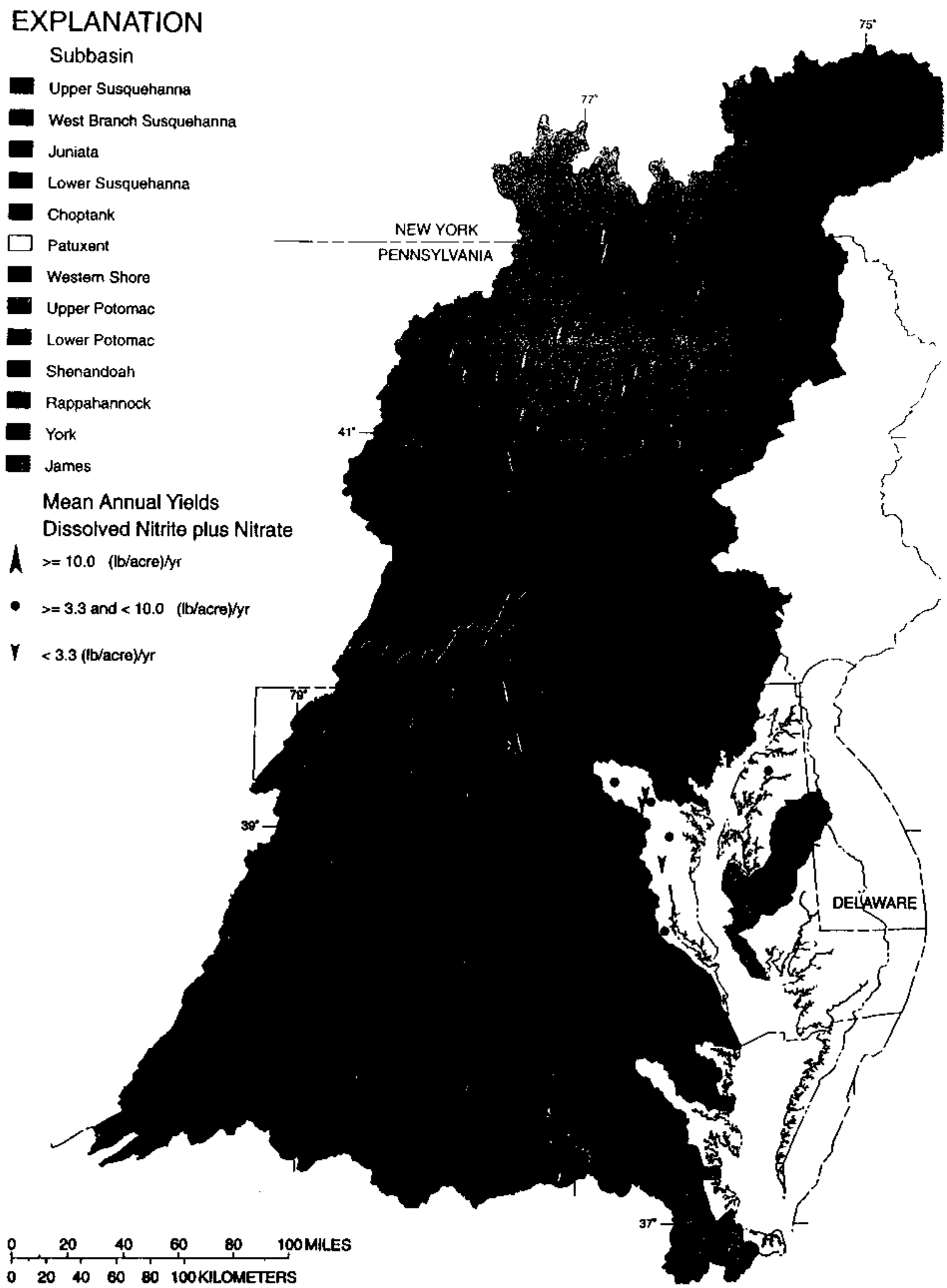

Figure 15. Locations of all dissolved nitrate sites and range in annual dissolved nitrate yields in the Chesapeake Bay Basin.

***Table 8.** Distribution of load basins and mean annual yields for total nitrogen, dissolved nitrate, and total phosphorus, by percentage of land use and predominant (greater than 50 percent) rock type*

[minimum, mean, and maximum annual yields are pounds per acre; --, no data available; LT, contains values reported less than the detection limit]

Land use	Number of load sites	Annual yields											
		Total nitrogen				Dissolved nitrogen				Total phosphorus			
		Minimum	Mean	Maximum	Coefficient of variation	Minimum	Mean	Maximum	Coefficient of variation	Minimum	Mean	Maximum	Coefficient of variation
Forest - greater than 75 percent													
Carbonate	2	--	--	--	--	1.3	3.3	5.4	0.86	0.61	0.61	0.61	--
Siliciclastic	26	4.7	8.6	12.6	0.65	.70	3.41	10.61	.69	.01	.53	.89	.75
Crystalline	LT	LT	--	--	--	--	--	--	--	--	--	--	--
Unconsolidated	LT	LT	--	--	--	--	--	--	--	--	--	--	--
Agriculture - greater than 50 percent													
Carbonate	5	18.4	28.9	35.0	.31	12.1	19.6	28.4	.39	.48	2.4	4.8	.89
Siliciclastic	8	12.7	20.4	39.5	.54	9.0	14.0	19.7	.25	.27	2.2	6.3	1.1
Crystalline	11	8.7	14.2	22.1	.31	2.0	9.5	14.5	.38	.31	1.1	2.2	.71
Unconsolidated	1	6.0	6.0	6.0	--	3.7	3.7	3.7	--	.30	.30	.30	--
Urban - greater than 25 percent													
Carbonate	1	--	--	--	--	8.6	8.6	8.6	--	4.0	4.0	4.0	--
Siliciclastic	2	8.0	8.0	8.0	--	3.6	3.6	3.6	--	.09	.45	.80	.08
Crystalline	10	8.3	10.7	13.5	.21	3.1	6.3	11.3	.43	.28	.57	.96	.39
Unconsolidated	2	3.28	3.28	3.28	--	1.68	1.68	1.68	--	.40	.40	.40	--
Mixed land use - forest less than 75 percent, agriculture less than 50 percent, and urban lass than 25 percent													
Carbonate	5	--	--	--	--	.83	1.9	4.2	.72	.43	.34	.22	.32
Siliciclastic	37	1.5	6.4	9.0	.35	1.6	4.2	8.2	.43	.07	.43	1.4	.43
Crystalline	14	2.0	5.3	11.4	.64	.58	3.6	7.8	.84	.16	.65	1.9	.89
Unconsolidated	1	5.8	5.8	5.8	--	3.4	3.4	3.4	--	.69	.69	.69	--

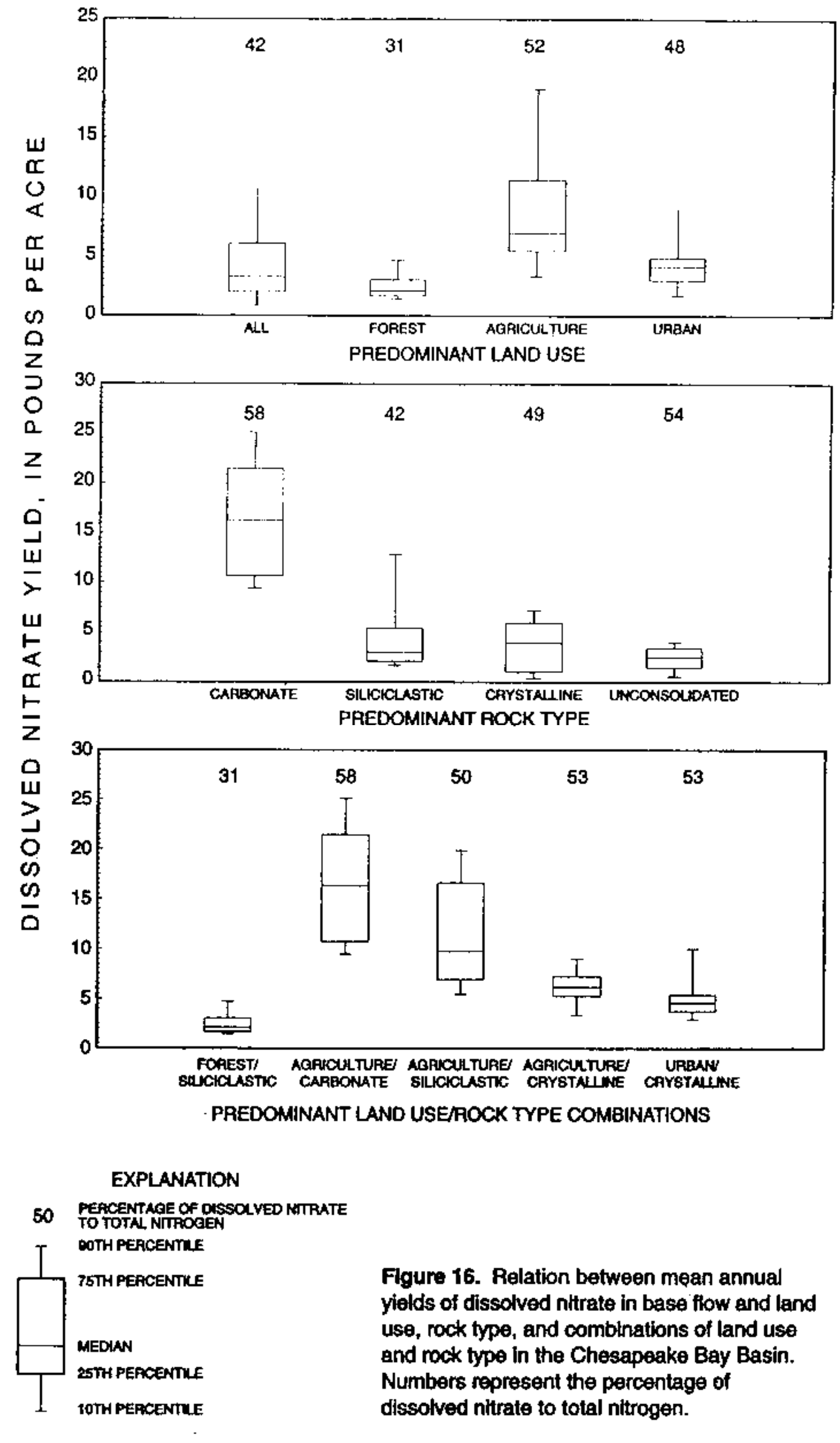

Figure 16. Relation between mean annual yields of dissolved nitrate in base flow and land use, rock type, and combinations of land use and rock type in the Chesapeake Bay Basin. Numbers represent the percentage of dissolved nitrate to total nitrogen.

Table 9. Percentage of the total area of the Chesapeake Bay Basin in combination with specific land use and physiographic province or rock type and the percentage of the specific land use within each physiographic province and rock type

[mi^2, square mile; <, less than]

	Forest ($34,811 mi^2$)		Agriculture ($19,811 mi^2$)		Urban ($4,726 mi^2$)	
	Percentage of Bay Basin	Percentage of forest	Percentage of Bay Basin	Percentage of agriculture	Percentage of Bay Basin	Percentage of urban
Physiographic Province						
Appalachian Plateau Province	16.8	30	6.0	19	0.66	12
Appalachian Mountain Section	17.3	31	6.3	21	.73	13
Great Valley Section	2.0	3	4.3	14	.55	11
Blue Ridge Province	2.9	5	.76	.02	.07	.03
Reading Prong Section	<.01	<.01	<.01	<.01	<.01	<.01
Mesozoic Lowlands Section	1.4	2	1.8	6	.28	7
Piedmont Lowland Section	.1	<.01	.68	.02	.15	4
Piedmont Upland Section	8.4	15	6.3	21	1.4	22
Coastal Plain Province	7.9	14	5.9	19	2.1	31
Rock type						
Carbonate	4.1	6	5.6	17	.75	15
Siliciclastic	33.7	61	13.3	42	1.8	30
Crystalline	11.0	19	7.0	21	1.3	22
Unconsolidated	8.0	14	6.2	20	2.0	33

Distribution of Geographic Data

One of the major advantages of using a GIS database is that many different data layers of spatial information can be overlaid (or intersected) to provide a means of combining data. The intersection of the data sets for land use, in combination with physiographic province or rock type for the Bay Basin (table 9), indicates about one-third of the Basin is forest underlain by siliciclastic rock. About 61 percent of the forested areas in the Bay Basin are in the Appalachian Plateau Physiographic Province and the Appalachian Mountain Section. The largest amount of agriculture, 42 percent, is in areas underlain by siliciclastic rock. Only 17 percent of agricultural areas are underlain by carbonate rock. Agricultural areas underlain by carbonate rock are predominantly in the Piedmont Lowlands and Great Valley Sections. The location of carbonate rock and the intersection of agricultural areas underlain by carbonate rock in the Bay Basin are shown in figure 17. Agricultural basins, especially those underlain by carbonate rock, generally have been given a high priority for study and implementation of best-management practices because studies have documented elevated nutrient and sediment loads from agricultural basins. About 21 percent of the agricultural land in the Bay Basin is located in the Piedmont Uplands and Lowlands Sections, which accounts for about 18 percent of the basin area. The Piedmont Physiographic Province contains the locations of some of the highest nutrient yields in the Bay Basin, suggesting the agricultural activity here may be more intensive than in other physiographic province, rock-type, and land-use combinations. Urban land use is distributed fairly evenly among rock types. Urban land use is primarily in the Piedmont Upland and Coastal Plain Physiographic Provinces.

Identification of Spatial and Temporal Data Gaps

The preceding sections discussed the distribution of the water-quality, load, and yield data according to land use, physiographic province, rock type, and hydrologic condition. However, the data analysis was limited by many factors, or "gaps," in data needed to calculate nutrient or sediment loads and analyze and interpret the data.

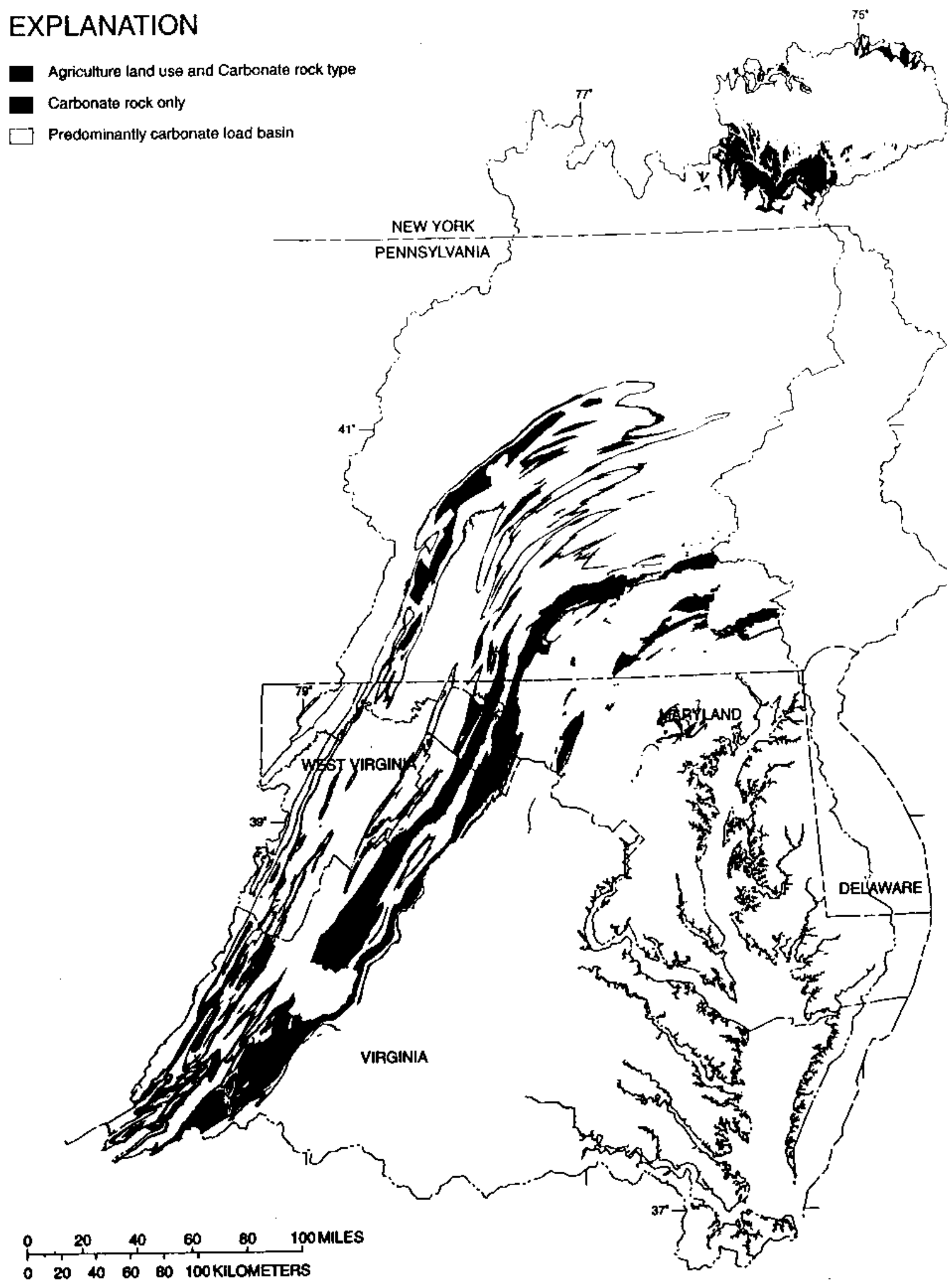

Figure 17. Carbonate rock areas and agricultural areas underlain by carbonate rock in the Chesapeake Bay Basin.

The following section identifies spatial and temporal gaps in the database. Spatial gaps are defined as those areas where insufficient data exist to adequately characterize or identify the following: the areal coverage and geographic location of basins; the number of water-quality and load sites; and the combination of land use, physiographic province, and rock type. Temporal gaps are defined as interruptions in the water-quality and water-discharge records of sufficient lengths to prevent data analysis. Spatial and temporal gaps affect the ability to target locations for management actions intended to improve water quality or to document water-quality changes. The identification of gaps may also indicate the need to revise existing monitoring programs.

The simplest method of identifying spatial data gaps is visual observation of the distribution of the data through mapping. The locations of the 1,058 water-quality sites (fig. 3) where nutrient and sediment samples were collected suggests good areal coverage throughout the Bay Basin. The sites are fairly evenly distributed in the 13 major subbasins, although there is some clustering around areas of high populations. The water-quality sites are less dense in headwater streams and more dense near main stems of major rivers.

Only 127 or 12 percent (fig. 4) of the 1,058 water-quality sites (table 2) had sufficient data to estimate nutrient and sediment loads. Loads could not be calculated for many of the water-quality sites because large temporal gaps existed in the water-quality data, only short-term data (less than 3 years) was collected, less than the minimum number of samples needed for the load model were collected, or continuous daily-discharge data were not available. Continuous daily-discharge data did not exist for 487 water-quality sites (207 sites in Virginia) that met the minimum criteria required for load estimations.

Most of the load sites are located in the Lower Potomac, the upper reaches of the James, and most of the Susquehanna River Basins (fig. 4). Conversely, very few load sites are in the Juniata River, the York River, and middle and lower reaches of the James River Basins and in the nontidal parts of the eastern shore of the Bay. Drainage areas of the 127 load sites cover approximately 92 percent of the nontidal part of the Chesapeake Bay Basin. Most of the area not covered by load basins is located on the eastern shore of the Bay. Coverage of load basins was evaluated by comparing the average areal coverage of each load basin to the total area of the Chesapeake Bay. If load basins were evenly distributed across the Bay Basin, each would drain about 500 mi^2. Computation of the average drainage area per load site within each basin, ignoring basin overlap common to upstream-downstream sites, indicates only four of the river subbasins—the Upper Susquehanna, West Branch Susquehanna, Juniata, and James, which are dominated by forest areas (fig. 5)—exceed 500 mi^2 per site. However, basin size varies widely, from very small (0.38 mi^2) to very large (27,100 mi^2). Thirty percent of the basins are smaller than 100 mi^2, and 16 percent are larger than 2,500 mi^2. Also, many of the load sites are nested within one or more other load sites. None of the load sites represented a basin with a single land use; however, one-third of the load sites contained greater than 70 percent forest land, only a few sites contained greater than 70 percent agricultural land, and no sites contained greater than 70 percent urban land (fig. 11).

Because drainage areas of the load basins cross physiographic provinces and rock-type boundaries, visual inspection of the locations of data-collection points for the load sites may be misleading for identification of gaps. The percentage physiographic province and percentage rock type were determined for each load basin and were stored in the database (appendix 9). The Appalachian Plateau Province and the Appalachian Mountain Section, comprising about 48 percent of the Bay Basin, are predominant (greater than 50 percent) in 53 of the load sites (fig. 6). The Piedmont Province, comprising only 22 percent of the basin, is predominant in 36 sites. The Reading Prong Section of the New England Province is not predominant in any load sites. Almost 51 percent of the load sites are underlain by predominantly siliciclastic rocks. Only 8 load sites are located in the Coastal Plain; 7 of these are underlain predominantly by unconsolidated rocks. Although 20 percent of the Bay Basin is underlain by unconsolidated rocks, only parts are nontidal and suited for load sites.

Of the 127 load basins, 28 were in predominantly forested (greater than 75 percent) areas; nearly all of those were underlain by siliciclastic rock. Load data is available for only two predominantly forest sites underlain by carbonate rock and none underlain by crystalline or unconsolidated rock, where 31 percent of the forest cover is located (tables 8 and 9). Of the 25 predominantly agricultural (greater than 50 percent) load basins, 5 were underlain by carbonate, 8 by siliciclastic, and 11 by crystalline rocks. Only one was underlain by unconsolidated rocks, where about 20 percent of the agricultural land use is located (tables 8 and 9). Only 15 of the load basins were predominantly urban (greater than 25 percent). Ten of the 15 urban basins were underlain by crystalline rock; however, only 22 percent of the urban land use is underlain by crystalline rock. This analysis suggests that insufficient load sites and data exist in the Chesapeake Bay Basin to determine the relative importance of rock type in transport of nutrients and sediment loads. This was found to be important in at least one case: nutrient loads from agriculture were larger in areas underlain by carbonate rock than in areas underlain by other rock types.

Spatial gaps also can be determined by examining the amount of area being monitored for a given category of land use, physiographic province, rock type, and combinations thereof, relative to the amount of land in that category in the entire Bay Basin. The land-use/rock-type categories for which load data were available for more than two sites (table 8) were examined using a "density of monitoring" method. A comparison of the ratio of drainage areas for load basins in a predominant land-use/rock-type combination with the percent of the Bay Basin in the same land-use/rock-type combination provided the following results. The ratios, or density of monitoring, are shown as "less than" because drainage areas for load basins also include areas not in the predominant category:

Predominantly agricultural/carbonate basins - less than 34 percent

Predominantly agricultural/siliciclastic basins - less than 18 percent

Predominantly agricultural/crystalline basins - less than 43 percent

Predominantly forested/carbonate basins - less than 35 percent

Predominantly forested/siliciclastic basins - less than 91 percent

Predominantly urban/crystalline basins - less than 43 percent

The predominantly forested and siliciclastic combination had the greatest density of monitored area (up to 91 percent). There are 26 load sites in this combination; however, sufficient data for calculating total nitrogen yields existed at only 2 of the 26 load sites. The agricultural and siliciclastic combination with the greatest maximum yields of total nitrogen and total phosphorus (table 8) had the least dense monitoring. This type of information could be important in targeting areas for future monitoring. It may be desirable to have information over a larger percentage of certain combinations of land-use, physiographic-provinces, or rock-type combinations because of the impact of that combination on water quality in the tributaries and the Bay. As "high-impact" areas are targeted for management practices, baseline data and post-implementation data will be needed to evaluate the effect of management practices on water quality. For example, it may be more desirable to monitor a greater density of basins in agricultural land than forested land because discharges from agricultural areas deliver larger nutrient and sediment loads to streams and the Bay than forested land. Conversely, if nutrient and sediment loads are low from some categories with little data available, it is also important to have a sufficient density of monitoring data to document that these areas actually discharge small loads. Adequate density of monitoring data will help prevent invalid assumptions and predictions of the impact of a factor such as land use or rock type on water quality. Limited data exist in three of the predominantly forested, one of the predominantly agricultural, and three of the predominantly urban land-use/rock-type combinations (table 8).

If the variability is large, there may be need for additional monitoring or analysis to interpret and apply the data results, even where a large number of load sites are monitored. The coefficient of variation (cv), a dimensionless ratio of the standard deviation to the mean, is sometimes used to compare variabilities between data sets, particularly when ranges in data values are large. Generally, the greater the cv, the more variable the data. For most of the land-use and rock-type combinations, there is insufficient data to calculate a useful cv (table 8). For the few land-use and rock-type combinations where cv's were calculated, the variances for total nitrogen, dissolved nitrate, and total phosphorus yields were low and not extremely different from each other. Koerkle reported ranges in the CV from studies in the Piedmont area of Lancaster County in southeastern Pennsylvania to range from 0 to 15 (Edward H. Koerkle, U.S. Geological Survey, written commun., 1995). This suggests that nutrient yield data from some combinations, where there are sufficient load sites for analysis, could be used to project yields from similar, nonmonitored sites or used to target management practices.

Spatial and temporal gaps in the database can be identified by examining the years for which each site has an estimated load. Loads for total nitrogen, total ammonia plus organic nitrogen, dissolved nitrate, total phosphorus, and suspended sediment (fig. 18) for 127 load sites are organized in downstream order in the 13 major subbasins. The load sites are identified by basin number and arranged in downstream order to correspond to figure 18 and are presented in appendix 10. Total nitrogen loads don't exist for most of the load basins (fig. 13) for most years. Only 38 percent of the load sites had total nitrogen-load data for 3 or more years. Total nitrogen is a calculated sum of total ammonia-plus-organic and dissolved-nitrate data. Total nitrogen data are available at most sites after 1985, when analysis of samples for total ammonia plus organic nitrogen increased. Prior to 1985, most of the estimated loads of total ammonia plus organic nitrogen were in the Potomac and James River Basins; since 1985, most of the loads of total ammonia plus organic nitrogen are from the Lower Susquehanna River Basin (fig. 18). The number of sites where dissolved-nitrate loads existed (108) were the most for any water-quality constituent. Dissolved-nitrate loads were available at most sites for most years, with the exception of the Lower Potomac Basin (figs. 15 and 18). Spatial and temporal distribution of total phosphorus loads indicates excellent coverage in the Susquehanna River Basin (figs. 14 and 18). Spatial and temporal gaps existed in the Upper and Lower Potomac Basins from 1985 to 1989. These gaps were caused by a laboratory problem with the total phosphorus analysis method (Sherm Garrison, Maryland Department of the Environment, oral common., 1995). The largest number of annual loads were estimated for total phosphorus (1,429) (fig. 15). Very little suspended-sediment-load data exists throughout the Chesapeake Bay Basin (fig. 18). Spatially, suspended-sediment-load data is concentrated in the Lower Susquehanna and Patuxent River Basins. Most of the suspended-sediment data were collected through cooperative programs with the USGS or were collected as part of the National Stream Quality Accounting Network (NASQAN). Analysis of water samples for the state programs was primarily for total suspended solids rather than suspended sediment. However, loads were not estimated for total suspended solids because Hardy (U.S. Geological Survey, oral commun., 1993) noted that studies have documented differences of up to 30 percent between suspended-sediment and total-suspended-solids-concentration data. Differences in laboratory methods used to determine total suspended-solids concentrations also contributed to variable results. Although loads were not calculated for total suspended solids, concentration data are included in the water-quality database.

Water-quality-trend analysis is one of the primary techniques used to indicate if water quality is changing over time. Any changes in water quality can be further examined with respect to a management practice to determine if the management practice is producing the desired change. To calculate water-quality trends for any basin, ideally, the water-quality record should be at least 10 years in length to eliminate the chance of false trends caused by the natural variation in streamflow and seasonality. However, trend studies on water-quality data of less than 10 years are common. Within the Chesapeake Bay Basin, the length of record for annual loads was examined at all 127 load sites. Load sites were identified in three groups: less than 5 years, 5 to 9 years, and 10 or more years of estimated annual loads. For the 48 total nitrogen sites, 9 sites had 3 to 5 years, 28 sites had 5 to 9 years, and 11 sites had 10 or more years of annual load data (fig. 19); the average length of annual load record was about 8 years. Unlike total nitrogen, 58 of the 108 total phosphorus load sites had 10 or more years, 35 sites had 5 to 9 years, and 15 sites had 3 to 5 years of annual load data (fig. 20). The average length of the total phosphorus annual load record was about 12 years.

Limitations in the GIS spatial data sets for land use, physiographic province, rock type, and watershed delineations prevented certain types of data analysis and may have contributed to some data gaps. For example, the land-use data set classification for agricultural land includes both

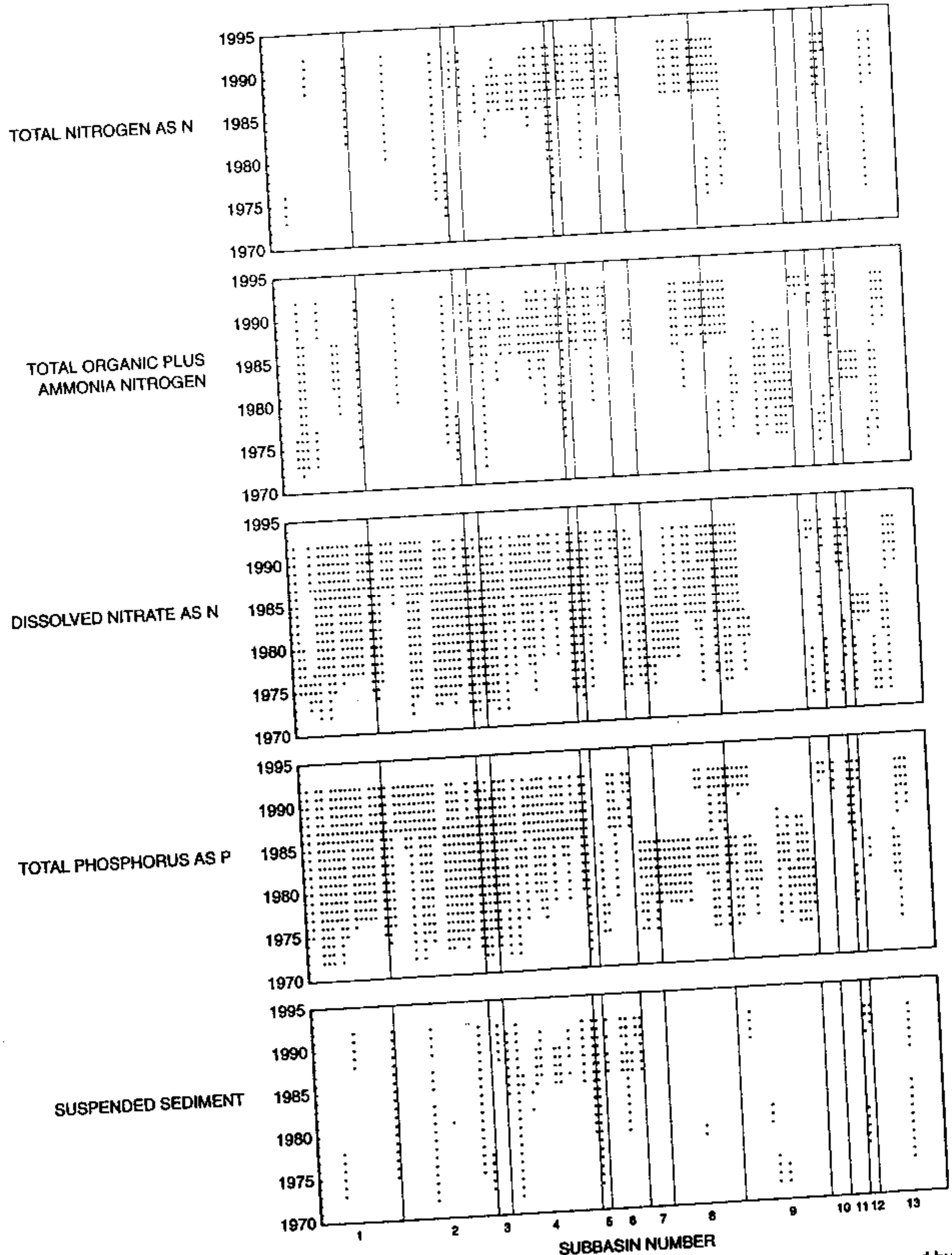

Figure 18. Spatial and temporal distribution of the 127 load sites and years with an estimated load arranged by the 13 subbasins in downstream order (see appendix 10).

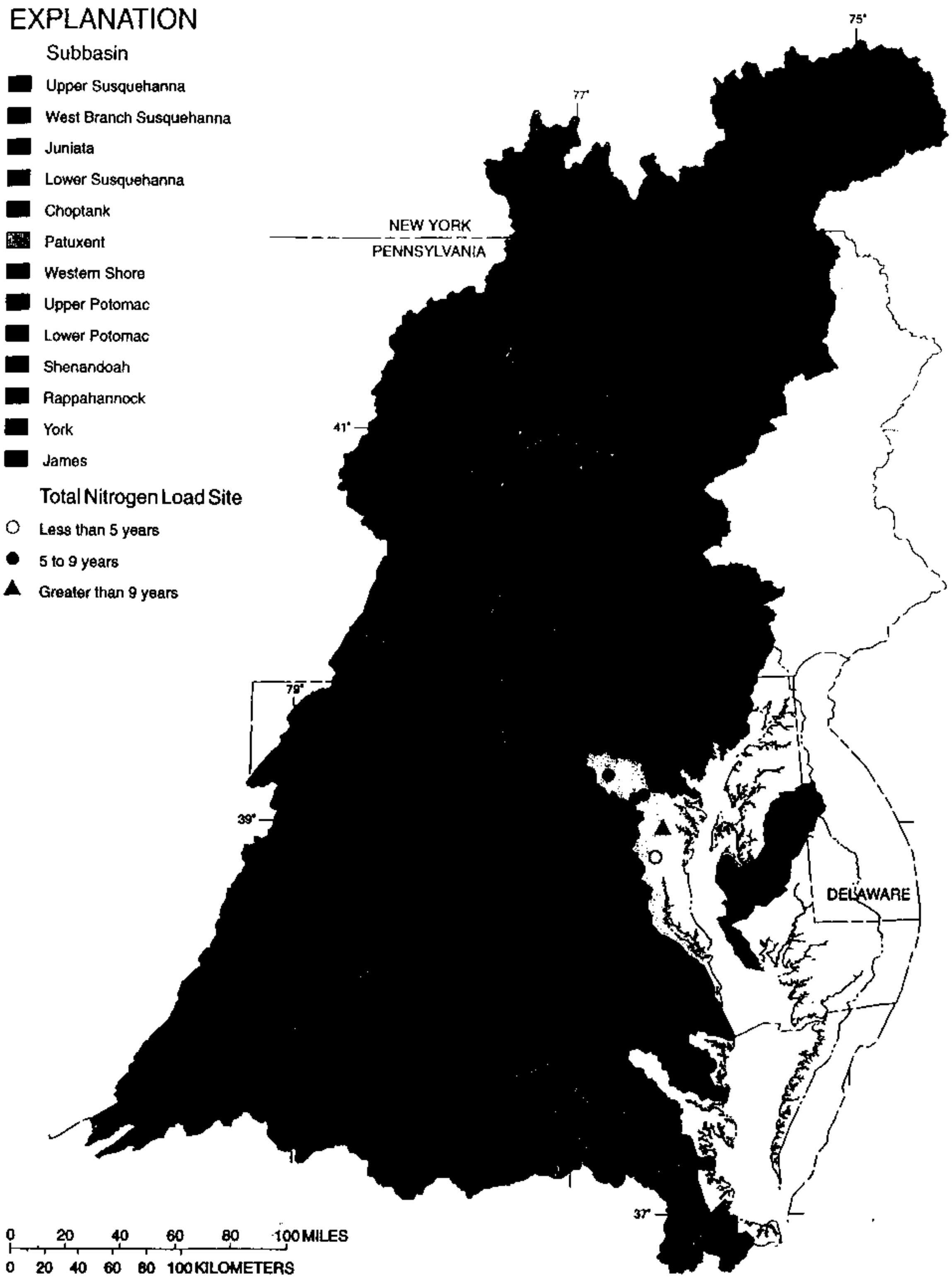

Figure 19. Length of annual estimated load record for 48 total nitrogen sites in the Chesapeake Bay Basin.

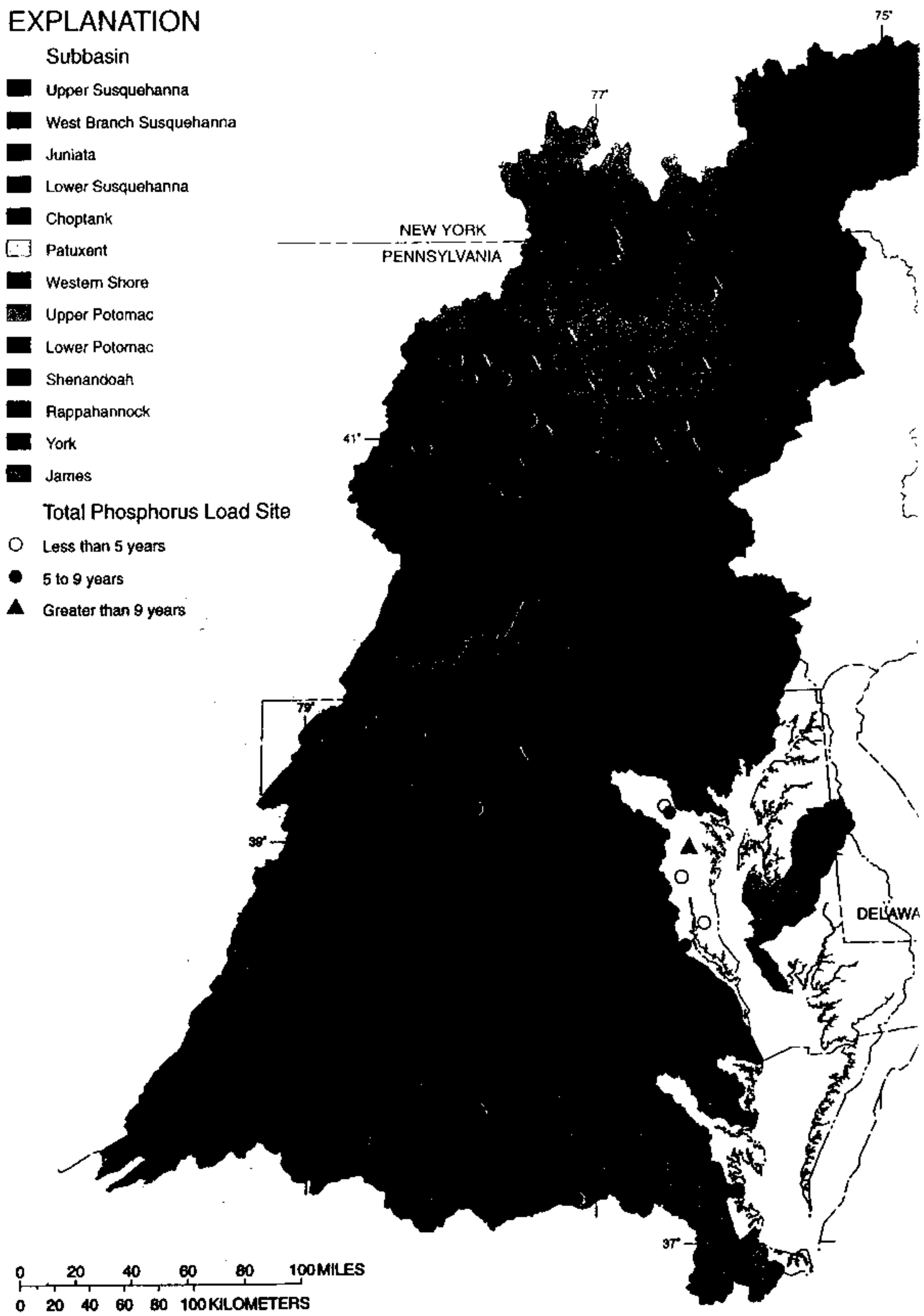

Figure 20. Length of annual estimated load record for 99 total phosphorus sites in the Chesapeake Bay Basi

crop land and pasture land; however, contributions of nutrients and sediments from crop land may vary from contributions of nutrients and sediments from pasture land (Lietman and others, 1983). Therefore, distinguishing between crop and pasture land within a basin may help in the analysis of relations between land use, other physical factors, and nutrient and sediment loads. Although physiographic-province and rock-type data sets were compiled from existing data sets, different resolutions were available for use in Pennsylvania, Maryland, and New York. When data sets are compiled at two different resolutions, the resultant analysis is dependent upon the scale of the least resolution. For example, if you combine 1:24,000 scale data and 1:500,000 scale data, the resulting data set will be accurate at the 1:500,000 scale. When the GIS data sets were combined, gaps and inconsistencies were most prevalent across the state boundaries. Along with scale, descriptive information (attributes) can also cause gaps when data are combined. Although watershed delineations were combined from existing data at a scale of 1:24,000, the information and criteria used to define the delineations were different. In Pennsylvania, all named streams are delineated; in Maryland, all third order streams are delineated; and in Virginia, delineations appear to be related to the Natural Resource Conservation Service (NRCS) hydrologic unit boundaries. Selection of basins in predominant combinations of land use and rock type was very difficult because of the different attributing and delineation schemes used. For example, while 5 of the 127 load basins were considered predominantly agricultural/carbonate basins, the total number of predominantly agriculture/carbonate basins that could potentially be targeted for study is unknown. In order to identify these basins, additional basin delineations are needed.

The availability of a Bay-wide spatial and temporal water-quality SAS data set and a Bay-wide spatial data set of land use, physiographic province, and rock type provides much of the vital information needed to guide decisions on future monitoring. Identification of the characteristics of areas with high or low nutrient or sediment yields and knowledge of the locations of previously monitored areas can be useful in designing a monitoring strategy to evaluate nutrient-reduction programs.

Potential Applications of Database

The SAS and GIS databases described in this report, and delivered to the Chesapeake Bay Program, include the following: (1) water-quality concentration data for 129,990 individual sample analyses, and associated flows where available, collected during 1972 to 1992 from 1,154 different sites in the nontidal part of the Chesapeake Bay, (2) nutrient- and sediment-load estimates for a total of 8,080 annual load values from 127 sites, (3) dissolved-nitrate base-flow load estimates for a total of 978 annual load values from 92 sites, (4) geographical data layers for land use, physiographic province, rock type, and basin delineations for the entire Chesapeake Bay Basin, and (5) attributes for the percentage of each geographical data layer for all 127 load subbasins.

Considering the importance of this data source, it is imperative to keep it as a "living database" with future updates of water-quality data, load calculations and GIS information. It is equally important that all potential users of this database be made aware of its existence and be informed on how to use it. This central source for nutrient data collected in the nontidal part of the Chesapeake Bay watershed should be accessible to researchers and managers through the Chesapeake Bay Program Office. This hopefully will encourage future studies to use this information and, thus, contribute to the ultimate goal of the USEPA Chesapeake Bay Program: to improve ecological conditions and the health of living resources in the Bay. Persons wishing to use the information may do so in a number of different ways. Some examples are listed here:

- The database can be used to perform trend analysis of the nitrogen and phosphorus water-quality-concentration and load data.
- Managers and researchers may refer to the spatial and temporal distribution of the water-quality data when determining future needs for data collection.
- The database may be accessed so that GIS overlay maps of nutrient- and sediment-load data with geographic information can be created in ARC/INFO computer software. This may be particularly useful to guide managers and scientists in identifying and targeting areas for implementation and monitoring.

- Areas where best-management practices are implemented can be tracked in a GIS system and compared to water-quality changes over time in basins where implementation occurs.
- Subsets of the data may be obtained from the USEPA Oracle database for a researcher having a particular project requiring the information.

SUMMARY AND CONCLUSIONS

Nutrient and sediment data on tributaries from nontidal parts of the approximately 64,000 mi^2 Chesapeake Bay Basin were compiled into a single database. An evaluation of nutrient- and sediment-yield data (1) examined yields with respect to land use, physiographic province, rock type, and hydrologic characteristics, (2) identified spatial and temporal gaps, and (3) revealed potential additional uses of the database.

Nutrient- and sediment-concentration data collected by local, state, and Federal agencies between 1972 and 1992 for 1,058 sites were compiled in a SAS data set. Minimum requirements for inclusion in the data set were collection of at least 12 water-quality samples representing the 4 seasons of the year and at least 3 consecutive years of sample collection. If at least 50 water-quality samples and continuous-flow data were available over any 3 year period, annual nutrient and sediment loads were estimated by use of a 7-parameter log-linear multiple regression model. Of the 1,058 unique site locations where water-quality data were collected, adequate data were available to estimate annual loads for 127 of the sites. Annual loads and yields were compiled in a SAS data set and classified as high, normal, or low flow on the basis of the ratio of the annual mean discharge to the long-term mean annual discharge.

Spatial data were compiled in a GIS data set for the entire Bay Basin. The USEPA EMAP data set (1:100,000) provided data for nine land use categories: forest, agriculture, four urban classifications, water, exposed land, and wetland. The physiographic province data set (1:500,000), compiled from several state and Federal agencies, identifies six major provinces—the Appalachian Plateau, Ridge and Valley, Blue Ridge, New England, Piedmont, and Coastal Plain—and includes subdivisions for two provinces. The rock-type data set (1:500,000) represents data compiled from state and Federal agencies and contains four broad rock types based on similar lithologic and geologic characteristics: carbonate rocks, crystalline rocks, siliciclastic rocks, and unconsolidated sediments. Nutrient and sediment data were examined with respect to land use, physiographic province, rock type, and hydrologic condition. To facilitate analysis of the 127 sites where loads were estimated, the sites were grouped by 13 major subbasins in the Chesapeake Bay.

The largest median concentrations of total nitrogen (4.2 mg/L) and total phosphorus (0.23 mg/L) were in the Lower Susquehanna River Basin, the largest median concentration of dissolved nitrate (1.9 mg/L) was in the Western Shore Basin, and the largest median concentration of suspended sediment (124 mg/L) was in the Upper Potomac River Basin. The greatest range in concentrations and the maximum concentrations were in the Lower Susquehanna River Basin.

Six major rivers contribute about 90 percent of the freshwater flow to the Bay. The Susquehanna River, which contributes about 50 percent of the freshwater to the Bay, annually delivers about 66 percent of the total nitrogen and about 40 percent of the total phosphorus transported from the major river basins during normal flow years.

Correlations of annual yields of nutrients and sediments for normal flow years with respect to land use, physiographic province, and rock type indicates (1) basins with greater percentages of agricultural land produced greater nutrient and sediment yields, (2) basins in physiographic provinces where agricultural land is concentrated (Piedmont Lowlands, Piedmont Uplands, and the Great Valley) produced some of the highest nutrient yields, and yields increased as the percentage of agricultural land use increased, and (3) basins with the greatest percentage of forested land produced the smallest nutrient and sediment yields. Further analysis indicated (1) the highest total nitrogen yields from predominantly agricultural areas are from basins underlain by carbonate rock, and (2) mean annual yields of nutrients from predominantly urban basins were substantially less than the mean annual yields from predominantly agricultural basins and generally were less than the means for all 127 load basins.

Data analysis was limited by "gaps" or deficiencies in the water-quality and spatial data sets. Spatial data gaps refer to deficiencies in areal extent and location, water quality and quantity, data-collection activities, and inconsistencies in resolution and definition in the GIS data sets of land use, physiographic province, and rock type. Temporal data gaps refer to the length of water-quality data-collection activities and interruptions in those activities.

Visual inspection of the concentration data indicated that water-quality data were collected at more sites in areas with higher densities in population centers and near main stems of major rivers, and less data were collected from headwater streams.

Significant temporal gaps existed in the nutrient- and sediment-concentration data collected at many of the sites because data were collected for short time periods, or continuous daily discharge data were not collected at or near the water-quality sampling site. Loads were only estimated for 12 percent of the 1,058 sites for which data were available for 3 or more years.

Visual inspection of the geographic locations of the load sites indicates that very few sites are located in the Juniata, the York, the middle and lower reaches of the James, and the nontidal parts of the eastern shore of the Bay. The drainage basins for the load sites averaged about 486 mi^2 and cover about 92 percent of the nontidal part of the Chesapeake Bay Basin. Drainage basins of the 127 load sites ranged from 0.38 mi^2 to 27,100 mi^2, and most were nested within one another.

No single land-use load site existed in the database. About one-third of the load sites contained greater than 70 percent forest land, few sites contained greater than 70 percent agricultural land, and no sites contained greater than 70 percent urban land. Load sites were designated as having a "predominant" land use if they contained greater than 75 percent forest land, greater than 50 percent agricultural land, or greater than 25 percent urban land. Using this designation, nearly all the predominantly forested load sites (26 of 28) were underlain by siliciclastic rock. The other two predominantly forested sites were underlain by carbonate rock. The 25 predominantly agricultural sites were distributed more evenly among rock type—5 in carbonate, 8 in siliciclastic, 11 in crystalline—but only one was underlain by unconsolidated rock. Ten of the 15 predominantly urban sites were underlain by crystalline rock. Rock type has been shown in at least one case (agricultural land use underlain by carbonate rock) to be an important factor in nutrient loads.

The ratio of the drainage area of load sites in a predominant land-use/rock-type combination to the percentage of the total drainage area in the Bay in the same combination was useful for identifying spatial data gaps. Nutrient and sediment data were available for less than 18 percent of the predominantly agricultural areas underlain by siliciclastic rock, less than 35 percent of the agricultural areas underlain by either carbonate rock or unconsolidated rock, and less than 35 percent of the forested land underlain by carbonate rock.

Not all nutrient species and suspended sediment were analyzed in samples collected from sites where sufficient samples were collected to estimate loads. Total nitrogen loads could not be estimated for most load sites for most years. However, total nitrogen loads, the sum of total ammonia plus organic and dissolved nitrate loads, were available for more load sites after 1985 when additional data were collected in the Potomac and James River Basins. Total phosphorus load data from 1985 to 1989 for the Upper and Lower Potomac and Western Shore Basins was not available because of laboratory problems. Very little suspended-sediment load data exists in the Bay Basin except for the Lower Susquehanna River Basin.

Data analysis was limited by deficiencies or inconsistencies in available spacial data. The GIS land use data set classified cropland and pasture land together as one classification, thus preventing a differentiation of the two in data analysis. Inconsistencies in the densities of basin delineations from different states interfered with the comparison of the number of monitored drainage basins of a certain land-use rock-type or combination to the total number of similar, unmonitored drainage basins that exist in the Chesapeake Bay Basin.

The databases described in this report could be used in a variety of ways to provide further information to managers and researchers working to improve the health of the Chesapeake Bay.

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APPENDIX 1. LIST OF WATER-QUALITY STATION NUMBERS, LATITUDE AND LONGITUDE, AND STATION NAMES

Appendix 1. List of water-quality station numbers, latitude and longitude, and station names

Station	Latitude	Longitude	Station name
[redacted]			
01503000	420207	754812	Susquehanna River at Conklin, N.Y.
01508800	423839	761114	Factory Brook at Homer, N.Y.
01508803	423818	761036	West Branch Tioughnioga River at Homer, N.Y.
01509150	423004	760738	Gridley Creek above East Virgil, N.Y.
01512850	420611	755455	Chenango River at Binghamton, N.Y.
[redacted]			
01527000	423000	773002	Cohocton River at Cohocton, N.Y.
01527050	422928	772910	Switzer Creek near Cohocton, N.Y.
01528000	422318	772129	Fivemile Creek near Kanona, N.Y.
01530900	420102	764324	Chemung River at Wellsburg, N.Y.
01531000	420008	763806	Chemung River at Chemung, N.Y.
[redacted]			
01518000	415430	770747	Tioga River at Tioga, Pa.
01518400	415033	771632	Crooked Creek at Middlebury Center, Pa.
01518500	415408	770855	Crooked Creek at Tioga, Pa.
01518550	415455	770842	Crooked Creek at Tioga, Pa.
01518600	415438	770816	Crooked Creek at Tioga, Pa.
[redacted]			
01532005	414245	762815	Towanda Creek at Monroeton, Pa.
01533205	413834	760940	Susquehanna River at Laceyville, Pa.
01533992	413348	755230	South Branch Tunkhannock Creek near Tunkhannock, Pa.
01534000	413330	755342	Tunkhannock Creek near Tunkhannock, Pa.
01534055	413053	755741	Bowman Creek near Tunkhannock, Pa.
[redacted]			
01535060	412411	753952	Roaring Brook at Scranton, Pa.
01536000	412133	754441	Lackawanna River at Old Forge, Pa.
01536103	412038	754713	Lackawanna River at Pittston, Pa.
01536500	411503	755252	Susquehanna River at Wilkes-Barre, Pa.
01537000	411651	755346	Toby Creek at Luzerne, Pa.

Appendix 1. List of water-quality station numbers, latitude and longitude, and station names—Continued

Station	Latitude	Longitude	Station name
[redacted]			
01538600	410249	761317	Nescopeck Creek at Nescopeck, Pa.
01540348	405650	762721	Catawissa Creek at Catawissa, Pa.
01540500	405729	763710	Susquehanna River at Danville, Pa.
01540823	405206	784314	Chest Creek at Mahaffey, Pa.
01541000	405349	784038	West Branch Susquehanna River at Bower, Pa.
[redacted]			
01542310	410212	780328	Moshannon Creek near Moshannon, Pa.
01542500	410703	780633	West Branch Susquehanna River at Karthaus, Pa.
01542790	412002	780808	Bennett Branch Sinnemahoning Creek at Driftwood, Pa.
01543000	412448	781150	Driftwood Branch Sinnemahoning Creek, Sterling Run, Pa.
01543500	411902	780612	Sinnemahoning Creek at Sinnemahoning, Pa.
[redacted]			
01547500	410306	773617	Bald Eagle Creek at Blanchard, Pa.
01547950	410642	774209	Beech Creek at Monument, Pa.
01548075	410431	772840	Fishing Creek near Cedar Springs, Pa.
01548095	411022	772201	Chatham Run, 220 Bridge at Charlton, Pa.
01548340	414419	773734	Pine Creek at Galeton, Pa.
[redacted]			
01548418	413705	771840	Hunter Drift Discharge near Antrim, Pa.
01548421	413650	771738	Basswood Run at mouth near Antrim, Pa.
01548423	413551	771750	Wilson Creek at Morris, Pa.
01548425	413623	771929	Unnamed tributary to Paint Run near Morris, Pa.
01548427	413456	772046	Stony Fork near mouth near Blackwell, Pa.
[redacted]			
01552000	411930	765446	Loyalsock Creek at Loyalsockville, Pa.
01553150	410429	765221	White Deer Creek at White Deer, Pa.
01553480	405819	765330	Buffalo Creek at Lewisburg, Pa.
01553500	405803	765236	West Branch Susquehanna River at Lewisburg, Pa.
01553700	410342	764050	Chillisquaque Creek at Washingtonville, Pa.

Appendix 1. *List of water-quality station numbers, latitude and longitude, and station names—Continued*

Station	Latitude	Longitude	Station name
[redacted]			
01555251	404328	764857	Mahanoy Creek near Herndon, Pa.
01555252	404334	765016	Mahanoy Creek at Herndon, Pa.
01555500	403640	765444	East Mahantango Creek near Dalmatia, Pa.
01555600	403214	765739	Wiconisco Creek at Millersburg, Pa.
01556010	402834	781039	Frankstown Branch Juniata River near Williamsburg, Pa.
[redacted]			
01559920	400850	783321	Bobs Creek at Reynoldsdale, Pa.
01560000	400418	782934	Dunning Creek at Belden, Pa.
01560510	400126	782839	Dunning Creek near Bedford, Pa.
01562000	401257	781556	Raystown Branch Juniata River at Saxton, Pa.
01563500	402332	775607	Juniata River at Mapleton Depot, Pa.
[redacted]			
01565515	403507	773327	Jacks Creek at Lewistown, Pa.
01566010	403141	772332	Tuscarora Creek at Port Royal, Pa.
01567000	402842	770746	Juniata River at Newport, Pa.
01567350	402320	770156	Little Juniata Creek at Duncannon, Pa.
01568000	401924	771009	Sherman Creek at Shermans Dale, Pa.
[redacted]			
01570230	401744	765755	Conodoguinet Creek tributary number 2A near Enola, Pa.
01570260	401747	765751	Conodoguinet Creek tributary number 2B near Enola, Pa.
01570280	401638	765700	Conodoguinet Creek at Enola, Pa.
01570300	401805	765657	Conodoguinet Creek tributary number 3 near Enola, Pa.
01570500	401517	765311	Susquehanna River at Harrisburg, Pa.
[redacted]			
01572000	403215	762240	Lower Little Swatara Creek at Pine Grove, Pa.
01572200	402838	763126	Swatara Creek at Inwood, Pa.
01573205	402102	763652	Quittapahilla Creek at Syner, Pa.
01573560	401754	764005	Swatara Creek near Hershey, Pa.
01573610	401128	764352	Swatara Creek at Middletown, Pa.

Appendix 1. *List of water-quality station numbers, latitude and longitude, and station names—Continued*

Station	Latitude	Longitude	Station name
[redacted]			
01575585	400107	764136	Codorus Creek at Pleasureville, Pa.
01575990	400319	763133	Chickies Creek at Marietta, Pa.
01576000	400316	763152	Susquehanna River at Marietta, Pa.
0157608335	400847	755537	Little Conestoga Creek, Site 3a, near Morgantown, Pa.
01576085	400841	755920	Little Conestoga Creek near Churchtown, Pa.
[redacted]			
01576786	395428	761906	Pequea Creek Tributary near Martic Forge, Pa.
01576787	395421	761943	Pequea Creek at Martic Forge, Pa.
01576788	395327	761813	Pequea Creek Tributary near Mt. Nebo, Pa.
01576789	395339	762134	Pequea Creek near Martic Forge, Pa.
01576990	394901	761924	Susquehanna River at Holtwood, Pa.
[redacted]			
WQN0202	401527	765312	Susquehanna River at Harrisburg
WQN0203	405115	764821	Bainbridge Street Bridge in Sunbury
WQN0204	395339	762134	Pequea Creek in Martic Township
WQN0205	400300	761639	Conestoga River in Lancaster
WQN0206	400319	763133	Chickies Creek at Rt. 441 Bridge
[redacted]			
WQN0212	401327	765138	Yellow Breeches at New Cumberland
WQN0213	401531	770439	Conodoguinet Creek at SR1009 Branch
WQN0214	402842	770746	Juniata River at Newport
WQN0215	402342	775624	LR31084 Bridge at Mapleton
WQN0216	402905	780109	TRA135 Bridge at Huntingdon
[redacted]			
WQN0224	402834	781039	PC Railroad Bridge in Woodbury Township
WQN0225	403214	765739	Wiconisco Creek at Millersburg
WQN0226	403640	765443	Mahantango Creek in Upper Paxton Township
WQN0228	404629	765211	US 11 & 15 Bridge in Penn Township
WQN0229	405200	770255	Penns Creek at Penns Creek

Appendix 1. List of water-quality station numbers, latitude and longitude, and station names—Continued

Station	Latitude	Longitude	Station name
[redacted]			
WQN0239	400816	771052	Mountain Creek near Mt. Holly Spring
WQN0240	401638	765700	Conodoguinet Creek near Enola
WQN0241	400456	773238	Middle Spring Creek near Shippensburg
WQN0242	404719	770241	US 522 Bridge at Middleburg
WQN0243	402249	770456	Shermans Creek near Duncannon
[redacted]			
WQN0249	402005	775136	TR403 Bridge at Aughwick Mill
WQN0250	400126	782839	Railroad Bridge off TR 477, Bedford Township
WQN0251	400850	783321	LR05060 Bridge at Reynoldsdale
WQN0252	402554	782130	At Mouth in Blair Township
WQN0253	403917	773500	Old US Rt. 322 Branch in Brown Township
[redacted]			
WQN0261	395156	760640	SR0472 (Pa. Rt. 472) Bridge near Black Rock
WQN0262	400121	771831	T340 (Pine Grove Furnace), Cooke Township
WQN0263	394224	760657	Bridge on New Bridge Road near jct. Horseshoe Road
WQN0264	403546	773424	SR3001 (Main St.) Bridge at Lewistown
WQN0301	405729	763610	PR54 Bridge at Danville
[redacted]			
WQN0307	405650	762721	PR42 Bridge in Catawissa Township
WQN0308	405942	762825	PR44 Bridge in Hemlock Township
WQN0309	410250	761312	Bridge on LR40017
WQN0310	410417	760802	Rt. 29 Bridge in Conyngham Township
WQN0311	411415	755638	Solomon Creek near Buttonwood
[redacted]			
WQN0317	413329	755342	Bridge on Rt. 6
WQN0318	414245	762814	Towanda Creek at Monroeton
WQN0319	415430	770747	Bridge on Rt. 667
WQN0320	415916	770854	Cowanesque River near Lawrenceville
WQN0321	415438	771215	Crooked Creek near Tioga

***Appendix 1.** List of water-quality station numbers, latitude and longitude, and station names—Continued*

Station	Latitude	Longitude	Station name
[redacted]			
WQN0327	412416	753907	Cedar Avenue Bridge
WQN0328	413053	755741	Bowman Creek near Tunkhannock
WQN0329	413339	755201	South Branch Tunkhannock Creek near Tunkhannock
WQN0330	412038	754713	Lackawanna River near Pittston
WQN0331	410027	761000	Black Creek at Tank
[redacted]			
WQN0401	405802	765245	West Branch Susquehanna River
WQN0402	411344	770109	Maynard St. Bridge in Williamsport
WQN0403	411926	774502	Eighth Street Bridge in Renovo
WQN0404	410703	780633	PR879 Bridge in Karthaus Township
WQN0405	405741	783110	PR453 Bridge at Curwensville
[redacted]			
WQN0411	413118	772652	TR762 Bridge in Brown Township
WQN0412	410331	773544	First Bridge below Sayre Dam
WQN0413	405831	774435	LR14010 Bridge at Curtin
WQN0415	405323	774740	LR14040 Bridge at Bellefonte
WQN0416	405427	774657	Willowbank Street Bridge, Bellefonte
[redacted]			
WQN0423	410429	773532	US 220 Bridge at Beech Creek
WQN0425	410340	764050	PR54 Bridge near Washingtonville
WQN0426	405819	765330	US 15 Bridge at Lewisburg
WQN0427	410429	765221	US 15 Bridge in White Deer
WQN0428	412722	764124	Loyalsock Creek near Forksville
[redacted]			
WQN0436	405206	784314	T-324 Bridge at Mahaffey
WQN0437	412017	780809	PR555 Bridge at Driftwood
WQN0438	410050	781159	LR17062 Bridge near Kylertown
WQN0439	412002	780810	T343 Bridge south of Driftwood
WQN0440	405831	783150	Meadow St. Bridge in Curwensville

Appendix 1. *List of water-quality station numbers, latitude and longitude, and station names—Continued*

Station	Latitude	Longitude	Station name
[redacted]			
01487000	384345	753341	Nanticoke River near Bridgeville, De.
01487030	383955	753445	Nanticoke River at Middleford, De.
01487450	383328	753431	Broad Creek at Laurel, De.
01488500	385059	754024	Marshyhope Creek near Adamsville De.
01492960	392119	754342	Cypress B near Van Dyke, De.
[redacted]			
01493110	391717	755543	Chester River Tributary at Chesterville, Md.
01493500	391648	760054	Morgan Creek near Kennedyville, Md.
01578310	393926	761031	Susquehanna River at Conowingo, Md.
01589452	392241	763836	Jones Falls at Lake Roland Dam near Baltimore, Md.
01589465	391928	763734	Stony Run near Mouth at Baltimore, Md.
[redacted]			
01594440	385721	764136	Patuxent River near Bowie, Md.
01594526	384852	764452	Western B at Upper Marlboro, Md.
01594670	383502	763620	Hunting Creek near Huntingtown, Md.
01594675	383407	763705	Agricultural Runoff Site near Huntingtown, Md.
01594710	382837	764408	Killpeck Creek at Huntersville, Md.
[redacted]			
01595800	392644	790639	North Branch Potomac River at Barnum, W. Va.
01600000	393359	785025	North Branch Potomac River at Pinto, Md.
01603000	393719	784624	North Branch Potomac River near Cumberland, Md.
01614500	394257	774928	Conococheague Creek at Fairview, Md.
01619500	392701	774352	Antietam Creek near Sharpsburg, Md.
[redacted]			
01645784	385548	772043	Snakeden Branch at Reston, Va.
01646580	385546	770702	Potomac River at Chain Bridge at Washington, D.C.
01647685	390832	770548	Williamsburg Run near Olney, Md.
01647720	390659	770609	North Branch Rock Creek near Norbeck, Md.
01647725	390636	770600	Manor Run near Norbeck, Md.

Appendix 1. *List of water-quality station numbers, latitude and longitude, and station names—Continued*

Station	Latitude	Longitude	Station name
[redacted]			
1G	384051	771035	Pohick Creek
13A	384104	770937	Accotink Creek
15001.4	390356	772100	Potomac Basin/Seneca at Midstream
15002.0	390400	772348	Potomac Basin/South Van Deventer Island
15006.0	390522	772800	Potomac Basin/North Selden Island
[redacted]			
20051	390211	772030	Potomac Basin/l Seneca Creek below Rt. 28
20060	390742	772011	L Seneca Creek at Potomac River
50010	385900	770000	Sligo Creek near Washington Hospital
50033	385915	765900	Potomac Basin/Long Br. near Carrloo Avenue
50035	390020	770000	Long Branch above East Wayne Avenue
[redacted]			
A15	390100	765200	Beaverdam Creek at Research Road
A17	390100	765400	Indian Creek at Sunnyside Road
A4	385720	765700	Nwr. at Wueen's Chapel Road
A7	385730	765600	Ne Branch at Riverdale River.
B1	385500	765400	Lower Beaverdam Creek at Dc Bor.
[redacted]			
CHO365	383112	772142	Chopawamsic Creek
DIF86	385839	771433	Difficult Run
GOO238	390456	773033	Goose Creek
KNG01	385325	765640	Kingman L.e.cap.st. Bridge w.
PIM15	385549	770706	Pimmit Run
[redacted]			
RWCC	390356	772200	Intake at Senecca Pool
SUG442	390313	772147	Sugarland Run
TBK01	385504	770715	Canl Road, northwest/Fletc. Boat
TCO01	385340	770430	Potomac Basin/just west of 27 St., northwest
TCO06	385539	770606	Potomac Basin/Fletcher"s Boathouse

Appendix 1. *List of water-quality station numbers, latitude and longitude, and station names—Continued*

Station	Latitude	Longitude	Station name
[redacted]			
TFS01	385200	765830	1900 Block of Good Hope Road
THR01	385430	765745	North side Bridge on H. Lane
TNA01	385436	765630	Anacostia Avenue Northeast
TOR01	384954	770228	Potomac Basin/100 yards below Audrey Lane
TPB01	385242	765820	Fairlawn Avenue M St./M Pl., southeast
[redacted]			
AAR0000	392906	790501	Aaron Run just above its mouth
AFR0025	382452	765631	At bridge on Md. Rt. 234
ANA0082	385619	765638	At bridge on Bladensburg Road
ANT0044	392700	774355	At gaging station just below Burnside Bridge
ANT0203	393539	774240	At bridge on Poffenberger Road near Funks
[redacted]			
BEL0043	393643	754901	Md. 281 crossing
BEV0005	392916	763841	Beaver Run Lane, wooden bridge
BEV0006	392908	763845	York Road Crossing
BLW0130	382255	760404	At bridge on Shorters Wharf Road
BPC0035	393642	771419	Bridge on Maryland Rt. 194
[redacted]			
CHE0367	391443	755431	Midriver Md. 290 Bridge Crossing Chester
CHO0429	384825	755445	Mid River off Ganey's Wharf, below Tucka
CHO0626	385949	754712	At Red Bridges near Sewell Mills
CJB0005	385824	770857	At Bridge on Macarthur Blvd.
CKB0010	392618	765219	Ivy Mill Road Crossing
[redacted]			
CON0180	394256	774931	At gaging station 0.7 mi above bridge
CQP0018	392200	763557	Northern Parkway Bridge
DDR0020	391809	764239	Cooks Lane off of Franklintown Road
DER0015	393723	760954	Bridge on Stafford Bridge Road
DER0124	393715	761800	Bridge on US Rt. 1

Appendix 1. *List of water-quality station numbers, latitude and longitude, and station names—Continued*

Station	Latitude	Longitude	Station name
[redacted]			
EKL0000	392557	790734	Elklick Run just above its mouth
FED0009	384908	764540	Marlboro Pike Bridge
FED0014	384746	764720	Access road south of Md. Rt. 408
FGH0012	393841	764310	Along Parsonage Road, 1 mi WSW
FZH0001	392800	763420	Just north of Dulaney Valley Road
[redacted]			
GOB0124	393926	765245	50 feet below Manchester Stp Outfall Point
GOB0125	393929	765248	Just above Manchester Stp Effluent
GOB0126	393932	765250	40 ft upstream from Dutterers Effluent
GRG0013	393915	764647	Upper Beckleysville Road Crossing
GUN0036	392451	762425	Bridge on Old Philadelphia Road Rt. 7
[redacted]			
GUN0216	393007	763721	Loch Raven Res. Ashland Avenue Crossing
GUN0237	393124	763727	At Bridge on Phoenix Road (Philpot Road)
GUN0258	393301	763810	End of Glencoe Road at Old Bridge Cross
GUN0334	393632	763809	Bridge on Big Falls Road
GUN0387	393712	764126	At bridge on Falls Road downstream from Prettyboy River
[redacted]			
GWN0022	391632	763928	Off Wilkens Avenue near Brunswick St.
GWN0054	391821	764106	Just below Confluence with Dead Run
GWN0073	391859	764211	Just above Dickyville Dam-in Impounded A
GWN0075	391907	764237	Purnell Drive near Gwynn Oak Avenue
GWN0115	392046	764404	At Bridge on Essex Road in Villa Nova
[redacted]			
JON0023	391838	763711	Under North Avenue Bridge
JON0034	391930	763757	Near the intersection of Falls Road/Clipper Mill
JON0071	392159	763853	100 yards below Kelly Avenue Bridge
JON0074	392217	763908	At end of Appleby Avenue off Falls Road
JON0100	392323	763916	From perr abandoned bridge near 1805 Ind

Appendix 1. List of water-quality station numbers, latitude and longitude, and station names—Continued

Station	Latitude	Longitude	Station name
[redacted]			
LGU0024	392529	762242	Bridge on Md. Rt. 7
LMR0015	392535	765740	Bartholow Road Crossing, 1.5 mi NW
LQB0002	392533	763547	Dulaney Valley Road, 0.1 mi N of Semin
LXT0173	390802	764903	Downstream of US Rt. 1 Bridge at gaging station
LXT0200	391005	765105	Midstream at the gaging station upstream
[redacted]			
MON0020	391617	772631	Bridge on Maryland Rt. 28
MON0155	391759	772134	Bridge on Reels Mill Road
MON0167	392353	772206	Jug Bridge US Rt. 40 West USGS gaging station
MON0204	392552	772250	Bridge on Gas House Pike
MON0269	392848	772323	Bridge on Biggs Ford Road
[redacted]			
MOR0040	392707	765719	London Br Road Crossing, 1.2 mi Southwest of Gambe
MRH0058	383436	754743	At bridge on Md. Rt. 14 near Brookview
MRM0001	392740	763522	Dulaney Valley Road Crossing
MXT0021	390935	765111	Murray Hill Road Crossing
NAN0302	383240	754315	Mid River at Old Sharpstown Bridge
[redacted]			
NBP0326	393359	785021	USGS gaging station near W. Md. Rr Bridge
NBP0461	392641	785819	At Bridge on US Rt. 220
NBP0514	392859	790248	North Branch at Piedmont Westernport Bridge
NBP0534	392844	790406	North Branch at Bloomington Upstm of Con
NBP0597	392645	790639	USGS Gage at Bridge at Barnum
[redacted]			
NPA0075	392542	765325	Upstream of Morgan Run Mouth
NPA0105	392658	765240	Midchannel at Deer Park/Nicodemus Road
NPA0136	392826	765258	Midchannel above Mouth of Keysers Run
NPA0150	392909	765203	Midchannel just below US Rt. 140
NPA0165	393000	765257	Bridge at Md. Rt. 91 near Gage

Appendix 1. *List of water-quality station numbers, latitude and longitude, and station names—Continued*

Station	Latitude	Longitude	Station name
[redacted]			
PAT0107	391451	763644	At South Hanover Street Bridge
PAT0112	391423	763657	Patapsco Avenue Crossing
PAT0176	391303	764220	At Bridge on Washington Boulevard
PAT0285	391844	764733	At Bridge on Md. Rt. 99 near Hollofield
PBH0015	393701	764402	Traceys Store Road Crossing, 1.4 mi north
[redacted]			
PIU0051	393334	764739	Bridge on Mt. Zion Road
PIU0065	393435	764841	Bridge on Trenton Road
PIU0083	393547	764956	0.25 mi South of Md. Rt. 88 on County L
PIU0084	393554	765012	Uppermost Portion of Channelized Section
POK0014	375845	753823	At Piers at Shelltown
[redacted]			
POT1472	390919	773121	Western Terminus of Whites Ferry
POT1595	391624	773238	At bridge on US Rt. 15 near Point of Rocks
POT1596	391619	773253	Potomac River/Va. side Point of Rocks
POT1830	392605	774811	At gaging station below bridge on Md. Rt. 3
POT2386	394149	781036	At gaging station 0.5 mi below bridge
[redacted]			
PXT0494	384838	764245	At bridge on Md. Rt. 4 near Waysons Corner
PXT0603	385719	764140	At bridge on US Rt. 50
PXT0630	385922	764220	Patuxent River. at bridge on Rt. 3
PXT0809	390700	765231	At the gaging station just below Rocky G
PXT0972	391421	770323	At bridge on Md. Rt. 97 near Unity Gage
[redacted]			
SCC0023	382000	764331	At gage near bridge on Md. Rt. 242
SEN0008	390446	772024	At bridge on Md. Rt. 112
SIE0006	394125	764553	Slab Bridge Road Crossing, 0.5 mi NW of Rockd
SMR0120	381429	763018	At gaging station near bridge on Md. Rt.
SOU0004	393129	783519	0.4 mi from mouth off Stickley Road

Appendix 1. List of water-quality station numbers, latitude and longitude, and station names—Continued

Station	Latitude	Longitude	Station name
[redacted]			
TUK0022	384951	755453	At bridge on Md. Rt. 328
TUK0133	385520	755702	Bridge on Rt. 404
UDI0005	384911	764625	0.2 mi N. Sha Garage on Rt. 408
UDJ0000	390849	771848	Just above first trib above Schaeffer Road
UDN0009	390711	770024	30 ft right of Bryants Nursery Road
[redacted]			
UFD0011	394055	764519	Cotter Road Crossing, 0.3 mi Nw Flintstone Road
UFM0004	392647	763543	Dulaney Valley Road Crossing
UFT0007	393919	764428	Mt. Carmel Road Crossing near Junct. W/Spook
UHB0008	392630	763415	Between Smallmouth Hotel and Peach Orchard
UHK0000	390845	771857	Mouth of first trib entering Urg from the N
[redacted]			
UKS0001	384901	764655	Below confl. of tribs draining sludge di
UKT0004	384922	764604	Brown Station Road, 0.7 mi south of Broo
UKT0008	384927	764626	0.6 mi NW Rt. 408 next to old RR
UNP0002	392940	765205	Glen Falls Road Crossing of 1st tributary north of Rt
UOK0001	390712	770004	300 ft down road right of Bryants Nursery River
[redacted]			
UPS0004	390734	770056	Crossing Old Orchard Road 0.15 mi from Ednor
UQQ0005	392355	763855	Bridge at Circle Road
UQQ0007	392354	763855	From Roland Run at Circle Road Bridge
UQT0001	384545	765036	Access P-4a Sludge Disposal Site
UQW0001	384617	765032	Access P-4a Sludge Disposal Site
[redacted]			
UWS0001	392531	763540	Seminary Avenue Crossing
UYU0003	394040	764633	Upper Beckleysville Road 0.3 mi south of Alesi
UZM0007	385150	764411	Leeland Road Crossing, southeast of Leeland
UZM0016	385225	764346	Between Settling Basins
UZM0017	385234	764325	Between Settling Basins

Appendix 1. *List of water-quality station numbers, latitude and longitude, and station names—Continued*

Station	Latitude	Longitude	Station name
[redacted]			
WGP0016	392937	763838	Bridge on Ashland Avenue
WGP0050	393039	764039	Bridge on Western Run USGS-01583500
WHR0029	392216	762648	At bridge on Md. Rt. 7 USGS-01585100
WIL0013	393941	784650	Gaging station downstream from Confluew/Brad
WIN0030	392635	761856	US Rt. 7 Bridge
[redacted]			
WXT0045	384851	764504	Water Street Crossing in Upper Marlboro
West Virginia			
01595300	392200	791045	Abram Creek at Oakmont, W. Va.
01604500	392635	784920	Patterson Creek near Headsville, W. Va.
01606500	385928	791034	South Branch Potomac River near Peterson, W. Va.
[redacted]			
01610200	390318	784331	Lost River at Mccauley near Baker, W. Va.
01611500	393443	781834	Cacapon River near Great Cacapon, W. Va.
01616500	392525	775620	Opequon Creek near Martinsburg, W. Va.
01617000	392810	775818	Tuscarora Creek above Martinsburg, W. Va.
01618000	392604	774807	Potomac River at Shepherdstown, Wv
[redacted]			
01644295	385710	772204	Smilax Branch at Reston, Va.
01656100	383658	773316	Cedar Run near Aden, Va.
01656725	385321	773414	Bull Run near Catharpin, Va.
01658480	383422	772051	Quantico Creek near Dumfries, Va.
01658550	383438	772436	South Fork Quantico Creek at Camp 5 near Joplin, Va.
[redacted]			
01668000	381920	773105	Rappahannock River near Fredericksburg, Va.
01673000	374603	771957	Pamunkey River near Hanover, Va.
01674500	375316	770948	Mattaponi River near Beulahville, Va.
01677000	372617	764712	Ware Creek near Toano, Va.
02012500	375236	795839	Jackson River at Falling Spring, Va.

Appendix 1. *List of water-quality station numbers, latitude and longitude, and station names—Continued*

Station	Latitude	Longitude	Station name
02019500	373150	794045	James River at Buchanan, Va.
02035000	374015	780510	James River at Cartersville, Va.
02037700	373155	772605	James River at Richmond, Va.
02038850	372455	783810	Holiday Creek near Andersonville, Va.
02041650	371330	772832	Appomattox River at Matoaca, Va.
02042287	373830	772519	Chickahominy River near Atlee, Va.
02042426	373647	772528	Upham Brook near Richmond, Va.
02042440	373307	771617	Chickahominy River at Rt 156 near Seven Pines, Va.
02042500	372630	770255	Chickahominy River near Providence Forge, Va.
02042720	372431	765618	Chickahominy River Walkers Dam at Walkers, Va.
02042726	372852	765821	Diascund Creek at Rt 628 near New Kent, Va.
02042736	372858	765423	Beaverdam Creek at Rt 632 near Barhamsville, Va.
02042742	372730	765157	[illegible] Swamp at Rt [illegible] near Barhamsville, Va.
02042754	372048	764856	Yarmouth Creek below [illegible] Road near [illegible]
1AABR000.76	391045	780508	Rt. 7 Bridge, Winchester
1AABR000.78	391045	780510	Approx 0.2 mi above Rt. 7 Bridge
1AABR002.73	391047	780659	Rt. 656/659 Bridge
1AABR005.80	390952	780938	Rt. 17-50-522 Bridge, Winchester
1AABR007.14	390955	781054	Rt. 11 Bridge, Winchester
1AACC006.13	382303	772303	Rt. 608 Bridge
[redacted]			
1ABAR041.86	391709	781551	Rt. 522 Bridge above Gore
1ABEC004.76	390214	774322	Rt. 734
1ABIR000.76	385011	772700	Rt. 29/211 Bridge
1ABRB002.15	390248	772558	Rt. 7 Bridge
1ABRU006.65	384334	773254	At southern RR bridge off Rt. 28
[redacted]			
1ACAX000.19	391635	773315	Rt. 672 bridge across river from Point of Rocks, Md.
1ACAX004.57	391518	773436	Rt. 663
1ACER000.20	384112	772722	Rt. 619 Bridge below Brentsville
1ACER016.46	383812	773734	Rt. 806 Bridge
1ACER032.15	384427	774718	Rt. 672 Bridge
[redacted]			
1ADUT000.62	391824	773905	Rt. 674 Bridge near mouth of creek
1AFLB000.64	384721	772841	Rt. 1501 Bridge (Prince Wm. Co-Manassas Town)
1AFLB001.40	384655	772915	Rt. 1530 Bridge (Prince Wm. Co-Manassas Town)
1AFOU001.92	385037	770439	E. Glebe Road, 120 Bridge
1AFOU004.22	385123	770638	Rt. 244 Bridge

Appendix 1. *List of water-quality station numbers, latitude and longitude, and station names—Continued*

Station	Latitude	Longitude	Station name
[redacted]			
1AHOC003.67	391604	781427	Rt. 522 Bridge
1AHOC006.23	391425	781541	Rt. 679 Bridge northeast of Hayfield
1AHOC007.96	391329	781646	Rt. 50 Bridge northwest of Winchester
1AHPR003.87	385740	772552	Dulles Airport Access Road, Loudoun Co.
1ALII003.97	384936	773419	Rt. 705 Bridge
[redacted]			
1ANOF002.14	384734	773731	Rt. 29/211 Bridge
1ANOG005.69	390438	774152	Rt. 722 Bridge
1AOCC006.71	384110	771547	Rt. 123 Bridge
1AOCC024.74	384219	772650	Rt. 234 Bridge
1AOPE023.56	391552	780159	Rt. 667 Bridge, Va.-W. Va. state line
[redacted]			
1APIN000.57	381537	770240	Rt. 205 Bridge
1APOH004.79	384154	771207	Rt. 611 Bridge
1APOH005.36	384204	771236	Rt. 1 Bridge above Stp
1APOH007.65	384312	771244	Rt. 641 Bridge
1APOH015.09	384733	771625	Rt. 645 Bridge
[redacted]			
1ARED001.24	391123	780558	Private Bdg. Upstream Rt. 660
1ARED001.61	391133	780620	Rt. 656 Bridge
1ARED004.45	391243	780851	Rt. 11 Bridge
1ASCA001.39	380523	764724	Off Rt. 3 below Arrowhead Mfg. Co.
1ASCO000.76	385702	771221	Rt. 193 Bridge
[redacted]			
1ASUG004.42	390047	772209	Rt. 7 Bridge
1ATUS000.37	390503	773101	Rt. 653 Bridge
1ATUS003.19	390615	773112	Rt. 643 Bridge
1AUMC009.61	381928	770540	Rt. 301 Bridge
1BBLK000.57	382242	785534	Rt. 794 Bridge

Appendix 1. *List of water-quality station numbers, latitude and longitude, and station names—Continued*

Station	Latitude	Longitude	Station name
[redacted]			
1BCKS001.03	382115	785621	Rt. 867 Bridge at Mt. Crawford
1BCKS003.10	382223	785606	Rt. 11 Bridge
1BCKS005.10	382324	785651	Rt. 704 Bridge
1BCKS007.12	382447	785610	Rt. 701 Bridge at Dayton
1BCRO000.43	385717	781126	Riverton Corp. Bridge
[redacted]			
1BDGR000.23	390618	775523	Rt. 621 Bridge, near Berryville
1BDGR004.02	390814	775735	Upstream of Town of Berryville Stp
1BHKS000.96	384230	782721	Rt. 648 Bridge below Luray
1BHKS006.04	384014	782727	Immediately below Town of Luray Stp
1BHKS006.23	384005	782732	Rt. 675 Bridge in Luray
[redacted]			
1BLEW005.68	380917	790226	Above Sewage Disposal Discharge
1BLEW006.93	380904	790333	Below State School For Deaf & Blind, Staunton
1BLEW007.08	380900	790337	Above State School for Deaf & Blind, Staunton
1BLNV000.21	383705	784755	Downstream of Rt. 257 Bridge
1BMDD001.65	382649	785902	Rt. 734 Bridge 1.5 mi below Va. Valley Processors
[redacted]			
1BNFS000.57	385658	781154	Approx. 0.1 mi below Rt. 340/522 Bridge
1BNFS010.34	385836	782013	Rt. 55 Bridge Warren/Shenandoah County
1BNFS012.98	385904	782203	Rt. 648 Bridge at Strasburg
1BNFS037.89	385411	782853	Rt. 663 Bridge
1BNFS043.06	385239	782803	Rt. 758 Bridge near Woodstock
[redacted]			
1BNFS072.78	384350	783842	Rt. 11 Bridge
1BNFS081.42	383907	784152	Rt. 617/953 Bridge, West of New Market
1BNFS087.02	383814	784625	Rt. 42 Bridge at Timberville
1BNFS088.00	383808	784717	Upstream from Shen-valley Meat Packers Effluent
1BNFS088.38	383756	784714	Upstream of Rockingham Poultry Discharge

Appendix 1. List of water-quality station numbers, latitude and longitude, and station names—Continued

Station	Latitude	Longitude	Station name
[redacted]			
1BNTH021.00	382303	785919	River Mile at Wildwood Park Dam in Bridgewater
1BPSG001.36	385732	781600	Rt. 55 Bridge
1BSHN022.63	390728	775329	Rt. 7 Bridge, Castlemans Ferry Bridge
1BSHN038.27	390228	775752	Rt. 50 Bridge
1BSHN048.00	385729	780718	Rt. 624 Bridge
[redacted]			
1BSSF003.56	385449	781236	Rt. 619 Bridge at gaging station
1BSSF046.67	384204	782937	Rt. 675 Bridge, West of Luray
1BSSF054.20	383845	783206	Rt. 211 Bridge, east of New Market
1BSSF060.57	383520	783357	Rt. 340 Bridge
1BSSF078.20	382857	783740	Ri. mi near Dam on South Fork Shen. near Shenandoah
[redacted]			
1BSTH000.19	381740	784836	Rt. 629 Bridge at Port Republic
1BSTH007.80	381307	785015	Rt. 778 at Harrisonburg
1BSTH014.49	380922	785137	Rt. 612 Bridge at Crimora
1BSTH019.26	380640	785146	Rt. 611 Bridge, near Dooms, Augusta County
1BSTH024.70	380410	785307	Rt. 250 Bypass in Waynesboro, Augusta County
[redacted]			
1BSTY006.81	385213	783751	Rt. 675 Bridge
2-ACU001.77	371324	772626	Rt. 600 Bridge near Ferndale Park (Upper Canal)
2-ALM000.42	373023	772444	Rt. 5 Bridge
2-APP012.79	371357	772504	Rt. 36 Bridge
2-APP016.38	371331	772835	Rt. 600 Bridge (Chesterfield County)
[redacted]			
2-APP029.23	371600	773914	Lake Chesdin, above entrance of Namazine Creek
2-APP029.99	371632	773939	Lake Chesdin, in stump area above Namozine Creek
2-APP050.23	372117	775106	Rt. 360 Goodes Bridge
2-APP068.93	372905	775756	Rt. 609 Giles Bridge (Amelia/Powhatan Co. Line)
2-APP110.93	371826	782321	Rt. 45 Bridge at Farmville (Co. of Prince Edward)

Appendix 1. *List of water-quality station numbers, latitude and longitude, and station names—Continued*

Station	Latitude	Longitude	Station name
[redacted]			
2-BCC004.71	380410	795350	Rt. 39 at gaging station
2-BCC005.58	380448	795350	Rt. 39 Bridge gaging station
2-BEN006.27	364925	762953	Rt. 337 Bridge
2-BKW005.57	372457	791109	Alt. Rt. 501 Bridge
2-BKW007.19	372406	791104	Rt. 221 Bridge
[redacted]			
2-BUF002.10	373635	785521	Rt. 657 at gaging station
2-BUF013.53	373619	790134	Rt. 29 Bridge
2-BUF023.21	373916	790612	Rt. 778 Bridge, NW of Amherst
2-CAT000.34	373607	794712	Bridge near Salisbury Furnace-Botetourt County
2-CAT023.83	372800	800020	Gage near Catawba, Rt. 779 Bridge
[redacted]			
2-CHK055.04	373307	771617	Rt. 156 Bridge
2-CHK062.57	373543	772257	Rt. 360 Bridge
2-CHK064.64	373641	772218	Rt. 627 Bridge
2-CHK074.79	374138	772927	Rt. 626 Bridge
2-CHK076.59	374202	773049	Rt. 625 Bridge
[redacted]			
2-DPC026.04	371221	780714	Northeast of Crewe Stp at Rt. 619
2-EBE004.98	365226	761238	Rt. 13 Bridge, City of Norfolk
2-FAC000.85	372623	772620	Rt. 1 Bridge
2-FAC003.67	372739	772758	Hopkins Road Bridge
2-FAC005.78	372730	772909	Rt. 10 Bridge
[redacted]			
2-HOL000.99	372328	783809	Appomattox-Buckingham State Forest (Holiday Lake)
2-HOL001.15	372321	783824	4-H Camp, recreational area
2-HOL001.24	372342	783810	Appomattox-buckingham State Forest (Holiday Lake)
2-HOL003.15	372458	783810	Rt. 614 Bridge
2-HRD011.57	384845	782718	Rt. 637 Bridge

Appendix 1. *List of water-quality station numbers, latitude and longitude, and station names—Continued*

Station	Latitude	Longitude	Station name
[redacted]			
2-JKS018.68	374523	795915	Rt. 18, City of Covington
2-JKS023.61	374719	800003	Jackson River at Covington Gage City Park
2-JKS036.11	375235	795839	Jackson River at Falling Spring Gage Smtih Bridge
2-JKS058.60	380233	795255	Rt. 603 at gaging station, Bath County
2-JMS110.30	373149	772602	Rt. 360 Bridge
[redacted]			
2-JMS189.31	374751	782747	Downstream approximately 0.2 mi below Rt. 20 Bridge
2-JMS229.14	373211	784939	Rt. 60 at Bent Creek
2-JMS258.54	372420	790850	Rt. 29
2-JMS275.75	373048	791954	Below Big Island
2-JMS277.30	373142	792107	Boat Dock on Property of Ownes-Illinois
[redacted]			
2-JMS345.73	374632	794651	Rt. 220, 1st Bridge below Cowpasture River
2-JOB000.39	373023	800618	Johns Creek at New Castle Gage Rt. 615 Bridge
2-JOD001.96	371944	771904	Rt. 724 Bridge
2-LAF000.00	365342	761953	Buoy 2-between Tanner Pt & Lamberts Pt (Mouth)
2-LKN001.67	380338	784021	Pt. Approx. 20 ft above confluence with unnamed tributary
[redacted]			
2-MRY014.78	374508	792332	Rt. 60 at Ben Salem Wayside
2-MRY016.01	374608	792301	Off Rt. 703 upstream from gaging station
2-MRY038.10	375412	792500	Downstream of Rt. 39 Bridge N. of Rockbridge Baths
2-MSC000.11	380110	782714	At Confluence with Rivanna River
2-NMZ000.11	371538	773857	Entrance to Allen's Marina
[redacted]			
2-PCT002.46	372250	772521	Rt. 1 Bridge
2-PCT004.92	372335	772728	Centralia Road Bridge below Stp
2-PNY003.06	374205	785949	Rt. 674 Bridge at Roses Mill
2-PNY008.15	374309	790403	Rt. 778 Bridge
2-POT000.12	374506	795949	Rt. 18 Bridge

Appendix 1. List of water-quality station numbers, latitude and longitude, and station names—Continued

Station	Latitude	Longitude	Station name
[redacted]			
2-RKF000.19	374357	783854	Rt. 626 Bridge
2-RRN002.19	380517	782448	Rt. 649 Bridge
2-RRS003.12	380605	782744	Upstream of Rt. 29 Bridge
2-RRS009.06	380726	783103	Rt. 660 Bridge, N. of Charlottesville
2-RTD003.68	373503	790212	Below Amherst Stp
[redacted]			
2-SFT004.92	371658	772443	Rt. 1 Bridge
2-SFT019.15	372204	773104	Rt. 655 Bridge
2-SFT021.25	372304	773229	Pocahontas State Park, Dam
2-SFT023.36	372318	773430	Pocahontas State Park, Recreation Area
2-SFT025.32	372343	773549	Rt. 653 Bridge
[redacted]			
2-TNB001.73	372949	795250	Rt. 606 Fincastle
2-TYE000.30	373832	784844	Rt. 626 Bridge, above Confl. with James River
2-TYE013.75	373921	785737	Rt. 29 Bridge
2-UPM003.53	373655	772626	Rt. 1 Bridge (Brook Road)
2-WLN007.35	375410	794811	Douthat State Park Lake at Dam
[redacted]			
2-WPK003.23	371950	774338	Rt. 602 Bridge, Lake Chesdin
2-WSR001.59	380348	794945	Rt. 687 Bridge below Stp
2-WSR003.84	380257	794750	Rt. 39 Bridge above Stp
2-XAL000.02	380340	784020	Approx.100 ft above Confl W/Lickinghole Creek
2-XAL000.65	380353	784047	Approx 10 ft above Morton's Frozen Foods Plant
[redacted]			
3-CON002.26	381957	782353	Rt. 230
3-DPR001.70	382549	773747	Rt. 17 Bridge
3-GRT001.70	383834	775135	Rt. 687 Bridge
3-HAL000.57	381731	772727	Rt. 17/2 Bridge
3-HAZ009.58	383535	775757	Rt. 229 Bridge

Appendix 1. List of water-quality station numbers, latitude and longitude, and station names—Continued

Station	Latitude	Longitude	Station name
[redacted]			
3-LDR000.70	382319	781308	Rt. 680 (Ford) Ne of Madison, below Mad. Stp
3-LIK001.96	375658	764344	Rt. 360 Bridge below Stp For Warsay, Richmond Co
3-MAH000.19	382829	774622	Rt. 651 Bridge near Confluence with Rappahannock
3-MAP007.97	381410	773010	Rt. 1 Bridge
3-MIR004.05	382036	775134	Rt. 611 Bridge
[redacted]			
3-RAP030.21	382132	775825	Rt. 522 Bridge
3-RAP043.70	381644	780720	Rt. 634 Bridge below Madison Mills
3-RAP045.08	381649	780825	Rt. 15 Bridge
3-RAP066.54	381647	782028	Rt. 29 Bridge at gaging station (Greene/Madison Co)
3-ROB001.90	381921	780544	Rt. 614 Bridge
[redacted]			
3-RPP175.51	384523	780142	Rt. 647 Bridge
3-RUS005.24	384221	780908	Rt. 626 Bridge
3-THO006.50	383601	780352	Rt. 729 Bridge
3-THO021.19	383847	781224	Rt. 620 Bridge
3-THR000.50	383950	781303	Rt. 522 Bridge
[redacted]			
7-BHB001.19	373147	754826	Rt. 600 Bridge
7-CRD001.31	374514	754048	Rt. 793 Bridge
7-HAB000.14	371801	755807	East Side of Rt. 13, Northampton County
7-LMB000.57	374632	754058	Rt. 658 Bridge
7-LNC000.68	365157	755954	Little Neck Creek
[redacted]			
7-XAZ000.30	375410	753447	Rt. 693 Bridge (Sandy Bottom Branch)
7-XBB000.58	375237	753546	Rt. 693 Bridge at J.M. Taylor Packing Co. effluent
7-XBG000.24	374546	754008	Rt. 763 Bridge
7-XBQ000.64	371854	755659	Adjacent to Railroad Tracks, Northampton County
8-CON000.23	380441	774846	Contrary Creek Arm of Lake

Appendix 1. List of water-quality station numbers, latitude and longitude, and station names—Continued

Station	Latitude	Longitude	Station name
[redacted]			
8-CON006.92	380248	775336	Below Boyd Smith Mine
8-CON007.69	380217	775403	Below Arminius Mine
8-CON007.88	380207	775409	Above all mines
8-FLG000.76	374800	772821	Rt. 1 Bridge
8-FRS004.65	372254	764758	50 yards Downstream Toano Stp
[redacted]			
8-MPN083.62	375750	772035	Rt. 2/301 Bridge
8-MPN094.79	380337	772305	Rt. 605 Bridge
8-MTA001.69	380611	772853	Rt. 632 Bridge
8-MTN000.96	380939	780606	Rt. 643 Bridge
8-NAR005.42	375100	772541	Sta.1, Rt. 30 Br (Morris Bridge)
[redacted]			
8-NAR033.92	380045	774204	Rt. 601 Bridge (Smiths Mill Bridge)
8-NAR047.57	380517	774850	Rt. 208 Bridge (New)
8-NIR003.96	381018	773109	Rt. 1 Bridge
8-NIR009.61	381303	773412	Rt. 208 Bridge NE of Spotsylvania
8-NST003.46	380236	774136	Rt. 622 Bridge
[redacted]			
8-PMK088.11	374719	772214	Rt. 2/301, N of Hanover
8-PNI002.43	380816	772646	Rt. 606 Bridge
8-POR004.13	380859	773128	Rt. 1 Bridge
8-POR008.97	381016	773545	Rt. 208 Bridge
8-POR016.04	381217	773802	Rt. 608 Bridge
[redacted]			
8-TRY004.98	381113	775539	Rt. 629, Orange County
8-XAF000.15	380731	781205	Just below Gordonsville Stp Effluent
8-YRK011.14	371730	763413	Buoy 34
8-YRK028.10	372800	764555	Bells Rock Light
ST01	384139	771706	Occoquan Dam

Appendix 1. List of water-quality station numbers, latitude and longitude, and station names—Continued

Station	Latitude	Longitude	Station name
[redacted]			
ST45	384812	772659	Yorkshire Southwest Fairfax County
ST50	384916	772757	Cub Run near Bull Run
ST60	385321	773414	Bull Run near Catharpin
ST70	384650	774022	Broad Run at Buckland

APPENDIX 2. SAMPLE SUPPLEMENTAL INFORMATION DATA SHEET

PROGRAM/PROJECT DATA—QUESTIONS 1-12

1. Program or project name ____________________

2. Basin name(s) ____________________

3. Agency name ____________________

4. Program description and objectives
____
____
____

5. Number of stations ______

6. Contact person ____________________

7. Your name ____________________

8. Collection methods

   a. Method (check all that apply)

      __ Discrete automatic sampler
      __ Grab (hand) sample
      __ Composite
      __ Other

   b. Samples were collected (check all that apply)

      __ Single point center of stream
      __ Single point anywhere in stream
      __ Multiple point sampling (width integrated) How many points? _____
      __ Multiple depth sampling (depth integrated)

9. Did your agency collect the samples? Yes No

   If no, please identify the collector agency ____________________

10. Did your agency analyze the samples? Yes No

    If no, please identify the analyzing agency ____________________

11. Water-quality assurance (QA) information

    a. Were (QA) samples sent to the analyzing agency? Yes No

    b. Does your agency have (QA) procedures documented? Yes No

12. Sample collection frequency (check or answer)

    a. Primary stream conditions at sample collection time

       __ Base flow
       __ Storm flow
       __ Total flow

    b. Frequency of sample collection

       __ Monthly
       __ Bi-weekly
       __ Quarterly
       __ Other

    c. Are storms sampled? Yes No

       If yes, number of storms per year _____ Number of samples per storm _____

INDIVIDUAL STATION INFORMATION—QUESTIONS 13-20

13. Station name/description ______________________________

____

14. Station number ______________________________

Corresponding station #'s from other agencies ______________________________

____

15. Latitude and longitude ______________________________

16. Period of QW record (mo/yr) ______ to ______ (______ to ______ ; ______ to ______)

Period of ADAPS Q record (if available) ______ to ______ ; ______ to ______

17. Land use (subdivide any category if possible)

a. ____% Agriculture ______________________________

b. ____% Urban ______________________________

c. ____% Residential ______________________________

d. ____% Forest ______________________________

18. Watershed characteristics

a. Drainage area (square miles) ______________________________

b. Slope (range or average) ______________________________

c. Physiographic province (Coastal, Piedmont, etc.) ______________________________

d. Underlying lithology (sandstone, shale, etc.) ______________________________

19. Objective of study (check all that apply)

__ Agricultural management (type and date of implementation)

__ Manure management
__ Crop management (row cropping, cover crops, etc.)
__ Pesticide management
__ Stream bank fencing
__ Other ______________________________
__ Contact agency for additional data

__ Long-term trend studies
__ Water-quality network
__ Sediment or nutrient transport
__ Acid mine drainage
__ Other ______________________________

20. Questions or comments

____

____

____

____

____

____

____

APPENDIX 3. EXAMPLE OUTPUT FROM 7-PARAMETER LOG-LINEAR REGRESSION MODEL USED TO ESTIMATE NUTRIENT AND SEDIMENT LOADS

MODEL FOR ESTIMATING CONSTITUENT LOADS
TIM COHN VERSION 93.05

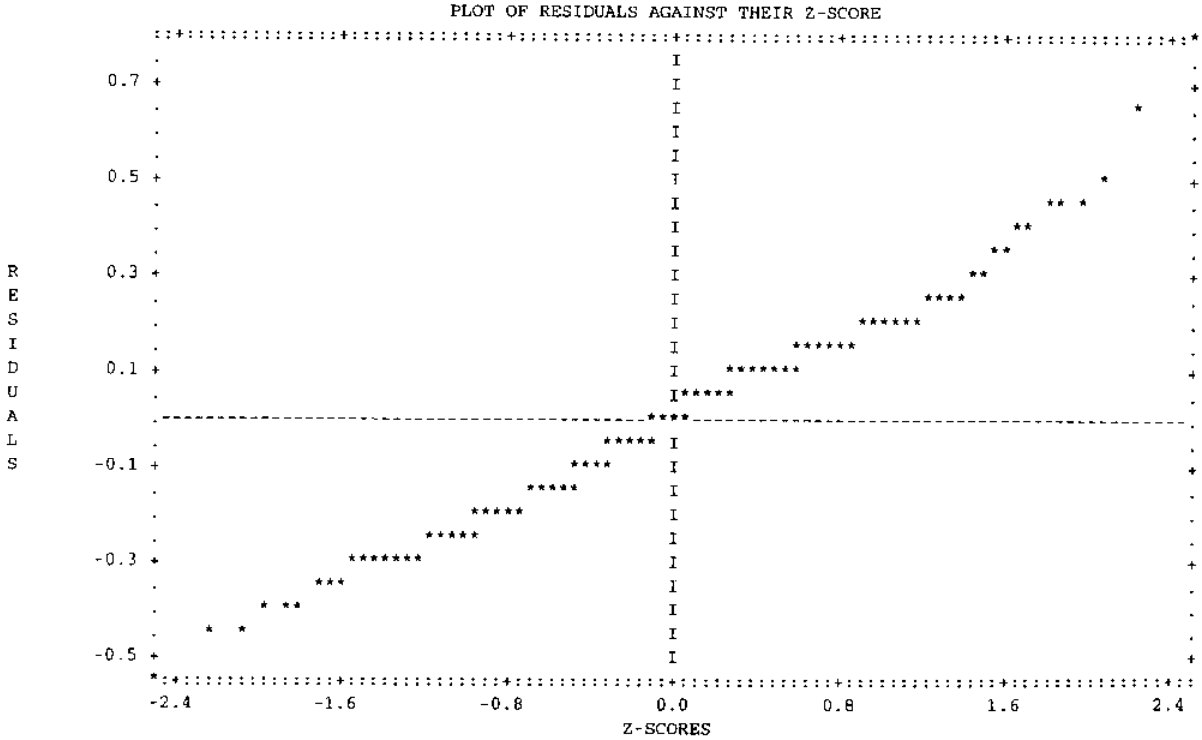
OUTPUT FILE:/hbgl/langland/ches.bay/data/model/model.out/rerun
APPROXIMATE VARIANCES
CALIBRATION FLOWS FROM DV FLOW FILE
USER SPECIFIED PERIOD: 1985.75-1989.75
DATE OF FIRST OBS. USED IN CALIBRATION: 10/24/1985
DATE OF LAST OBS. USED IN CALIBRATION: 09/22/1989
STATION NUMBER: 01575500
REGRESSION OF P00630
ON 7 REGRESSORS

			CONCENTRATION MODEL				LOAD MODEL			
NUMBER	NAME	CENTER	COEFF.	S.D.	T	P	COEFF.	S.D.	T	
1	CONSTANT	0.000	1.1211	0.0317	35.31	0.000000	7.8389	0.0317	246.90	0.0000
2	LOG-FLOW	5.823	-0.0051	0.0196	-0.26	0.789560	0.9949	0.0196	50.78	0.0000
3	LOG-FLOW SQUARED	5.823	-0.0528	0.0158	-3.35	0.000762	-0.0528	0.0158	-3.35	0.0007
4	DEC_TIME	1987.855	-0.0449	0.0176	-2.54	0.010100	-0.0449	0.0176	-2.54	0.0101
5	DEC_TIME SQUARED	1987.855	0.0351	0.0170	2.07	0.036055	0.0351	0.0170	2.07	0.0360
6	SIN(2*PI*T)	0.000	0.3120	0.0288	10.82	0.000000	0.3120	0.0288	10.82	0.0000
7	COS(2*PI*T)	0.000	0.0551	0.0279	1.98	0.044788	0.0551	0.0279	1.98	0.0447
	S			0.22299			0.22299			
	R**2 (%)			57.3			96.4			

N 167
M 160
NCENS 0
SER. CORR. OF RES. 0.49801

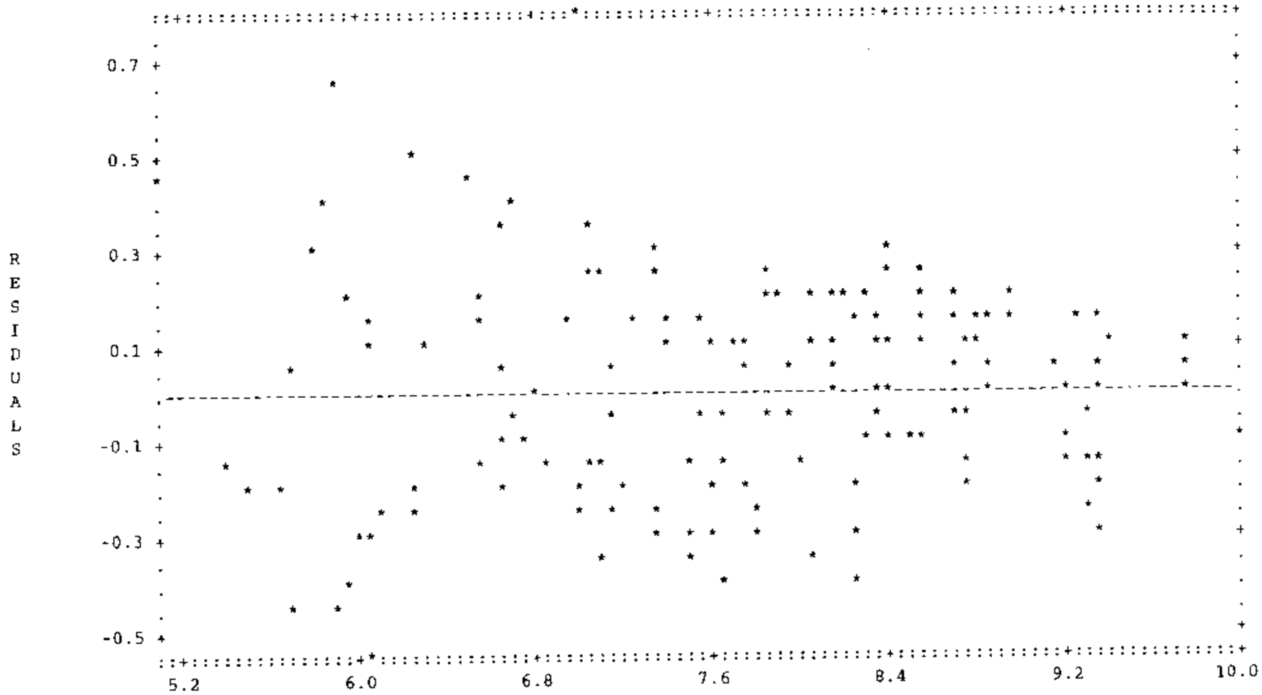
	CONSTANT	LOG-FLOW	LOG-FLOW	DEC_TIME	DEC_TIME	SIN(2*PI*
LOG-FLOW	0.0000					
LOG-FLOW	0.0000	0.0000				
DEC_TIME	0.0000	0.0665	0.2051			
DEC_TIME	0.0000	-0.0137	0.0328	0.0000		
SIN(2*PI*	0.0000	0.4743	-0.1759	0.1475	0.0568	
COS(2*PI*	0.0000	-0.0022	-0.3029	-0.2636	-0.0884	0.0740

PLOT OF RESIDUALS AGAINST THEIR Z-SCORE



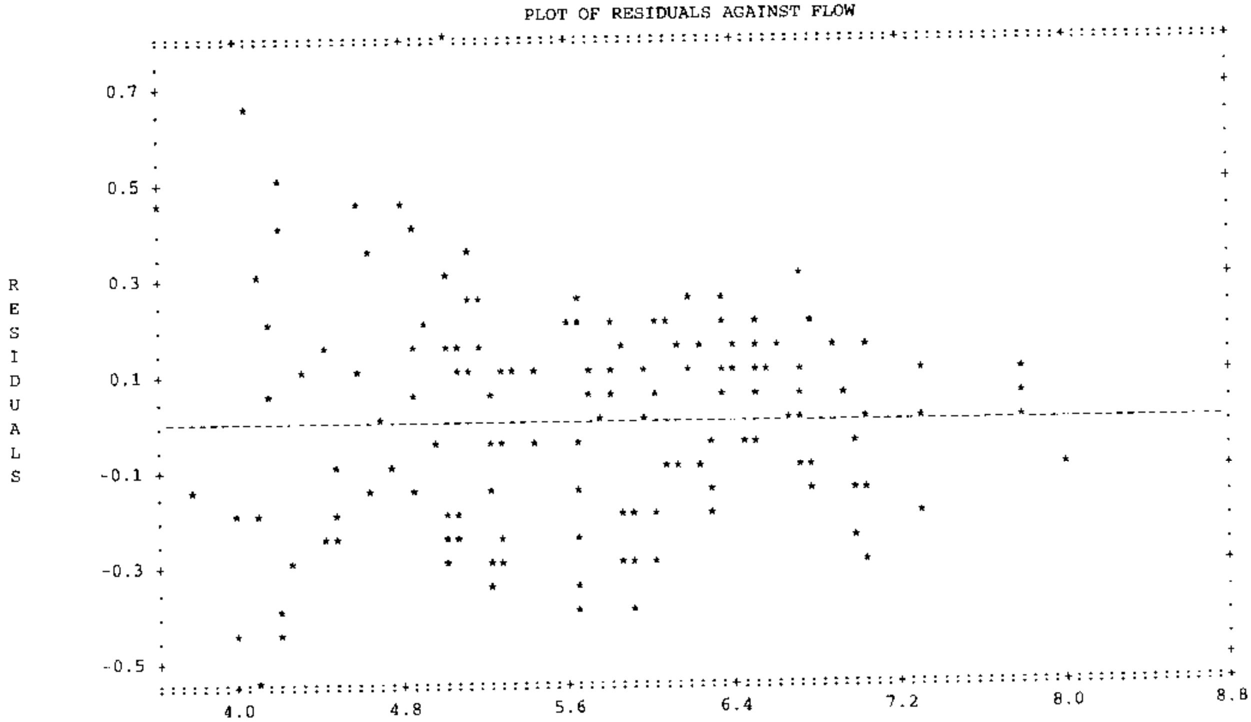
PPCC CORRELATION = 0.99101

PLOT OF RESIDUALS AGAINST PREDICTED VALUES



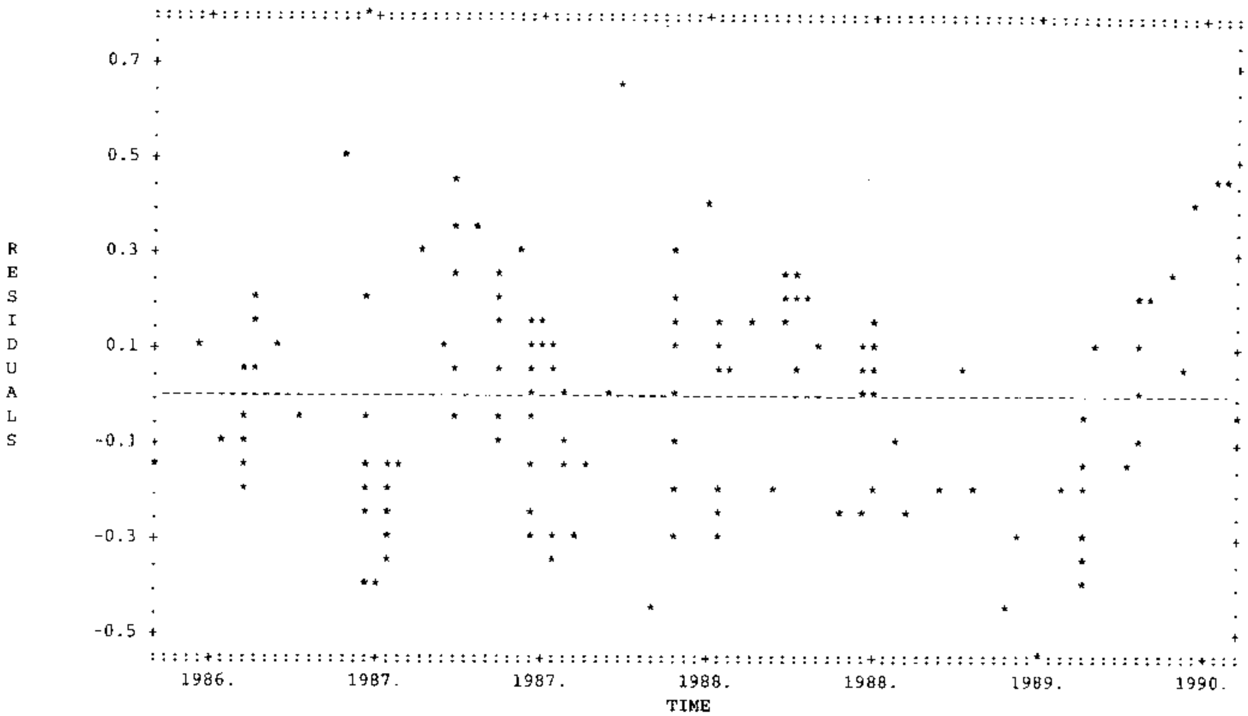
PREDICTED VALUES

PLOT OF RESIDUALS AGAINST FLOW



LOG OF FLOW

PLOT OF RESIDUALS AGAINST TIME



COMPUTED LOADS [KG/DAY] OR [G/DAY]

YEAR MO.		LOAD:P00630	S.E.	S.E. PRED.
1985 CALENDAR YEAR				
	1	1893.8955	235.2045	248.0641
	2	5670.1230	686.1372	808.0714
	3	2469.9547	271.1824	290.0292
	4	1991.4629	209.0784	230.5401
	5	2759.4766	269.9209	304.9097
	6	1151.7763	107.9963	118.8306
	7	1197.4386	102.4507	138.2845
	8	680.9838	54.9347	62.2470
	9	603.8636	44.7089	64.5313
	10	628.4970	43.7144	51.0526
	11	1764.5794	112.8979	149.3977
	12	2201.5500	129.6659	165.5437
CY 1985		1892.8756	175.9880	180.6091
WY 1985		1965.6582	216.3693	220.3421
1986 CALENDAR YEAR				
	1	1470.2527	78.0603	106.5123
	2	4856.8862	228.5473	332.7634
	3	4105.6503	184.0469	268.4612
	4	3771.8346	167.1700	254.3408
	5	1648.9157	80.0868	105.5096
	6	826.7393	41.2721	56.1586
	7	531.7982	25.4527	35.9870
	8	451.6450	19.5965	28.3976
	9	272.3994	14.6486	18.5981
	10	305.0298	15.3663	20.1976
	11	887.8485	29.6464	56.9267
	12	1972.5853	64.3226	133.2529
CY 1986		1736.4922	62.6355	70.6892

WY	1986	1855.4712	78.7501	85.4751
1987 CALENDAR YEAR				
	1	2516.6968	74.1571	137.4233
	2	2096.8047	65.8623	113.4753
	3	3089.3880	92.5220	184.1371
	4	2727.5553	99.4189	155.4620
	5	1671.9093	68.8267	100.3250
	6	807.1973	35.9963	50.3865
	7	580.9247	24.4726	38.5301
	8	286.1468	14.9179	18.9303
	9	728.3548	27.9038	53.4186
	10	481.8863	18.8393	31.0254
	11	1105.7289	43.6875	91.8428
	12	1184.1011	44.2456	67.6669
CY	1987	1435.3925	35.2500	42.4770
WY	1987	1469.4310	35.1152	42.9285
1988 CALENDAR YEAR				
	1	1681.1461	58.2788	115.4421
	2	3394.4692	112.2161	187.8205
	3	2118.9747	75.4546	118.2140
	4	1560.7819	61.8023	90.2596
	5	3998.5604	136.1870	252.9906
	6	1067.0053	42.8146	62.9816
	7	604.5615	23.4477	36.0153
	8	397.6803	16.1202	23.3031
	9	358.0504	14.9904	21.9751
	10	355.6673	16.1363	24.0661
	11	644.0938	28.2477	43.5762
	12	552.7678	27.3652	36.1390
CY	1988	1388.8733	35.9807	44.2719
WY	1988	1490.8766	38.3850	46.8202
1989 CALENDAR YEAR				
	1	1047.7935	45.8805	67.1891
	2	1226.6818	52.7079	80.8141
	3	2459.2804	96.8173	150.3199
	4	1794.6096	76.3023	109.5358
	5	5631.0881	232.9202	368.3232
	6	1620.6994	80.8806	106.3212
	7	1110.9359	59.9807	76.9918
	8	658.7571	38.1895	47.6396
	9	478.9419	31.0720	40.2125
	10	1032.7842	77.5098	101.6626
	11	1145.0560	90.9638	109.1949
	12	870.8593	71.6682	80.0451
CY	1989	1596.3911	65.6773	72.1220
WY	1989	1470.6916	52.7633	60.1728

APPENDIX 4. LIST OF SITES AND LOAD CONSTITUENTS IN THE CHESAPEAKE BAY BASIN

[All nutrients as nitrogen (N) or phosphorus (P); calculated constituent loads are represented by the shaded areas.]

Appendix 4. *List of sites and load constituents in the Chesapeake Bay Basin*

USGS flow sites	USGS or SRBC load sites	PaDER load sites (WQN)	Base load (nitrate)	Total nitrogen 00600	Total ammonia 00610	Dissolved ammonia 00608	Total nitrate 00620	Dissolved nitrate 00618	Total Kjeldahl nitrogen 00625	Dissolved Kjeldahl nitrogen 00623	Total nitrate plus nitrite 00630	Dissolved nitrate plus nitrite 00631	Total phosphorus 00665	Dissolved phosphorus 00666	Ortho-phosphorus 00671	Suspended sediment 80154
New York																
01503000	01503000	306	■		■		■						■			
01509150	01509150		■				■				■					
01520500	01520500			■	■		■		■				■			
01531000	01531000	332			■		■		■				■			
Pennsylvania																
01518000		319	■		■		■		■				■			■
01518700		324	■		■		■						■			
01520000	01520000	320	■		■		■		■				■			
01531500	01531500	305	■		■		■						■			
01532000		318	■		■		■						■			
01534000		317	■		■		■						■			
01536000	01536000	313	■		■		■		■				■			
01536500		302	■		■		■		■				■			
01537000		312	■		■		■						■			
01538000		310	■		■		■						■			
01539000		308	■		■		■						■			
01540500	01540500	301	■	■	■		■		■		■		■			■
01541000		406	■		■		■						■			
01541200		405	■		■		■						■			
01541500		422	■		■		■						■			
01543000		420	■		■		■						■			
01543500		418	■		■		■						■			
01544000		419	■		■		■						■			
01545000		434	■		■		■						■			
01545600	01545600	443		■	■	■	■		■		■	■	■			■
01546500		415	■		■		■						■			
01547500		412	■		■		■						■			
01547950		423	■		■		■						■			
01548408	01548408															■
01548500		411			■		■						■			

Appendix 4. *List of sites and load constituents in the Chesapeake Bay Basin—Continued*

USGS flow sites	USGS or SRBC load sites	PaDER load sites (WQN)	Base load (nitrate)	Total nitrogen 00600	Total ammonia 00610	Dissolved ammonia 00608	Total nitrate 00620	Dissolved nitrate 00618	Total Kjeldahl nitrogen 00625	Dissolved Kjeldahl nitrogen 00623	Total nitrate plus nitrite 00630	Dissolved nitrate plus nitrite 00631	Total phosphorus 00665	Dissolved phosphorus 00666	Ortho-phosphorus 00671	Suspended sediment 80154
Pennsylvania—Continued																
01549700		410	■		■		■						■			
01551500		402	■		■		■						■			
01552000		408			■		■						■			
01552500		407	■		■		■						■			
01553500	01553500	401	■	■	■		■		■	■	■		■			■
01553700		425	■		■		■						■			
01554000	01554000	203	■	■	■		■		■				■			■
01555000	01555000	229			■		■						■			
01558000		217	■		■		■						■			
01562000	01562000	223	■		■		■						■			
01567000	01567000	214			■		■						■			
01568000	01568000	243	■	■	■		■		■	■	■	■	■	■	■	■
01570000		213	■		■		■						■			
01570500	01570500	202	■		■		■		■		■		■			■
01571000	01571000		■	■	■	■	■		■	■	■	■	■	■	■	■
01571500		212	■		■		■		■				■	■	■	
01572000	01572000			■	■	■	■		■	■	■		■	■	■	■
01573560	01573560	211	■		■		■						■			
01573810	01573810		■	■	■	■	■		■	■	■	■	■	■	■	■
01574000	01574000	210	■		■		■						■			
01575000		209	■		■		■						■			
01575500	01575500	207	■		■		■						■			
01575585	01575585		■	■	■	■	■		■	■	■	■	■	■	■	■
01576000	01576000	201	■		■	■	■		■				■	■	■	
0157608335	0157608335		■	■	■	■	■		■	■	■	■	■	■		■
01576085	01576085		■	■	■	■	■		■	■	■	■	■	■		
01576500		205			■				■				■			
01576754	01576754	231	■	■	■	■	■		■	■	■	■	■	■	■	■
01576788	01576788			■												
01577400	01577400		■	■	■	■	■			■	■	■	■	■	■	

Appendix 4. *List of sites and load constituents in the Chesapeake Bay Basin—Continued*

USGS flow sites	USGS load sites	MDE load sites	Base load (nitrate)	Total nitrogen 00600	Total ammonia 00610	Dissolved ammonia 00608	Total nitrate 00620	Dissolved nitrate 00618	Total Kjeldahl nitrogen 00625	Dissolved Kjeldahl nitrogen 00623	Total nitrate plus nitrite 0630	Dissolved nitrate plus nitrite 00631	Total phosphorus 00665	Dissolved phosphorus 00666	Ortho-phosphorus 00671	Suspended sediment 80154
								Maryland								
01491000	01491000	CHO0626														
01493500	01493500															
01578310	01578310	SUS0109														
01583500		WGP0050														
01586000		NPA0165														
01589000		PAT0285														
01589300		GWN0115														
01589440		JON0184														
01591000	01591000	PXT0972														
01592500		PXT0809														
01593500		LXT0200														
01594000	01594000															
01594440	01594440	PXT0603														
01594526	01594526															
01594670	01594670															
01594710	01594710															
01595500		NBP0689														
01597500		SAV0037														
01599000		GEO0009														
01600000		NBP0326														
01601500		WIL0013														
01603000		NBP0196														
01610000		POT2766														
01610200	01610200															
01613000		POT2386														
01614500		CON0180														
01618000		POT1830														
01619500		ANT0044														
01637500		CAC0148														
01638500		POT1595														

Appendix 4. *List of sites and load constituents in the Chesapeake Bay Basin—Continued*

USGS flow sites	USGS load sites	MDE load sites	Base load (nitrate)	Total nitrogen 00600	Total ammonia 00610	Dissolved ammonia 00608	Total nitrate 00620	Dissolved nitrate 00618	Total Kjeldahl nitrogen 00625	Dissolved Kjeldahl nitrogen 00623	Total nitrate plus nitrite 0630	Dissolved nitrate plus nitrite 00631	Total phosphorus 00665	Dissolved phosphorus 00666	Ortho-phosphorus 00671	Suspended sediment 80154
Maryland—Continued																
01639000	01639000	MON0528		■	■	■	■	■	■	■	■	■	■	■	■	■
01639500		BPC0035		■		■		■	■			■	■		■	
01643000		MON0155		■				■	■			■	■		■	
01643000	01643020			■			■		■		■		■			
01646500		POT1184		■		■		■				■	■		■	
01646580	01646580			■	■	■	■	■	■	■	■	■	■	■	■	■
01647720	01647720															■
01649500		A7				■						■				
01650450	01650450															■

Appendix 4. *List of sites and load constituents in the Chesapeake Bay Basin—Continued*

USGS flow sites	USGS load sites	VaDER load sites	Base load (nitrate)	Total nitrogen 00600	Total ammonia 00610	Dissolved ammonia 00608	Total nitrate 00620	Dissolved nitrate 00618	Total Kjeldahl nitrogen 00625	Dissolved Kjeldahl nitrogen 00623	Total nitrate plus nitrite 0630	Dissolved nitrate plus nitrite 00631	Total phosphorus 00665	Dissolved phosphorus 00666	Ortho-phosphorus 00671	Suspended sediment 80154
Virginia																
01616000		1AABR000.78			■		■		■				■		■	
01631000		1BSSF003.56			■		■		■				■			
01625000		1BMDL001.83							■							
01634000		1BNFS010.34			■		■		■				■			
01634500		1BCDR013.29													■	
01646000		1ADIF000.86			■		■		■				■		■	
01664000	01664000	3-RPP147.10			■		■	■	■			■	■		■	
01666500		3-ROB001.90							■							
01667500		3-RAP030.21			■				■							
01668000	01668000			■		■	■	■	■			■	■	■	■	
01673000	01673000	8-PMK082.34		■	■	■	■	■	■		■	■	■	■	■	■
01674500	01674500			■		■	■	■	■			■	■	■	■	■
02012500	02012500	2-JKS036.11					■	■	■			■			■	
02013100		2-JKS023.61			■		■		■				■		■	
02016000		2-CWP002.58					■		■							
02017500		2-JOB000.39					■		■						■	
02019500	02019500						■	■				■			■	
02021500		2-MRY038.10					■		■							
02026000		2-JMS229.14					■		■				■		■	
02035000	02035000			■	■	■	■	■	■	■	■	■	■	■	■	■
02037500		2-JMS117.35					■		■				■			
02041650	02041650	2-APP016.38		■		■	■	■	■			■	■	■	■	
01657655		ST05				■			■	■			■	■	■	
01656700		ST10				■			■	■		■	■	■	■	
01656100		ST20				■			■	■		■	■	■	■	
01656650		ST30				■			■	■		■	■	■	■	
01657415		ST40				■			■	■		■	■	■	■	
01656960		ST50				■			■	■		■	■	■	■	
01656725		ST60				■			■	■		■	■	■	■	
01656500		ST70				■			■	■		■	■	■	■	

APPENDIX 5. EXAMPLE FORMAT OF NUTRIENT- AND SEDIMENT-LOAD DATABASE

Appendix 5. *Example format of nutrient- and sediment-load database*

[T, total flow; F, fixed flow; H, high-flow condition; N, normal-flow condition; L, low-flow condition]

Station identification number	Agency	Parameter	Year	Annual load (tons)	Yield (pounds per acre)	Load type	Percent error	Hydrologic condition
[redacted]								
01491000	USGS	00600	1980	246	6.80	T	2.8	H
01491000	USGS	00600	1981	129	3.57	T	2.7	L
01491000	USGS	00600	1982	185	5.12	T	2.8	L
01491000	USGS	00600	1983	302	8.34	T	3.3	H
01491000	USGS	00600	1984	356	9.83	T	3.1	H
[redacted]								
01491000	USGS	00600	1990	255	7.05	T	2.4	N
01491000	USGS	00600	1991	173	4.80	T	3.0	L
01491000	USGS	00600	1992	136	3.75	T	3.6	L
01491000	USGS	00608	1980	17.5	.49	T	16.6	H
01491000	USGS	00608	1981	6.7	.18	T	14.2	L
[redacted]								
01578310	MdMDE	00600	1986	69,700	8.03	F	6.2	N
01578310	MdMDE	00600	1987	70,900	8.18	F	3.8	L
01656960	OCCOQ	00608	1974	14.7	.92	F	20.0	L
01656960	OCCOQ	00608	1975	15.8	.99	F	20.0	H
01656960	OCCOQ	00608	1976	9.9	.62	F	18.6	L
[redacted]								
02035000	USGS	00671	1980	364	.18	T	11.6	H
02035000	USGS	00671	1981	221	.11	T	13.3	L
02035000	USGS	00671	1982	357	.18	T	19.7	N
02035000	USGS	00671	1983	229	.11	T	47.5	N
01616000	VDEQ	00625	1980	265	50.1	F	59.7	H
[redacted]								
01616000	VDEQ	00665	1981	21.1	3.99	F	15.0	N
01616000	VDEQ	00665	1982	22.5	4.27	F	10.6	H
01616000	VDEQ	00665	1983	23.0	4.36	F	11.0	H
01616000	VDEQ	00665	1984	26.4	5.00	F	12.9	H

APPENDIX 6. STATISTICAL SUMMARIES OF WATER-QUALITY CONCENTRATION DATA FOR TOTAL NITROGEN, TOTAL PHOSPHORUS, DISSOLVED NITRATE, AND SUSPENDED SEDIMENT FOR ALL 127 LOAD SITES GROUPED BY SUBBASIN

[Concentration data in milligrams per liter; n, number of samples; Min, minimum; Max, maximum; --, no data; LT, contains values reported less than the detection limit]

Appendix 6. *Statistical summaries of water-quality concentration data for total nitrogen, total phosphorus, dissolved nitrate, and suspended sediment for all 127 load sites grouped by subbasin—Continued*

Site number	n	Minimum date	Maximum date	Total nitrogen				Total phosphorus				Dissolved nitrate				Suspended sediment			
				n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max
North Branch Susquehanna																			
01503000	19	720907	750515	18	0.18	0.64	0.95	18	0.02	0.03	0.11	8	0.20	0.35	0.80	0	--	--	--
WQN0306	203	720831	920915	0	--	--	--	195	.02	.05	2.6	0	--	--	--	0	--	--	--
01509150	73	741216	801209	1	1.2	1.2	1.2	9	.01	.02	.03	0	--	--	--	1	328	328	328
01520500	114	720624	920916	45	.16	.42	4.4	45	.01	.03	.92	2	.51	.66	.80	96	1	43	7,590
01531000	78	720622	920917	56	.18	.80	1.6	52	.04	.10	.34	3	1.0	1.2	1.3	33	4	13	904
WQN0332	109	760217	920901	0	--	--	--	106	.04	.08	1.7	0	--	--	--	0	--	--	--
WQN0319	126	711116	871209	0	--	--	--	119	.01	.04	1.3	0	--	--	--	0	--	--	--
WQN0324	203	721128	920910	0	--	--	--	195	.01	.04	.91	0	--	--	--	0	--	--	--
01520000	58	711021	770916	34	.17	.42	1.4	37	.01	.04	.20	1	.58	.58	.58	34	2	10	996
WQN0320	210	720412	920910	0	--	--	--	201	.01	.06	2.0	0	--	--	--	0	--	--	--
01531500	128	721018	920914	112	.75	1.4	4.3	128	.02	.07	1.3	0	--	--	--	115	1	33	889
WQN0305	203	711116	920902	0	--	--	--	195	.02	.08	2.1	0	--	--	--	0	--	--	--
WQN0317	211	711116	920915	0	--	--	--	205	LT	.04	4.2	0	--	--	--	0	--	--	--
01536000	32	711014	760806	0	--	--	--	15	.04	.28	28	4	LT	.12	1.4	0	--	--	--
WQN0313	205	711117	920902	0	--	--	--	200	.03	.41	3.4	0	--	--	--	0	--	--	--
WQN0302	167	720726	920922	0	--	--	--	161	.02	.10	.80	0	--	--	--	0	--	--	--
WQN0312	145	711123	871207	0	--	--	--	141	.03	.44	3.8	0	--	--	--	0	--	--	--
01540500	600	711001	920916	408	.40	1.4	14	425	.01	.08	5.4	38	.10	.78	1.3	477	1	20	870
WQN0301	198	720301	920914	0	--	--	--	187	.03	.08	1.1	0	--	--	--	0	--	--	--
WQN0308	128	711130	920914	0	--	--	--	118	.01	.04	1.4	0	--	--	--	0	--	--	--
WQN0310	212	720217	920910	0	--	--	--	206	.02	.17	4.3	0	--	--	--	0	--	--	--
WQN0318	131	711116	920902	0	--	--	--	118	.01	.03	1.0	0	--	--	--	0	--	--	--

Appendix 6. *Statistical summaries of water-quality concentration data for total nitrogen, total phosphorus, dissolved nitrate, and suspended sediment for all 127 load sites grouped by subbasin—Continued*

Site number	n	Minimum date	Maximum date	Total nitrogen				Total phosphorus				Dissolved nitrate				Suspended sediment			
				n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max
								West Branch Susquehanna											
WQN0406	214	711213	920910	0	--	--	--	200	0.01	0.04	3.4	0	--	--	--	0	--	--	--
WQN0405	157	711213	871209	0	--	--	--	145	LT	.03	1.3	0	--	--	--	0	--	--	--
WQN0422	120	711213	920910	0	--	--	--	104	LT	.03	.10	0	--	--	--	0	--	--	--
WQN0420	123	711214	920902	0	--	--	--	113	LT	.03	.11	0	--	--	--	0	--	--	--
WQN0418	136	711214	920902	0	--	--	--	117	LT	.02	5.0	0	--	--	--	0	--	--	--
WQN0419	140	711214	920902	0	--	--	--	128	.01	.02	.46	0	--	--	--	0	--	--	--
01545600	184	711028	920714	42	0.20	0.58	3.2	95	LT	.01	.44	1	0.20	0.20	0.20	130	0	1	664
WQN0443	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
WQN0412	163	721031	871210	0	--	--	--	161	.02	.09	2.0	0	--	--	--	0	--	--	--
WQN0423	111	720913	920928	0	--	--	--	100	.01	.03	.59	0	--	--	--	0	--	--	--
01548408	41	771102	810318	0	--	--	--	0	--	--	--	0	--	--	--	40	0	2	235
WQN0411	69	711206	871102	0	--	--	--	65	.01	.04	2.8	0	--	--	--	0	--	--	--
WQN0410	228	711206	920902	0	--	--	--	216	.01	.04	.86	0	--	--	--	0	--	--	--
WQN0402	212	720306	920902	0	--	--	--	204	.01	.04	.46	0	--	--	--	0	--	--	--
WQN0408	229	711129	920901	0	--	--	--	212	.01	.03	5.6	0	--	--	--	0	--	--	--
01553500	515	711021	920916	309	.25	1.1	12.0	338	.01	.04	5.4	27	.14	.63	1.1	442	1	10	2,900
WQN0401	193	720928	920914	0	--	--	--	184	.01	.06	.86	0	--	--	--	0	--	--	--
WQN0425	159	720914	880105	0	--	--	--	154	.01	.06	2.5	0	--	--	--	0	--	--	--
01554000	125	720830	780920	107	.47	1.0	2.1	111	.01	.05	.41	1	.59	.59	.59	70	2	17	605
WQN0203	147	720302	920916	0	--	--	--	137	.02	.07	.45	0	--	--	--	0	--	--	--
WQN0229	125	720912	920916	0	--	--	--	119	.02	.04	.35	0	--	--	--	0	--	--	--
WQN0407	168	711129	871202	0	--	--	--	158	.01	.04	2.5	0	--	--	--	0	--	--	--
WQN0415	222	720302	920914	0	--	--	--	218	.02	.17	4.4	0	--	--	--	0	--	--	--
WQN0434	120	720913	920902	0	--	--	--	113	.01	.03	.64	0	--	--	--	0	--	--	--

Appendix 6. *Statistical summaries of water-quality concentration data for total nitrogen, total phosphorus, dissolved nitrate, and suspended sediment for all 127 load sites grouped by subbasin—Continued*

Site number	n	Minimum date	Maximum date	Total nitrogen				Total phosphorus				Dissolved nitrate				Suspended sediment			
				n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max
Juniata River																			
WQN0217	223	720815	920903	0	--	--	--	219	0.03	0.16	1.6	0	--	--	--	0	--	--	--
01562000	167	720111	920818	66	0.08	1.6	3.6	82	.01	.04	.36	15	0.10	1.6	2.4	93	1	9	339
WQN0223	219	720111	920908	0	--	--	--	215	.01	.06	.45	0	--	--	--	0	--	--	--
01567000	371	711002	920914	267	.14	1.9	3.7	294	.01	.08	.50	9	.63	1.1	11	303	1	35	699
WQN0214	192	711014	920909	0	--	--	--	186	.02	.08	2.1	0	--	--	--	0	--	--	--
Lower Susquehanna																			
01568000	210	750925	891120	187	.70	2.0	6.5	201	.01	.07	1.7	0	--	--	--	208	1	24	1,530
WQN0243	131	730321	920908	0	--	--	--	127	.01	.04	.33	0	--	--	--	0	--	--	--
WQN0213	230	711014	920908	0	--	--	--	220	.02	.08	.93	0	--	--	--	0	--	--	--
01570500	1,006	711019	920819	593	.30	1.6	4.5	620	.01	.07	.62	177	.06	.98	3.8	809	1	49	594
WQN0202	144	720502	920908	0	--	--	--	134	.02	.06	.55	0	--	--	--	0	--	--	--
01571000	359	841019	920926	254	.30	1.9	6.7	265	.01	.14	1.6	13	.52	.63	1.2	340	1	191	13,300
WQN0212	220	711014	920909	0	--	--	--	213	.02	.07	1.8	1	1.2	1.2	1.2	0	--	--	--
01572000	749	800128	840906	54	.35	1.5	3.8	58	.01	.05	.54	50	.33	1.4	3.3	749	1	12	3,260
01573560	221	841022	920925	212	2.2	4.0	14	218	.02	.10	.92	12	1.4	1.8	3.9	220	1	39	963
WQN0211	233	711103	920908	0	--	--	--	226	.03	.13	1.7	0	--	--	--	0	--	--	--
01573810	1,245	850927	920706	623	1.7	6.9	1,500	624	.04	1.0	66	8	1.7	5.5	14	985	LT	105	17,400
01574000	263	720803	891213	246	.54	3.4	8.6	259	.04	.25	13	9	1.2	1.6	1.9	249	1	66	1,130
WQN0210	222	711015	920910	0	--	--	--	216	.04	.18	2.4	0	--	--	--	0	--	--	--
WQN0209	152	711015	871222	0	--	--	--	147	.03	.10	2.3	0	--	--	--	0	--	--	--
01575500	206	841019	891213	194	2.6	4.6	16	204	.04	.15	2.2	1	2.4	2.3	2.4	203	3	40	3,690
WQN0207	224	711015	920910	0	--	--	--	217	.02	.28	4.3	0	--	--	--	0	--	--	--
01575585	432	841019	891213	430	2.1	5.0	13	432	.05	.28	3.5	0	--	--	--	430	3	189	2,980
01576000	215	720201	920917	198	.60	1.8	4.4	211	.02	.08	.52	0	--	--	--	203	1	50	441
WQN0201	172	711104	920916	0	--	--	--	168	.02	.08	.85	14	.02	.92	1.7	0	--	--	--

Appendix 6. *Statistical summaries of water-quality concentration data for total nitrogen, total phosphorus, dissolved nitrate, and suspended sediment for all 127 load sites grouped by subbasin—Continued*

Site number	n	Minimum date	Maximum date	Total nitrogen				Total phosphorus				Dissolved nitrate				Suspended sediment			
				n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max
Lower Susquehanna—Continued																			
0157608335	1,198	840308	910925	679	0.95	9.3	80	680	0.08	1.9	24	189	0.02	5.9	11	910	3	470	28,400
01576085	1,707	820519	920926	1,118	.56	9.4	62	1,129	.04	1.5	17	312	.04	4.3	14	1,248	4	506	34,300
WQN0205	166	711104	871221	0	--	--	--	165	.03	.21	.99	0	--	--	--	0	--	--	--
01576754	671	841022	920917	660	2.8	7.9	30	663	.08	.50	5.2	14	4.2	5.2	8.2	653	1	209	8,710
WQN0231	225	711104	920916	0	--	--	--	222	.05	.40	1.8	0	--	--	--	0	--	--	--
01576788	126	790522	860902	77	.48	3.4	6.8	76	.01	.06	.81	79	.02	2.5	5.0	84	1	50	1,510
01577400	516	851031	900927	263	.30	6.1	61	266	.02	.54	24	0	--	--	--	430	LT	172	15,100
01578310	685	780129	920902	562	.30	1.8	6.6	573	.01	.05	1.5	345	.33	1.2	4.7	607	1	17	454
SUS0109	220	740401	931214	92	1.0	1.8	3.6	199	.01	.06	.48	212	.14	1.1	9.3	0	--	--	--
Choptank River																			
01491000	550	711001	920924	348	.59	1.7	3.8	369	.01	.07	.91	225	.19	1.0	3.2	457	1	10	1,360
01493500	83	730720	910530	0	--	--	--	70	.03	.08	.64	6	1.5	1.7	3.0	0	--	--	--
CHO0626	225	740326	931209	83	.24	1.8	2.4	194	.02	.07	2.5	209	.03	1.0	3.1	0	--	--	--
Patuxent River																			
01591000	284	850904	920928	242	.15	2.8	14	235	.01	.06	3.2	222	LT	2.3	3.7	150	1	21	2,850
PXT0972	218	740403	931206	93	1.2	2.8	4.2	195	.01	.05	.92	207	.15	2.0	3.6	0	--	--	--
01594000	173	850905	920928	140	.03	2.3	6.4	136	LT	.06	1.5	134	.49	1.4	2.9	140	1	20	1,980
01594440	541	780130	920927	399	1.0	3.0	8.4	404	.04	.21	1.5	335	.17	2.0	6.8	496	4	43	1,110
PXT0603	784	660111	931215	318	1.4	3.2	8.4	666	.02	.37	2.1	651	.15	2.3	6.4	0	--	--	--
01594526	336	851009	920930	306	.33	1.0	3.2	315	.03	.10	2.3	308	LT	.37	1.4	97	1	45	857
01594670	130	851017	920929	103	.20	.64	6.3	102	.01	.11	1.2	94	.02	.12	2.0	108	1	18	131
01594710	314	851008	920929	210	.30	1.8	10	203	.01	.20	3.4	205	.02	.65	2.3	259	1	200	8,660
LXT0200	91	660110	820811	0	--	--	--	76	.01	.07	1.9	72	.06	.94	2.2	0	--	--	--
PXT0809	341	680715	931206	95	.66	1.7	3.7	314	.01	.04	1.8	320	.02	.62	2.0	0	--	--	--

Appendix 6. *Statistical summaries of water-quality concentration data for total nitrogen, total phosphorus, dissolved nitrate, and suspended sediment for all 127 load sites grouped by subbasin—Continued*

Site number	n	Minimum date	Maximum date	Total nitrogen n	Total nitrogen Min	Total nitrogen Median	Total nitrogen Max	Total phosphorus n	Total phosphorus Min	Total phosphorus Median	Total phosphorus Max	Dissolved nitrate n	Dissolved nitrate Min	Dissolved nitrate Median	Dissolved nitrate Max	Suspended sediment n	Suspended sediment Min	Suspended sediment Median	Suspended sediment Max
Western Chesapeake Basin																			
GWN0115	244	740326	931214	92	1.1	2.0	3.6	217	0.01	0.05	1.6	234	0.06	1.5	3.6	0	--	--	--
JON0184	316	740305	931214	93	1.5	2.2	4.8	263	.01	.04	1.6	289	.04	1.5	4.6	0	--	--	--
NPA0165	282	690616	931214	92	2.2	4.2	5.8	252	.01	.05	4.1	271	.04	3.0	5.7	0	--	--	--
PAT0285	215	660829	931214	91	1.1	3.0	4.4	190	.01	.10	.81	204	.04	1.9	4.2	0	--	--	--
WGP0050	139	690708	830503	0	--	--	--	133	.01	.05	8.0	132	.05	1.6	2.9	0	--	--	--
Upper Potomac																			
01610200	158	720215	791114	0	--	--	--	LT	--	--	--	31	LT	.40	1.2	134	LT	107	2,640
ANT0044	238	660321	931201	93	4.6	5.9	7.6	204	.01	.24	1.6	220	.02	4.4	6.9	0	--	--	--
CON0180	209	740318	931215	86	3.5	5.2	7.6	189	.01	.18	.74	200	.04	3.8	6.0	0	--	--	--
GEO0009	322	740326	931206	82	.82	1.7	2.8	232	.01	.08	2.4	231	.02	.90	2.8	0	--	--	--
NBP0196	136	660726	850911	0	--	--	--	88	.01	.08	8.3	115	LT	.64	1.5	0	--	--	--
NBP0326	355	660726	931207	85	.98	1.4	2.2	247	.01	.08	1.4	236	.01	.59	2.8	0	--	--	--
NBP0689	318	740327	931206	84	.85	1.5	3.2	191	LT	.04	1.6	222	.03	.57	1.9	0	--	--	--
POT1184	243	690915	931207	92	.59	2.0	3.0	221	.01	.08	2.3	224	.02	1.2	9.8	0	--	--	--
POT1830	251	740318	931201	96	.32	2.0	3.8	204	.01	.06	.83	227	.05	1.3	61	0	--	--	--
POT2386	204	740318	931215	87	.53	1.2	4.6	152	.01	.06	1.5	178	.04	.68	4.6	0	--	--	--
POT2766	331	740416	931207	84	.41	1.1	2.2	226	.01	.06	1.3	233	.03	.60	2.7	0	--	--	--
SAV0037	113	740326	850910	0	--	--	--	59	.01	.03	.60	108	.09	.70	1.4	0	--	--	--
WIL0013	319	740326	931207	80	.31	1.3	2.6	198	.01	.04	1.5	228	.02	.65	1.9	0	--	--	--
1AABR000.78	171	760825	920916	0	--	--	--	119	.10	.80	1.8	LT	--	--	--	0	--	--	--
1ADIF000.86	219	720706	920902	0	--	--	--	49	.01	.10	.30	LT	--	--	--	0	--	--	--

Appendix 6. *Statistical summaries of water-quality concentration data for total nitrogen, total phosphorus, dissolved nitrate, and suspended sediment for all 127 load sites grouped by subbasin—Continued*

Site number	n	Minimum date	Maximum date	Total nitrogen				Total phosphorus				Dissolved nitrate				Suspended sediment			
				n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max
Lower Potomac																			
01639000	317	711029	920902	239	0.46	2.2	5.2	244	0.01	0.22	0.91	95	0.09	1.4	4.8	80	2	63	460
MON0528	236	660321	931201	91	.44	2.7	7.0	203	.02	.16	1.1	218	.01	1.4	6.0	0	--	--	--
01643020	212	711026	920725	123	.23	2.9	4.9	139	.07	.21	.77	25	1.6	2.3	3.1	32	10	341	2,410
01646580	802	730102	920901	304	.23	1.7	9.8	310	LT	.08	2.2	212	.04	1.3	4.5	531	1	35	2,990
01647720	82	711124	750927	0	--	--	--	0	--	--	--	0	--	--	--	82	8	244	2,400
01650450	58	711124	740820	0	--	--	--	0	--	--	--	0	--	--	--	58	41	428	2,010
A7	144	850514	921215	0	--	--	--	27	.01	.08	.37	27	.20	1.1	24	0	--	--	--
BPC0035	204	660321	931201	92	2.1	4.2	7.5	175	LT	.07	1.5	191	.30	2.9	6.8	0	--	--	--
CAC0148	219	671017	931201	90	.58	1.8	4.0	200	.02	.11	.60	205	.07	1.1	4.8	0	--	--	--
MON0155	195	780724	931201	89	2.2	3.8	7.6	169	.03	.21	1.2	176	.15	2.4	5.4	0	--	--	--
POT1595	242	690916	931201	90	1.1	2.3	4.3	214	.02	.09	2.9	213	.01	1.4	3.9	0	--	--	--
ST05	267	741125	820419	0	--	--	--	260	.01	.05	.33	0	--	--	--	0	--	--	--
ST10	708	730207	921130	0	--	--	--	690	.01	.05	.67	0	--	--	--	0	--	--	--
ST20	706	730207	921130	0	--	--	--	691	.01	.05	.70	0	--	--	--	0	--	--	--
ST30	629	741125	921130	0	--	--	--	583	.01	.04	.81	0	--	--	--	0	--	--	--
ST40	711	730208	921130	0	--	--	--	662	.01	.05	1.6	0	--	--	--	0	--	--	--
ST50	719	730206	921130	0	--	--	--	678	.01	.06	2.4	0	--	--	--	0	--	--	--
ST60	715	730101	921130	0	--	--	--	650	.01	.03	.86	0	--	--	--	0	--	--	--
ST70	502	780712	921207	0	--	--	--	426	.01	.03	.14	0	--	--	--	0	--	--	--
Shenandoah River																			
1BCDR013.29	190	740509	920915	0	--	--	--	21	.1	.1	.4	0	--	--	--	0	--	--	--
1BMDL001.83	140	790430	920914	0	--	--	--	103	.1	.2	.8	0	--	--	--	0	--	--	--
1BNFS010.34	209	711019	920915	0	--	--	--	63	.1	.1	.4	0	--	--	--	0	--	--	--
1BSSF003.56	216	711118	920915	0	--	--	--	106	.1	.2	4.0	0	--	--	--	0	--	--	--

Appendix 6. *Statistical summaries of water-quality concentration data for total nitrogen, total phosphorus, dissolved nitrate, and suspended sediment for all 127 load sites grouped by subbasin—Continued*

Site number	n	Minimum date	Maximum date	Total nitrogen				Total phosphorus				Dissolved nitrate				Suspended sediment			
				n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max
Rappahannock River																			
01664000	197	711001	860616	0	--	--	--	0	--	--	--	154	LT	0.49	1.0	5	10	300	1,280
3-RPP147.10	236	711003	920914	0	--	--	--	40	0.10	0.10	0.6	0	--	--	--	0	--	--	--
01668000	433	711001	920925	316	0.1	1	3.6	315	.01	.05	1.1	270	LT	.60	1.1	145	1	6	718
3-RAP030.21	139	740909	870617	0	--	--	--	24	.10	.10	.3	0	--	--	--	0	--	--	--
3-ROB001.90	215	730409	920929	0	--	--	--	39	.10	.10	.7	0	--	--	--	0	--	--	--
York River																			
01673000	486	711001	920925	336	.26	.66	3.0	340	.01	.06	.39	296	LT	.21	1.1	184	1	10	890
8-PMK082.34	358	790808	920925	0	--	--	--	281	.02	.08	.40	202	.06	.22	.66	0	--	--	--
01674500	293	790410	920924	271	.10	.59	2.8	267	.01	.05	1.2	164	.04	.13	.87	117	1	7	129
James River																			
02012500	197	711001	860514	0	--	--	--	0	--	--	--	164	LT	.18	1.80	0	--	--	--
2-JKS036.11	103	790717	880615	0	--	--	--	24	.10	.10	.30	0	--	--	--	0	--	--	--
02019500	202	711001	860516	0	--	--	--	0	--	--	--	171	LT	.20	.72	4	2	14.5	19
02035000	789	711001	920929	479	.04	.72	3.7	496	LT	.12	1.5	414	LT	.29	1.1	387	1	16.0	1,700
02041650	295	771228	920923	259	.10	.56	3.5	259	.01	.04	.15	153	.04	.16	.53	131	2	8.0	69
2-APP016.38	139	890706	920923	0	--	--	--	139	.01	.05	.30	129	.04	.16	.53	0	--	--	--
2-CWP002.58	198	711021	910702	1	7.5	7.5	7.5	26	.10	.10	.50	0	--	--	--	0	--	--	--
2-JKS023.61	172	790717	920917	0	--	--	--	139	.10	.80	6.5	0	--	--	--	0	--	--	--
2-JMS117.35	230	711005	920922	0	--	--	--	94	.04	.10	.60	0	--	--	--	0	--	--	--
2-JMS229.14	261	711021	920922	0	--	--	--	126	.10	.20	.96	0	--	--	--	0	--	--	--
2-JOB000.39	98	790717	911104	0	--	--	--	12	.10	.10	.60	0	--	--	--	0	--	--	--
2-MRY038.10	209	711021	920903	0	--	--	--	23	.10	.10	.20	0	--	--	--	0	--	--	--

APPENDIX 7. MEAN ANNUAL YIELDS FOR 13 NUTRIENT AND SUSPENDED-SEDIMENT CONSTITUENTS BASED UPON HYDROLOGIC CONDITION FOR ALL 127 LOAD BASINS

[H, high flow; N, normal flow; L, low flow; --, no yield; yields in pounds per acre]

Appendix 7. *Mean annual yields for 13 nutrient and suspended-sediment constituents based upon hydrologic condition for all 127 load basins*

Station	Hydrologic characteristic	Total nitrogen	Dissolved ammonia	Dissolved nitrate	Total nitrate	Dissolved organic plus ammonia	Total organic plus ammonia	Total nitrate plus nitrite	Dissolved nitrate plus nitrite	Total phosphorus	Dissolved phosphorus	Ortho-phosphorus	Suspended sediment	Total ammonia	Dissolved nitrite
01491000	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.31	5.15	0.63	0.18	0.17	188	--	--
01491000	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.41	2.84	.15	.06	.04	28.8	--	--
[illegible]	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.16	.30	.10	.08	69.2	--	--
01493500	H	--	--	--	5.33	--	--	5.37	--	--	--	--	--	--	--
01493500	L	--	--	--	3.11	--	--	3.12	--	--	--	--	--	--	--
01493500	N	--	--	--	3.98	--	--	3.98	--	--	--	--	--	--	--
01503000	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.66	--	--	--	0.69	--
01503000	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.26	--	--	--	.17	--
01503000	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.37	--	--	--	.20	--
01509150	H	--	--	--	4.52	--	--	4.46	--	--	--	--	--	--	--
01509150	L	--	--	--	2.74	--	--	2.72	--	--	--	--	--	--	--
01509150	N	--	--	--	4.25	--	--	4.29	--	--	--	--	--	--	--
01518000	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.56	--	--	[illegible]	.59	--
01518000	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.23	--	--	96.8	.32	--
01518000	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.34	--	--	--	.50	--
01518700	H	--	--	--	3.25	--	--	--	--	.42	--	--	--	.50	--
01518700	L	--	--	--	1.84	--	--	--	--	.20	--	--	--	.26	--
01518700	N	--	--	--	1.96	--	--	--	--	.22	--	--	--	.28	--
01520000	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.54	--	--	--	.49	--
01520000	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.19	--	--	--	.25	--
[illegible]	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.29	--	--	--	.34	--
01520500	H	2.10	--	--	2.00	--	1.52	--	--	.33	--	--	--	.46	--
01520500	L	--	--	--	--	--	--	--	--	.11	--	--	--	--	--
01520500	N	1.47	--	--	1.89	--	1.50	--	--	.19	--	--	--	.43	--
01531000	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.43	--	--	--	.19	--
01531000	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.29	--	--	--	.20	--
[illegible]	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.37	--	--	--	.20	--
01531500	H	8.38	.31	--	5.69	2.36	4.06	4.22	--	.76	.17	.07	411	1.37	--
01531500	L	4.35	.24	--	3.14	.71	1.21	3.67	--	.32	.15	.02	123	.57	--
01531500	N	6.18	.23	--	3.88	1.71	2.69	3.50	--	.40	.14	.05	229	.53	--
01532000	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.38	--	--	--	.25	--
01532000	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	--	--	--	.10	--
[illegible]	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	--	--	--	.23	--
01534000	H	--	--	--	4.54	--	--	--	--	.70	--	--	--	.52	--
01534000	L	--	--	--	2.16	--	--	--	--	.22	--	--	--	.14	--
01534000	N	--	--	--	2.70	--	--	--	--	.30	--	--	--	.16	--

Appendix 7. *Mean annual yields for 13 nutrient and suspended-sediment constituents based upon hydrologic condition for all 127 load basins—Continued*

Station	Hydrologic characteristic	Total nitrogen	Dissolved ammonia	Dissolved nitrate	Total nitrate	Dissolved organic plus ammonia	Total organic plus ammonia	Total nitrate plus nitrite	Dissolved nitrate plus nitrite	Total phosphorus	Dissolved phosphorus	Ortho-phosphorus	Suspended sediment	Total ammonia	Dissolved nitrite
01536000	H	--	--	--	4.39	--	3.15	--	--	[illegible]	--	--	--	[illegible]	--
01536000	L	--	--	--	3.41	--	5.38	--	--	1.17	--	--	--	1.01	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.18	--	--	--	.73	--
01536500	H	--	--	--	4.19	--	7.66	--	--	.95	--	--	--	1.17	--
01536500	L	--	--	--	2.69	--	2.94	--	--	.39	--	--	--	.49	--
01536500	N	--	--	--	3.54	--	4.02	--	--	.58	--	--	--	.65	--
01537000	H	--	--	--	4.89	--	--	--	--	[illegible]	--	--	--	[illegible]	--
01537000	L	--	--	--	2.73	--	--	--	--	1.19	--	--	--	2.13	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.45	--	--	--	2.34	--
01538000	H	--	--	--	5.57	--	--	--	--	.74	--	--	--	.98	--
01538000	L	--	--	--	4.08	--	--	--	--	.66	--	--	--	.64	--
01538000	N	--	--	--	4.59	--	--	--	--	.82	--	--	--	.75	--
01539000	L	--	--	--	[illegible]	--	--	--	--	[illegible]	--	--	--	[illegible]	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
01540500	H	9.04	0.50	--	4.92	4.21	4.35	4.69	5.04	.76	0.13	0.08	1,080	.71	--
01540500	L	5.11	.23	--	2.85	1.60	2.62	2.77	3.04	.34	.08	.04	215	.31	--
01540500	N	6.98	.41	--	3.80	3.92	3.78	3.92	3.98	.50	.11	.10	460	.52	--
01541000	H	--	--	--	7.07	--	--	--	--	[illegible]	--	--	--	[illegible]	--
01541000	L	--	--	--	3.78	--	--	--	--	.35	--	--	--	.31	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.61	--	--	--	.52	--
01541200	H	--	--	--	6.15	--	--	--	--	.34	--	--	--	.97	--
01541200	L	--	--	--	4.02	--	--	--	--	.17	--	--	--	.36	--
01541200	N	--	--	--	4.90	--	--	--	--	.31	--	--	--	.60	--
01541500	L	--	--	--	[illegible]	--	--	--	--	[illegible]	--	--	--	[illegible]	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.21	--	--	--	.53	--
01543000	H	--	--	--	2.66	--	--	--	--	.24	--	--	--	.11	--
01543000	L	--	--	--	1.90	--	--	--	--	.14	--	--	--	.10	--
01543000	N	--	--	--	2.35	--	--	--	--	.16	--	--	--	.09	--
01543500	L	--	--	--	1.77	--	--	--	--	[illegible]	--	--	--	[illegible]	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.19	--	--	--	.15	--
01544000	H	--	--	--	--	--	--	--	--	.18	--	--	--	.48	--
01544000	L	--	--	--	--	--	--	--	--	.14	--	--	--	.14	--
01544000	N	--	--	--	--	--	--	--	--	.16	--	--	--	.25	--
01545000	H	--	--	--	3.33	--	--	--	--	[illegible]	--	--	--	[illegible]	--
01545000	L	--	--	--	1.82	--	--	--	--	.31	--	--	--	.09	--
[illegible]	[illegible]	[illegible]	2.30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.13	--	--	--	.11	--

Appendix 7. *Mean annual yields for 13 nutrient and suspended-sediment constituents based upon hydrologic condition for all 127 load basins—Continued*

Station	Hydrologic characteristic	Total nitrogen	Dissolved ammonia	Dissolved nitrate	Total nitrate	Dissolved organic plus ammonia	Total organic plus ammonia	Total nitrate plus nitrite	Dissolved nitrate plus nitrite	Total phosphorus	Dissolved phosphorus	Ortho-phosphorus	Suspended sediment	Total ammonia	Dissolved nitrite
01545600	H	5.11	0.10	--	1.68	--	3.00	1.65	1.73	0.09	--	--	31.6	0.08	--
01545600	L	3.00	.06	--	1.33	--	1.20	1.25	1.34	.04	--	--	111	.06	--
01545600	N	4.06	.07	--	1.69	--	1.55	1.58	1.66	.06	--	--	148	.07	--
01546500	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	1.26	--	--	[illegible]	.63	[illegible]
01546500	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.47	--	--	--	.37	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.48	--	--	--	.414	--
01547500	H	--	--	--	7.97	--	--	--	--	.65	--	--	--	1.24	--
01547500	L	--	--	--	5.90	--	--	--	--	.35	--	--	--	.57	--
01547500	N	--	--	--	8.24	--	--	--	--	.50	--	--	--	.77	--
01547950	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.11	--	--	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.15	--	--	--	.10	--
01548408	L	--	--	--	--	--	--	--	--	--	--	--	295	--	--
01548500	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	--	--	[illegible]	[illegible]	[illegible]
01548500	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.16	--	--	--	.13	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.21	--	--	--	.16	--
01549700	H	--	--	--	6.26	--	--	--	--	.35	--	--	--	.28	--
01549700	L	--	--	--	1.44	--	--	--	--	.14	--	--	--	.08	--
01549700	N	--	--	--	2.28	--	--	--	--	.21	--	--	--	.14	--
01551500	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	--	[illegible]	[illegible]	[illegible]	[illegible]
01551500	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.27	--	--	--	.20	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.43	--	--	--	.29	--
01552000	H	--	--	--	4.46	--	--	--	--	.24	--	--	--	.19	--
01552000	L	--	--	--	2.36	--	--	--	--	.19	--	--	--	.12	--
01552000	N	--	--	--	3.17	--	--	--	--	.22	--	--	--	.14	--
01552500	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.64	--	[illegible]	[illegible]	[illegible]	[illegible]
01552500	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.28	--	--	--	.13	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.34	--	--	--	.17	--
01553500	H	7.82	--	--	4.08	2.03	4.00	4.08	--	.41	--	--	778	.48	--
01553500	L	4.91	--	--	2.75	1.26	2.06	2.80	--	.21	--	--	164	.23	--
01553500	N	6.12	--	--	3.34	1.60	2.67	3.38	--	.28	--	--	235	.30	--
01553700	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	1.50	--	[illegible]	[illegible]	[illegible]	[illegible]
01553700	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.48	--	--	--	1.28	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.81	--	--	--	1.55	--
01554000	H	6.65	--	--	4.55	--	3.34	--	--	.65	--	--	930	.74	--
01554000	L	--	--	--	2.76	--	--	--	--	.27	--	--	--	.25	--
01554000	N	--	--	--	3.35	--	--	--	--	.40	--	--	--	.32	--

Appendix 7. *Mean annual yields for 13 nutrient and suspended-sediment constituents based upon hydrologic condition for all 127 load basins—Continued*

Station	Hydrologic characteristic	Total nitrogen	Dissolved ammonia	Dissolved nitrate	Total nitrate	Dissolved organic plus ammonia	Total organic plus ammonia	Total nitrate plus nitrite	Dissolved nitrate plus nitrite	Total phosphorus	Dissolved phosphorus	Ortho-phosphorus	Suspended sediment	Total ammonia	Dissolved nitrite
01555000	H	--	--	--	13.7	--	--	--	--	0.30	--	--	--	0.12	--
01555000	L	--	--	--	5.44	--	--	--	--	.18	--	--	--	.12	--
01555000	N	--	--	--	9.48	--	--	--	--	.26	--	--	--	.12	--
01558000	H	--	--	--	8.08	--	--	--	--	1.24	--	--	--	1.03	--
01558000	L	--	--	--	5.33	--	--	--	--	.73	--	--	--	.43	--
01558000	N	--	--	--	6.58	--	--	--	--	.90	--	--	--	.63	--
01562000	H	10.2	0.12	--	8.71	--	[illegible]	[illegible]	[illegible]	[illegible]	0.08	[illegible]	[illegible]	[illegible]	--
01562000	L	4.65	.05	--	4.34	--	2.04	--	--	[illegible]	.02	.02	2,250	.31	--
01562000	N	[illegible]	--	--	6.34	--	[illegible]	--	--	.59	--	--	--	.26	--
01567000	H	--	--	--	7.22	--	--	--	--	.56	--	--	--	.58	--
01567000	L	--	--	--	3.74	--	--	--	--	.30	--	--	--	.18	--
01567000	N	--	--	--	5.62	--	--	--	--	.42	--	--	--	.44	--
01568000	H	14.7	--	--	7.41	3.50	6.49	8.84	5.28	.58	.19	.26	800	[illegible]	--
01568000	L	6.13	--	--	4.08	1.12	1.62	4.38	3.34	.20	.10	.09	152	.15	--
01568000	N	9.01	--	--	5.85	2.23	3.50	5.57	5.94	.35	.14	.07	334	.38	--
01570000	H	--	--	--	14.8	--	--	--	--	1.13	--	--	--	.73	--
01570000	L	--	--	--	10.1	--	--	--	--	.21	--	--	--	.26	--
01570000	N	--	--	--	13.0	--	--	--	--	.27	--	--	--	.33	--
01570500	H	--	--	--	8.99	--	3.17	3.89	[illegible]	[illegible]	--	[illegible]	912	.86	--
01570500	L	--	--	--	3.07	--	2.15	3.05	--	.33	--	--	205	.20	--
01570500	N	--	--	--	4.54	--	2.89	3.56	--	.41	--	--	306	.26	--
01571000	H	9.48	.17	--	5.02	1.59	3.78	5.14	4.83	.61	.18	.05	--	--	--
01571000	L	4.62	.07	--	1.72	1.03	2.58	1.58	1.29	.10	.03	.03	528	.12	--
01571000	N	8.00	.21	--	3.66	2.42	4.52	3.70	3.70	.80	.17	.07	2,450	.28	--
01571500	H	--	--	--	10.0	--	--	--	--	.20	--	--	--	[illegible]	--
01571500	L	--	--	--	5.67	--	1.12	--	--	.28	.22	.04	--	.14	--
01571500	N	--	--	--	7.87	--	1.73	--	--	.38	.24	.14	--	.20	--
01572000	H	19.3	1.07	11.4	12.3	4.46	6.23	13.5	--	1.27	.28	.07	1,360	1.04	--
01572000	N	4.52	.36	8.19	8.80	3.96	4.43	4.71	--	.53	.20	.06	441	.43	--
01573560	H	--	--	--	19.5	[illegible]	[illegible]	[illegible]	[illegible]	1.08	[illegible]	[illegible]	[illegible]	1.55	--
01573560	L	14.5	.52	--	11.4	2.20	5.33	10.7	--	.49	.19	.41	360	.50	--
01573560	N	19.6	.66	--	16.3	[illegible]	3.99	14.5	--	.59	.28	.13	868	.56	--
01573810	H	51.5	12.8	--	25.2	26.5	29.9	26.8	27.3	9.38	6.96	6.16	1,750	12.0	--
01573810	L	32.5	6.50	--	13.3	14.8	19.7	15.3	14.7	6.59	3.58	3.51	1,160	7.43	--
01573810	N	39.5	10.4	--	19.7	21.2	22.4	20.5	20.1	6.33	5.79	5.66	1,250	9.75	--

Appendix 7. *Mean annual yields for 13 nutrient and suspended-sediment constituents based upon hydrologic condition for all 127 load basins—Continued*

Station	Hydrologic characteristic	Total nitrogen	Dissolved ammonia	Dissolved nitrate	Total nitrate	Dissolved organic plus ammonia	Total organic plus ammonia	Total nitrate plus nitrite	Dissolved nitrate plus nitrite	Total phosphorus	Dissolved phosphorus	Ortho-phosphorus	Suspended sediment	Total ammonia	Dissolved nitrite
01574000	H	[illegible]	[illegible]	[illegible]	14.9	[illegible]	[illegible]	--	--	2.28	--	--	--	2.56	--
01574000	L	10.2	[illegible]	[illegible]	[illegible]	[illegible]	3.68	6.96	--	.71	0.46	0.33	--	.48	--
01574000	N	12.7	[illegible]	[illegible]	10.8	[illegible]	4.69	8.25	--	.97	.54	.37	--	.79	--
01575000	H	--	--	--	15.6	--	--	--	--	.74	--	--	--	.67	--
01575000	L	--	--	--	10.5	--	--	--	--	.23	--	--	--	.39	--
01575000	N	--	--	--	14.5	--	--	--	--	.31	--	--	--	.49	--
01575500	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	--	2.17	--	--	--	2.66	--
01575500	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9.35	--	.58	.21	.14	502	1.27	--
01575500	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	--	.60	--	--	--	1.50	--
01575585	N	16.3	1.84	--	9.66	4.31	6.78	9.67	12.2	.95	.32	.24	516	2.03	--
01576000	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	--	1.02	.12	.05	--	.70	--
01576000	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	--	.31	.16	.04	--	.26	--
01576000	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	--	.52	.14	.02	--	.38	--
0157608335	H	32.7	1.30	17.8	17.2	5.18	15.9	18.0	18.2	5.94	1.22	--	3,830	2.08	--
0157608335	L	18.9	.50	11.9	9.55	3.87	9.25	9.22	12.4	2.92	.80	--	1,290	1.55	--
0157608335	N	25.4	1.64	14.4	13.9	4.96	12.1	14.5	14.9	4.53	1.32	--	1,950	2.22	--
01576085	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	27.5	26.0	8.60	2.69	--	--	3.29	--
01576085	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.7	[illegible]	.86	--	--	1.26	--
01576085	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	22.6	4.80	1.22	--	--	3.07	--
01576500	H	--	--	--	34.4	--	9.10	--	--	1.38	--	--	--	1.38	--
01576500	L	--	--	--	15.6	--	2.63	--	--	.54	--	--	--	.43	--
01576500	N	--	--	--	27.1	--	5.39	--	--	.84	--	--	--	.79	--
01576754	H	38.2	1.22	--	30.5	4.50	8.48	29.2	27.8	2.60	1.47	1.14	1,600	1.20	--
01576754	L	24.1	[illegible]	--	[illegible]	[illegible]	[illegible]	20.0	19.7	1.29	.66	.46	379	1.19	--
01576754	N	35.1	1.66	[illegible]	28.4	[illegible]	5.80	27.6	27.2	2.06	1.12	.80	902	1.58	--
01577400	H	30.9	--	--	14.2	17.2	17.9	15.0	12.3	4.77	--	--	--	4.68	--
01577400	L	20.8	.70	--	9.24	3.42	12.5	8.37	8.48	1.50	.48	.42	--	1.71	--
01577400	N	22.1	.87	--	13.3	3.84	8.40	13.7	13.9	2.23	.70	.62	--	1.52	--
01578310	H	10.2	[illegible]	7.10	[illegible]	[illegible]	2.49	6.65	7.09	.52	.14	.11	330	.67	0.10
01578310	L	6.75	[illegible]	4.79	[illegible]	[illegible]	[illegible]	4.50	4.82	.22	.08	.04	79.2	.35	.09
01578310	N	8.68	[illegible]	6.01	[illegible]	[illegible]	2.62	5.79	6.06	.30	.10	.06	120	.44	.09
01583500	H	--	--	8.68	--	1.16	--	--	8.74	--	--	--	--	--	.02
01583500	L	--	--	4.50	--	.80	--	--	4.48	--	--	--	--	--	.03
01583500	N	--	--	5.33	--	.69	--	--	5.13	--	--	--	--	--	.07

Appendix 7. *Mean annual yields for 13 nutrient and suspended-sediment constituents based upon hydrologic condition for all 127 load basins—Continued*

Station	Hydrologic characteristic	Total nitrogen	Dissolved ammonia	Dissolved nitrate	Total nitrate	Dissolved organic plus ammonia	Total organic plus ammonia	Total nitrate plus nitrite	Dissolved nitrate plus nitrite	Total phosphorus	Dissolved phosphorus	Ortho-phosphorus	Suspended sediment	Total ammonia	Dissolved nitrite
01586000	H	[illegible]	0.56	10.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
01586000	L	[illegible]	.34	8.20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
01589000	H	--	.62	4.61	--	--	--	--	4.67	--	--	0.68	--	--	0.07
01589000	L	3.89	.18	2.90	--	--	--	--	2.90	--	--	.14	--	--	.03
01589300	H	--	--	5.43	--	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.88	--	--	.05
01589300	L	--	--	3.50	--	--	1.54	[illegible]	3.52	--	--	.10	--	--	.09
[illegible]	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
01589440	H	--	--	7.67	--	3.32	--	--	7.65	.82	--	.56	--	--	.13
01589440	L	4.75	.10	4.05	--	1.08	1.10	--	4.02	.21	--	.12	--	--	.03
01589440	N	8.31	.12	6.11	--	1.94	2.17	--	6.09	.44	--	.26	--	--	.06
01591000	H	--	1.24	8.66	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.06	270	--	.02
01591000	L	7.28	.21	5.40	5.86	--	[illegible]	[illegible]	[illegible]	[illegible]	--	.12	814	--	.05
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
01592500	H	5.79	.64	3.21	--	--	2.74	--	3.33	--	--	.04	--	--	.06
01592500	L	1.93	.13	1.11	--	--	.68	--	1.15	--	--	.01	--	--	.02
01592500	N	3.64	.24	2.63	--	--	1.32	--	2.75	--	--	.02	--	--	.05
01593500	H	[illegible]	.47	--	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	--
01593500	L	[illegible]	.12	--	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
01594000	H	15.7	1.19	6.10	6.03	3.65	12.7	6.07	6.80	6.55	0.38	.15	--	--	--
01594000	L	5.47	.14	3.74	3.78	.97	2.22	3.82	4.03	.62	.14	.05	650	--	--
01594000	N	11.4	.17	6.08	6.03	1.59	4.04	6.06	6.42	.96	.20	.07	933	--	--
01594440	H	12.4	2.10	7.60	7.28	3.29	[illegible]	[illegible]	[illegible]	[illegible]	.28	.56	131	--	.16
01594440	L	7.56	1.12	5.02	4.88	2.26	2.58	[illegible]	[illegible]	[illegible]	.18	[illegible]	269	--	.10
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
01594526	L	2.15	.15	1.03	1.00	.88	1.14	.95	1.07	.34	.09	.02	323	--	--
01594526	N	3.28	.19	1.66	1.70	1.38	1.97	1.54	1.60	.40	.13	.06	216	--	--
01594670	H	3.81	.29	.86	.87	1.93	[illegible]	[illegible]	[illegible]	[illegible]	.04	.02	43.4	--	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.03	.58	.29	.23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
01594710	H	9.20	.32	3.92	3.92	2.30	5.74	3.92	3.92	2.08	.28	.10	2,310	--	--
01594710	L	4.34	.14	2.58	2.56	.89	1.82	2.54	2.54	.55	.10	.04	537	--	--
01594710	N	5.76	.22	3.39	3.44	1.68	2.36	3.38	3.38	.70	.22	.07	257	--	--
01595500	H	--	--	--	--	--	--	[illegible]	4.19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.02
01595500	L	--	--	3.42	--	--	--	[illegible]	3.04	[illegible]	--	--	--	--	.02
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.62	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.02

Appendix 7. *Mean annual yields for 13 nutrient and suspended-sediment constituents based upon hydrologic condition for all 127 load basins—Continued*

Station	Hydrologic characteristic	Total nitrogen	Dissolved ammonia	Dissolved nitrate	Total nitrate	Dissolved organic plus ammonia	Total organic plus ammonia	Total nitrate plus nitrite	Dissolved nitrate plus nitrite	Total phosphorus	Dissolved phosphorus	Ortho-phosphorus	Suspended sediment	Total ammonia	Dissolved nitrite
01597500	H	--	--	3.51	--	--	--	--	3.54	0.22	--	--	--	--	0.03
01597500	L	--	--	2.96	--	--	--	--	2.98	.22	--	--	--	--	.02
01597500	N	--	--	3.94	--	--	--	--	3.95	.24	--	--	--	--	.02
01599000	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	5.20	.41	--	0.08	--	--	.04
01599000	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	3.57	.44	--	.07	--	--	.04
01599000	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	2.35	.07	--	--	--	--	.02
01600000	H	--	1.01	4.18	--	--	--	--	4.21	.53	--	--	--	--	.04
01600000	L	--	--	2.70	--	--	--	--	2.89	.11	--	--	--	--	.04
01600000	N	--	1.44	3.11	--	--	--	--	3.14	.61	--	--	--	--	.06
01601500	H	--	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	7.70	.45	--	.07	--	--	.05
01601500	L	--	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	4.62	.41	--	.04	--	--	.04
01601500	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	5.10	.26	--	.03	--	--	.04
01603000	H	--	--	5.48	--	3.49	--	4.86	5.49	1.24	--	.03	--	--	.02
01603000	L	--	--	3.96	--	2.01	--	3.25	3.98	1.12	--	.04	--	--	.02
01603000	N	--	--	3.84	--	2.43	--	3.34	3.86	.89	--	.20	--	--	.03
01610000	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	3.68	.32	--	.08	--	--	.04
01610000	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	2.32	.52	--	.06	--	--	.04
01610000	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	2.72	.44	--	.06	--	--	.04
01610200	H	--	--	--	--	--	--	--	--	--	--	--	1,930	--	--
01610200	N	--	--	--	--	--	--	--	--	--	--	--	1,040	--	--
01613000	H	[illegible]	.29	4.46	[illegible]	[illegible]	[illegible]	--	4.48	--	--	--	--	--	.06
01613000	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	2.23	--	--	--	--	--	.03
01613000	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	3.41	--	--	--	--	--	.04
01614500	H	--	--	20.6	--	--	--	--	20.7	--	--	--	--	--	.12
01614500	L	12.7	--	11.0	--	--	--	--	11.0	--	--	.28	--	--	.06
01614500	N	18.1	--	15.2	--	--	--	--	15.2	--	--	.39	--	--	.08
[illegible]	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	--	4.30	--	3.93	--	17.7	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	--	3.99	--	3.70	--	10.1	--
01618000	H	7.31	.42	4.87	--	--	3.64	--	4.93	.54	--	.19	--	--	.07
01618000	L	5.35	.14	3.69	--	--	1.21	--	3.68	.21	--	.08	--	--	.04
01618000	N	7.18	.25	4.60	--	--	2.22	--	4.63	.37	--	.13	--	--	.06
01619500	H	[illegible]	.35	21.8	[illegible]	[illegible]	[illegible]	--	24.0	--	--	.83	--	--	.28
01619500	L	14.5	.21	12.5	[illegible]	[illegible]	1.91	--	12.8	--	--	.42	--	--	.12
01619500	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	14.8	--	--	.59	--	--	.15
01625000	H	--	--	--	--	--	.97	--	--	--	--	--	--	--	--
01625000	N	--	--	--	--	--	1.10	--	--	--	--	--	--	--	--

Appendix 7. *Mean annual yields for 13 nutrient and suspended-sediment constituents based upon hydrologic condition for all 127 load basins—Continued*

Station	Hydrologic characteristic	Total nitrogen	Dissolved ammonia	Dissolved nitrate	Total nitrate	Dissolved organic plus ammonia	Total organic plus ammonia	Total nitrate plus nitrite	Dissolved nitrate plus nitrite	Total phosphorus	Dissolved phosphorus	Ortho-phosphorus	Suspended sediment	Total ammonia	Dissolved nitrite
01631000	H	--	--	5.30	3.23	--	0.72	--	--	0.32	--	0.55	--	0.43	--
01631000	L	--	--	2.84	2.64	--	--	--	2.66	--	--	.32	--	.14	--
01631000	N	--	--	3.84	3.41	--	.52	--	4.46	.22	--	.42	--	.22	--
01634000	H	--	--	--	3.61	--	1.38	--	--	.39	--	--	--	.21	--
01634000	L	--	--	--	3.19	--	.70	--	--	.31	--	--	--	.11	--
01634500	H	--	--	--	1.33	--	--	--	--	--	--	.15	--	--	--
01634500	L	--	--	--	.48	--	--	--	--	--	--	.04	--	--	--
01637500	H	--	--	15.3	--	--	--	--	15.2	--	--	--	--	--	0.08
01637500	L	7.04	--	6.31	--	--	--	--	6.30	--	--	.12	--	--	.04
01637500	N	8.110	--	7.72	--	--	--	--	7.68	--	--	.17	--	--	.05
01638500	H	7.05	0.43	5.46	--	2.35	3.09	--	5.40	.51	--	.41	--	--	.07
01638500	L	3.31	.12	3.76	--	1.16	1.66	--	[illegible]	.24	--	.15	--	--	.04
01638500	N	6.78	.22	4.68	--	1.56	2.30	--	4.60	.36	--	.21	--	--	.05
01639000	H	13.5	1.76	11.9	9.61	--	4.70	9.23	12.19	.92	--	1.10	--	1.12	.14
01639000	L	8.53	.52	7.48	6.32	1.82	2.45	6.78	7.40	.36	0.23	.33	147	.52	.07
01639000	N	12.3	.61	13.0	9.38	2.50	3.84	9.66	10.7	.64	.44	.56	339	.62	.09
01639500	H	--	--	16.2	--	--	--	--	16.4	--	--	1.09	--	--	.14
01639500	L	11.3	.22	8.74	--	--	2.23	--	[illegible]	[illegible]	--	.31	--	--	.06
01639500	N	15.1	.32	11.5	--	--	2.84	--	11.5	--	--	.42	--	--	.09
01643000	H	--	1.85	12.2	--	--	--	--	12.2	--	--	1.02	--	--	.19
01643000	L	10.8	.59	7.53	--	--	3.02	--	7.52	--	--	.36	--	--	.09
01643000	N	13.1	.58	10.4	--	--	3.19	--	10.4	--	--	.54	--	--	.10
01643020	H	15.0	--	--	8.82	--	5.96	8.89	--	1.11	--	--	--	--	--
01643020	L	7.97	--	--	5.26	--	1.94	5.26	--	.44	--	--	--	--	--
01643020	N	8.73	--	--	6.59	--	5.61	6.72	--	1.05	--	--	--	--	--
01646000	L	--	--	--	2.44	--	2.54	--	--	.31	--	.23	--	.14	--
01646000	N	--	.20	--	3.11	--	2.81	--	-	.62	--	.44	--	.22	--
01646500	H	--	.47	5.35	--	2.72	--	--	5.39	--	--	.32	--	--	.06
01646500	L	5.15	.12	4.11	--	1.38	1.58	--	4.08	--	--	.11	--	--	.04
01646500	N	6.75	.22	5.09	--	1.46	2.15	--	5.06	--	--	.26	--	--	.05
01646580	H	9.89	.17	6.86	7.07	1.74	3.55	6.72	6.78	.80	.21	.12	902	.40	--
01646580	L	3.45	.16	2.10	2.11	.76	1.43	2.14	2.15	.27	.09	.06	143	.18	--
01647720	H	--	--	--	--	--	--	--	--	--	--	--	2,410	--	--
01647720	L	--	--	--	--	--	--	--	--	--	--	--	670	--	--

Appendix 7. *Mean annual yields for 13 nutrient and suspended-sediment constituents based upon hydrologic condition for all 127 load basins—Continued*

Station	Hydrologic characteristic	Total nitrogen	Dissolved ammonia	Dissolved nitrate	Total nitrate	Dissolved organic plus ammonia	Total organic plus ammonia	Total nitrate plus nitrite	Dissolved nitrate plus nitrite	Total phosphorus	Dissolved phosphorus	Ortho-phosphorus	Suspended sediment	Total ammonia	Dissolved nitrite
01649500	H	--	1.25	--	--	--	--	--	4.00	--	--	--	--	--	--
01649500	L	--	.74	--	--	--	--	--	2.78	--	--	--	--	--	--
01649500	N	--	.98	--	--	--	--	--	3.40	--	--	--	--	--	--
01650450	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	--	--	--	--	4,620	--	--
01656100	H	--	.56	--	--	3.12	5.34	--	8.14	0.74	0.51	0.21	--	--	--
01656100	L	--	.15	--	--	1.20	1.75	--	2.61	.23	.16	.07	--	--	--
01656100	N	--	.33	--	--	1.93	3.54	--	5.37	.40	.27	.12	--	--	--
01656500	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.05	.12	.09	.30	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	3.60	.23	.16	.11	--	--	--
01656650	H	--	.48	--	--	2.57	3.63	--	1.87	.39	.21	.11	--	--	--
01656650	L	--	.18	--	--	1.07	1.65	--	.89	.15	.06	.05	--	--	--
01656700	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.38	.30	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.44	.15	--	--	--
01656725	H	--	.25	--	--	2.28	2.99	--	20.4	.25	.18	.10	--	--	--
01656725	L	--	.09	--	--	.78	1.15	--	4.52	.10	.06	.04	--	--	--
01656725	N	--	.25	--	--	1.76	2.69	--	12.0	.21	.16	.09	--	--	--
01656960	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	3.16	[illegible]	.28	.16	--	--	--
01656960	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	2.03	.28	.11	.19	--	--	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	1.56	.09	.10	.03	--	--	--
01657415	H	--	1.00	--	--	3.30	3.96	--	5.00	.38	.37	.18	--	--	--
01657415	L	--	.70	--	--	1.45	2.13	--	2.88	.35	.37	.23	--	--	--
01657415	N	--	.41	--	--	1.99	2.69	--	5.42	.14	.18	.04	--	--	--
01657655	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	1.28	.42	.25	.14	--	--	--
01657655	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	.30	.10	.06	.04	--	--	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	[illegible]	.28	.14	.08	--	--	--
01664000	H	--	--	2.97	3.05	--	--	--	3.08	--	--	.05	--	--	--
01664000	L	--	--	1.86	1.50	--	1.28	--	2.15	.28	--	.04	--	0.13	--
01664000	N	--	--	2.28	1.95	--	1.17	--	2.08	.48	--	.04	--	.18	--
01666500	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	--	--	--	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--	--	--	--	--	--	--	--
01667500	H	--	--	--	--	--	.96	--	--	--	--	--	--	.39	--
01667500	L	--	--	--	--	--	.72	--	--	--	--	--	--	.13	--
01667500	N	--	--	--	--	--	.68	--	--	--	--	--	--	.22	--

Appendix 7. *Mean annual yields for 13 nutrient and suspended-sediment constituents based upon hydrologic condition for all 127 load basins—Continued*

Station	Hydrologic characteristic	Total nitrogen	Dissolved ammonia	Dissolved nitrate	Total nitrate	Dissolved organic plus ammonia	Total organic plus ammonia	Total nitrate plus nitrite	Dissolved nitrate plus nitrite	Total phosphorus	Dissolved phosphorus	Ortho-phosphorus	Suspended sediment	Total ammonia	Dissolved nitrite
01668000	H	--	--	3.06	--	--	--	--	--	--	--	--	--	--	--
01668000	L	3.45	0.13	1.62	1.46	--	2.02	--	1.72	0.52	0.08	0.04	--	--	--
01668000	N	4.40	.17	2.17	2.00	--	2.82	--	2.16	.77	.07	.06	--	--	--
01673000	H	2.80	.17	.79	.83	--	1.98	0.92	.79	.33	.07	.11	154	0.22	--
01673000	L	1.34	.10	.38	.40	--	.93	.38	.42	.17	.05	.05	107	--	--
01673000	N	2.56	.16	.73	.58	--	1.75	.35	.62	.40	.20	.11	843	--	--
01674500	H	2.16	.15	.64	.62	--	1.54	--	.63	.20	.05	.05	61.4	--	--
01674500	L	.88	.06	.20	.21	--	.67	--	.21	.10	.02	.02	18.9	--	--
02012500	H	--	--	1.47	.68	--	.83	--	1.01	--	--	--	--	--	--
02012500	L	--	--	.90	.74	--	.30	--	1.20	--	--	.03	--	--	--
02012500	N	--	--	1.39	1.34	--	.67	--	1.93	--	--	.08	--	--	--
02013100	H	--	--	--	.61	--	.89	--	--	--	--	--	--	--	--
02013100	L	--	--	--	.44	--	.86	--	--	1.43	--	1.35	--	.16	--
02013100	N	--	--	--	1.01	--	1.39	--	--	.76	--	.67	--	.57	--
02016000	H	--	--	--	.79	--	3.10	--	--	--	--	--	--	--	--
02016000	L	--	--	--	.25	--	.40	--	--	--	--	--	--	--	--
02016000	N	--	--	--	.85	--	.69	--	--	--	--	--	--	--	--
02017500	H	--	--	--	.55	--	1.58	--	--	--	--	.18	--	--	--
02017500	L	--	--	--	.29	--	.70	--	--	--	--	.05	--	--	--
02017500	N	--	--	--	.70	--	.77	--	--	--	--	.12	--	--	--
02019500	H	--	--	1.27	.82	--	--	--	.88	--	--	.24	--	--	--
02019500	L	--	--	1.10	1.26	--	--	--	1.34	--	--	.86	--	--	--
02021500	H	--	--	--	.50	--	1.08	--	--	--	--	--	--	--	--
02026000	H	--	--	--	1.66	--	1.28	--	--	.50	--	.28	--	--	--
02026000	L	--	--	--	.41	--	.56	--	--	.17	--	.11	--	--	--
02026000	N	--	--	--	1.04	--	1.05	--	--	.43	--	.30	--	--	--
02035000	H	4.41	.17	1.57	1.60	1.54	2.97	1.78	1.28	.97	.28	.22	806	.30	--
02035000	L	2.09	.10	.93	.83	1.18	1.27	.91	.85	.32	.15	.18	197	.15	--
02035000	N	4.73	.20	1.06	1.28	--	3.55	--	.96	1.54	.32	.34	634	--	--
02037500	H	--	--	--	1.08	--	1.72	--	--	.47	--	--	--	.17	--
02037500	N	--	--	--	.83	--	1.44	--	--	.36	--	--	--	.13	--
02041650	L	1.06	.09	.33	.36	--	.76	--	1.32	.09	.02	.02	--	--	--
02041650	N	1.99	.14	.94	.91	--	1.28	--	.73	.16	.04	.04	--	--	--

APPENDIX 8. SIMPLE STATISTICS FROM THE CORRELATION ANALYSIS RELATING MEAN ANNUAL NUTRIENT AND SEDIMENT YIELDS FROM NORMAL FLOW YEARS TO LAND USE, PHYSIOGRAPHIC PROVINCE, AND ROCK TYPE USING THE KENDALL TAU STATISTIC

Constituents: TN, total nitrogen; DNH4, dissolved ammonia; DNO3, dissolved nitrate; TNO3, total nitrate; DKN, dissolved Kjeldahl nitrogen; TKN, total Kjeldahl nitrogen; TNO32, total nitrate plus nitrite; DNO32, dissolved nitrate plus nitrite; TP, total phosphorus; DP, dissolved phosphorus; OP, orthophosphorus; SED, suspended sediment; TNH4, total ammonia; DNO2, dissolved nitrite.

Land use: FOREST, forest; AG, agricultural; HERBURB, herbaceous urban; WATER, water; EXPOSD, exposed; WETLND, wetland; URBAN, urban.

Physiographic province: APPL, Appalachian Plateau; APMN, Appalachian Mountain Section; GV, Great Valley Section; BR, Blue Ridge; RP, Reading Prong Section; MELO, Mesozoic Lowlands Section; PDLO, Piedmont Lowlands Section; PDUP, Piedmont Upland Section; CP, Coastal Plain.

Rock type: CARB, carbonate; SIL, siliciclastic; CRYST, crystalline; UNC, unconsolidated.

LT: contains values reported less than the detection limit.

Appendix 8. *Simple statistics from the correlation analysis relating mean annual nutrient and sediment yields from normal flow years to land use, physiographic province, and rock type using the Kendall tau statistic*

Variable	Number	Mean	Standard deviation	Median	Minimum	Maximum
[redacted]						
TKN	70	3.58	3.91	2.68	.52	22.4
TNO32	29	7.70	6.39	5.57	.35	27.6
DNO32	54	6.72	5.68	5.08	.62	27.2
TP	102	.68	.95	.401	.06	6.33
DP	33	.48	1.01	.20	.04	5.79
[redacted]						
AG	125	34.2	19.5	31.5	4.00	92.2
HERBURB	121	2.54	3.57	1.00	LT	19.6
WATER	110	.58	.47	.50	LT	2.30
EXPOSD	102	.46	1.00	.10	LT	4.70
WETLND	44	.05	.067	LT	LT	.20
[redacted]						
RP	111	.03	.22	LT	LT	1.90
MELO	111	10.1	22.9	LT	LT	100
PDLO	111	3.11	13.9	LT	LT	100
PDUP	121	21.6	35.7	LT	LT	100
CP	118	6.42	23.2	LT	LT	100
[redacted]						

APPENDIX 9. STATION, BASIN AREA, AND PERCENTAGE OF LAND USE, ROCK TYPE, AND PHYSIOGRAPHIC PROVINCE FOR ALL 127 LOAD SITES

[--, no data]

Appendix 9. *Station, basin area, and percentage of land use, rock type, and physiographic province for all 127 load sites*

Station number	Area	Land use: Agri-culture	Land use: Forest	Land use: Urban	Land use: Herba-ceous urban	Land use: Exposed	Land use: Wetland	Land use: Water	Rock type: Carbonate	Rock type: Silici-clastic	Rock type: Crystalline	Rock type: Uncon-solidated	Physiographic province: Appalachian Plateau	Physiographic province: Appalachian Mountain Section	Physiographic province: Great Valley	Physiographic province: Blue Ridge	Physiographic province: Reading Prong Section	Physiographic province: Mesozoic Lowlands Section	Physiographic province: Piedmont Lowlands Section	Physiographic province: Piedmont Upland Section	Physiographic province: Coastal Plain
01491000	113	54.8	42.4	[illegible]	2.2	0	.02	[illegible]	0	0	0	100	0	0	0	0	0	0	0	0	100.0
01493500	12.6	92.2	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	0	0	100	0	0	0	0	0	0	0	0	100.0
01503000	2,230	[illegible]	[illegible]	[illegible]	1.3	0	[illegible]	[illegible]	[illegible]	80	0	0	100.0	0	0	0	0	0	0	0	0
01509150	10.3	[illegible]	56.9	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	30	0	0	100.0	0	0	0	0	0	0	0	0
01518000	282	[illegible]	62.6	2.9	[illegible]	.2	0	[illegible]	0	100	0	0	100.0	0	0	0	0	0	0	0	0
01518700	446	31.0	64.9	2.8	.3	.1	0	.9	0	100	0	0	100.0	0	0	0	0	0	0	0	0
01520000	298	31.6	65.9	1.9	.4	0	0	.4	0	100	0	0	100.0	0	0	0	0	0	0	0	0
01520500	770	25.3	68.7	5.3	.5	0	0	.3	0	100	0	0	100.0	0	0	0	0	0	0	0	0
01531000	2,530	32.6	61.3	4.6	.9	0	0	.7	0	100	0	0	100.0	0	0	0	0	0	0	0	0
01531500	7,800	34.7	59.6	3.9	1.0	0	0	.9	9	91	0	0	100.0	0	0	0	0	0	0	0	0
01532000	215	29.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100	0	0	100.0	0	0	0	0	0	0	0	0
01534000	383	35.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100	0	0	99.5	.5	0	0	0	0	0	0	0
01536000	332	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0	43.2	56.8	0	0	0	0	0	0	0
01536500	9,960	35.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0	55.2	44.8	0	0	0	0	0	0	0
01537000	32.4	20.0	[illegible]	[illegible]	[illegible]	.5	[illegible]	[illegible]	[illegible]	100	0	0	0	100.0	0	0	0	0	0	0	0
01538000	43.8	11.7	73.7	11.5	1.1	.4	0	1.6	0	100	0	0	0	100.0	0	0	0	0	0	0	0
01539000	274	30.1	68.9	.5	.1	0	0	.3	0	100	0	0	23.9	76.1	0	0	0	0	0	0	0
01540500	11,200	33.4	59.6	4.7	1.0	.2	0	1.0	6	93	0	0	48.4	51.6	0	0	0	0	0	0	0
01541000	315	15.5	77.6	1.9	.4	4.3	0	.3	98	0	0	0	100.0	0	0	0	0	0	0	0	0
01541200	367	14.4	78.1	1.9	.4	4.5	0	.6	0	99	0	0	100.0	0	0	0	0	0	0	0	0
01541500	371	9.6	83.8	[illegible]	.2	[illegible]	[illegible]	[illegible]	[illegible]	100	0	0	100.0	0	0	0	0	0	0	0	0
01543000	272	5.6	[illegible]	[illegible]	.2	.2	[illegible]	[illegible]	[illegible]	100	0	0	100.0	0	0	0	0	0	0	0	0
01543500	685	6.1	[illegible]	[illegible]	.1	.5	0	[illegible]	[illegible]	99	0	0	100.0	0	0	0	0	0	0	0	0
01544000	245	6.9	[illegible]	[illegible]	.2	0	0	[illegible]	[illegible]	100	0	0	100.0	0	0	0	0	0	0	0	0
01545000	233	4.6	[illegible]	[illegible]	0	0	0	.4	[illegible]	100	0	0	100.0	0	0	0	0	0	0	0	0
01545600	46.2	4.0	95.9	0	0	0	0	0	0	100	0	0	100.0	0	0	0	0	0	0	0	0
01546500	87.2	50.4	31.8	13.9	3.9	.2	0	.1	83	16	0	0	0	100.0	0	0	0	0	0	0	0
01547500	339	32.4	59.5	5.6	1.5	.1	0	.9	45	56	0	0	4.4	95.6	0	0	0	0	0	0	0
01547950	152	29.6	68.2	1.6	.1	0	0	.5	0	100	0	0	100.0	0	0	0	0	0	0	0	0
01548408	12.0	51.8	47.4	.8	0	0	0	0	0	100	0	0	100.0	0	0	0	0	0	0	0	0
01548500	604	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	100	0	0	100.0	0	0	0	0	0	0	0	0
01549700	944	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	100	0	0	100.0	0	0	0	0	0	0	0	0
01551500	5,680	12.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0	47.0	53.0	0	0	0	0	0	0	0
01552000	443	17.0	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	100	0	0	98.6	1.4	0	0	0	0	0	0	0
01552500	23.8	16.7	[illegible]	[illegible]	0	0	0	[illegible]	[illegible]	100	0	0	100.0	0	0	0	0	0	0	0	0

Appendix 9. *Station, basin area, and percentage of land use, rock type, and physiographic province for all 127 load sites—Continued*

Station number	Area	Land use							Rock type				Physiographic province								
		Agri-culture	Forest	Urban	Herba-ceous urban	Exposed	Wetland	Water	Carbonate	Silici-clastic	Crystalline	Uncon-solidated	Appalachian Plateau	Appalachian Mountain Section	Great Valley	Blue Ridge	Reading Prong Section	Mesozoic Lowlands Section	Piedmont Lowlands Section	Piedmont Upland Section	Coastal Plain
01553500	6,847	15.1	80.8	1.8	0.3	1.2	0	0.7	5	95	0	0	33.6	66.4	0	0	0	0	0	0	0
01553700	51.3	70.8	26.7	1.1	.2	.4	0	.8	6	94	0	0	0	100.0	0	0	0	0	0	0	0
01554000	18,300	26.9	67.2	3.7	.8	.6	0	.9	6	94	0	0	65.0	35.0	0	0	0	0	0	0	0
01555000	301	31.8	66.9	.6	.4	0	0	.4	24	76	0	0	0	100.0	0	0	0	0	0	0	0
01558000	220	16.0	77.3	5.6	.7	.2	0	.2	21	78	0	0	24.3	75.7	0	0	0	0	0	0	0
01562000	756	30.7	66.8	1.3	.6	.1	0	.5	14	86	0	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0
01567000	3,350	27.5	[illegible]	1.9	.7	.4	0	.8	47	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0
01568000	200	31.4	[illegible]	.7	.2	0	[illegible]	.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0	0
01570000	470	54.5	[illegible]	6.0	.9	0	[illegible]	.3	38	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0	0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.8	[illegible]	0	1.0	8	91	0	0	[illegible]	41.9	21.1	[illegible]	0	0	0	0	0
01571000	11.2	26.4	28.4	36.9	8.3	0	0	0	9	91	0	0	0	18.2	81.8	0	0	0	0	0	0
01571500	216	35.3	54.6	8.4	1.2	.2	0	.3	34	20	45	0	0	0	41.5	41.0	0	17.5	0	0	0
01572000	34.3	47.4	51.6	.6	.2	0	0	.1	0	100	0	0	0	100.0	0	0	0	0	0	0	0
01573560	483	50.0	40.2	6.4	2.1	.9	0	.4	13	85	1	0	0	43.2	55.1	0	0	1.7	0	0	0
01573810	.38	91.2	6.7	2.1	0	0	0	0	0	100	0	0	0	0	0	0	0	100.0	0	0	0
01574000	510	63.0	[illegible]	.4	1.4	[illegible]	0	.9	6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100.0	0
01575000	117	64.9	[illegible]	3.3	[illegible]	0	[illegible]	.2	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0
01575500	222	64.5	[illegible]	4.2	1.7	0	[illegible]	.5	13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0
01575585	267	59.5	[illegible]	11.6	2.0	.1	[illegible]	1.3	18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.2	[illegible]	0
[illegible]	[illegible]	[illegible]	[illegible]	3.8	.9	[illegible]	0	1.0	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0157608335	1.42	65.1	25.5	9.2	.2	0	0	0	50	50	0	0	0	0	0	0	0	0	100.0	0	0
01576085	5.82	67.0	27.0	4.8	1.3	0	0	0	50	50	0	0	0	0	0	0	0	33.3	66.7	0	0
01576500	324	60.4	27.2	9.4	2.2	.3	0	.6	44	47	8	0	0	0	2.5	0	1.9	42.5	50.0	3.1	0
01576754	470	59.5	22.7	14.5	2.5	.2	0	.6	59	33	8	0	0	0	1.7	0	1.3	29.1	62.9	5.0	0
01577400	.43	87.0	13.0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100.0	0
01578310	27,100	31.2	62.3	3.9	.9	.5	0	1.1	10	84	6	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
01583500	59.8	50.6	47.8	1.3	.2	.1	0	0	18	0	82	0	0	0	0	0	0	0	0	100.0	--
01586000	56.6	51.0	3.4	38.0	7.7	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100.0	--
01589000	285	48.9	41.9	6.1	2.1	.2	[illegible]	1.6	0	[illegible]	100	[illegible]	[illegible]	0	0	0	0	0	0	100.0	--
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.6	[illegible]	0	6	0	94	0	0	0	0	0	0	0	0	100.0	--
01589440	25.2	22.8	39.1	31.8	6.1	0	.2	0	28	0	72	0	0	0	0	0	0	0	0	100.0	--
01591000	34.8	53.3	45.2	.9	.6	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100.0	--
01592500	132	48.0	43.7	4.6	1.8	0	0	1.8	0	0	98	2	0	0	0	0	0	0	0	100.0	--
01593500	38.0	23.8	20.7	47.5	7.5	0	.1	.6	0	0	100	0	0	0	0	0	0	0	0	100.0	--
01594000	98.4	37.0	32.8	25.4	4.4	0	0	.3	1	0	98	1	0	0	0	0	0	0	0	99.0	1.0

Appendix 9. *Station, basin area, and percentage of land use, rock type, and physiographic province for all 127 load sites—Continued*

Station number	Area	Land use: Agri-culture	Land use: Forest	Land use: Urban	Land use: Herbe-ceous urban	Land use: Exposed	Land use: Wetland	Land use: Water	Rock type: Carbonate	Rock type: Silici-clastic	Rock type: Crystalline	Rock type: Uncon-solidated	Physiographic province: Appalachian Plateau	Physiographic province: Appalachian Mountain Section	Physiographic province: Great Valley	Physiographic province: Blue Ridge	Physiographic province: Reading Prong Section	Physiographic province: Mesozoic Lowlands Section	Physiographic province: Piedmont Lowlands Section	Physiographic province: Piedmont Upland Section	Physiographic province: Coastal Plain
01594440	348	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	69	31	0	0	0	0	0	0	0	70.0	30.0
01594526	89.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	100	0	0	0	0	0	0	0	0	100.0
01594670	9.38	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	100	0	0	0	0	0	0	0	0	100.0
01594710	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	100	0	0	0	0	0	0	0	0	100.0
01595300	225	20.1	[illegible]	[illegible]	[illegible]	3.4	[illegible]	[illegible]	[illegible]	100	0	0	97.3	2.7	0	0	0	0	0	0	0
01597500	106	12.7	86.1	.6	0	.1	0	.5	4	96	0	0	100.0	0	0	0	0	0	0	0	0
01599000	73.0	13.4	74.5	6.7	.7	4.7	0	0	3	97	0	0	100.0	0	0	0	0	0	0	0	0
01600000	596	14.7	78.9	3.2	.3	2.1	0	.9	4	95	0	0	79.3	20.7	0	0	0	0	0	0	0
01601500	247	16.4	79.9	3.2	.3	.2	0	0	2	98	0	0	74.5	25.5	0	0	0	0	0	0	0
01603000	875	15.2	78.4	3.8	.5	1.5	0	.6	4	95	0	0	75.4	24.6	0	0	0	0	0	0	0
01610000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	2	59.0	41.0	0	0	0	0	0	0	0
01610200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	4	0	100.0	0	0	0	0	0	0	0
01613000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	2	61.1	38.9	0	0	0	0	0	0	0
01614500	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10	0	0	10.4	79.7	10.0	0	0	0	0	0
01616000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0	0	0	100.0	0	0	0	0	0	0
01618000	5,936	29.2	66.8	2.7	.6	.3	0	.5	19	78	0	2	33.1	13.4	51.0	2.5	0	0	0	0	0
01619500	281	55.7	32.2	10.6	1.2	.3	0	.1	69	6	25	0	0	0	74.6	25.0	0	0	0	.4	0
01625000	375	58.8	32.3	4.9	4.0	0	0	0	69	31	0	0	0	13.1	86.9	0	0	0	0	0	0
01631000	1,642	42.4	52.5	4.6	0	0	0	.5	46	33	20	0	0	43.7	4.6	51.7	0	0	0	0	0
01634000	768	40.2	52.2	3.4	3.9	0	0	.5	50	50	0	0	0	39.8	60.2	0	0	0	0	0	0
01634500	103	14.2	[illegible]	[illegible]	[illegible]	0	0	0	22	78	0	0	0	98.1	1.9	0	0	0	0	0	0
01637500	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100	0	0	0	0	85.1	0	0	0	14.9	0
01638500	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	39.4	2.7	4.2	41.9	0	0	0	11.8	0
01639000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	0	0	9.6	0	85.9	0	1.1	0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	71	0	0	0	0	0	0	27.5	0	72.5	0
01643000	817	57.2	36.4	4.9	.8	.2	0	.4	8	39	54	0	0	0	0	17.7	0	43.4	0	38.9	0
01643020	850	57.2	36.4	4.9	.8	.3	0	.4	8	39	54	0	0	0	0	17.6	0	43.3	0	39.1	0
01646000	57.9	11.4	27.8	50.9	9.3	0	.1	.5	0	2	98	0	0	0	0	0	0	1.7	0	98.3	0
01646500	11,600	38.5	57.9	1.0	1.8	.2	0	.6	25	56	18	0	25.3	1.7	2.6	36.5	0	25.5	0	8.4	0
01646580	11,600	37.1	55.9	4.4	1.7	.2	0	.6	25	55	18	0	25.2	1.7	2.6	36.4	0	25.4	0	8.7	0
01647720	[illegible]	34.4	34.2	[illegible]	[illegible]	[illegible]	0	0	[illegible]	[illegible]	100	0	0	0	0	0	0	0	0	100.0	0
01649500	72.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	22	77	0	0	0	0	0	0	0	22.2	77.8
01650450	1.69	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	100	0	0	0	0	0	0	0	0	100.0	0
01656100	155	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	56	0	0	0	0	0	0	66.7	0	33.3	0
01656500	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	90	0	0	0	0	0	0	14.0	0	86.0	0

Appendix 9. *Station, basin area, and percentage of land use, rock type, and physiographic province for all 127 load sites—Continued*

Station number	Area	Land use							Rock type				Physiographic province									
		Agri-culture	Forest	Urban	Herba-ceous urban	Exposed	Wetland	Water	Carbonate	Silici-clastic	Crystalline	Uncon-solidated	Appalachian Plateau	Appalachian Mountain Section	Great Valley	Blue Ridge	Reading Prong Section	Mesozoic Lowlands Section	Piedmont Lowlands Section	Piedmont Upland Section	Coastal Plain
01656650	89.6	37.9	42.7	9.9	7.7	0.1	0.1	1.6	0	36	64	0	0	0	0	0	0	48.3	0	51.7	0
01656700	343	40.9	38.8	11.0	8.5	.1	.1	.7	0	50	49	0	0	0	0	0	0	66.9	0	33.1	0
01656725	25.8	46.6	40.5	8.8	4.0	0	.1	.1	0	69	31	0	0	0	0	0	0	88.5	0	11.5	0
01656960	49.9	28.0	30.1	34.2	7.1	.3	.2	.2	0	70	30	0	0	0	0	0	0	92.0	0	8.0	0
01657415	185.00	30.2	37.3	24.5	7.6	.1	.1	.2	0	65	35	0	0	0	0	0	0	78.5	0	21.5	0
01657655	3.97	23.0	26.7	39.8	9.6	.4	.1	.4	0	0	100	0	0	0	0	0	0	0	0	100.0	0
01664000	620	90.1	0	2.9	6.7	.1	0	.2	0	1	99	0	0	0	0	50.9	0	1.8	0	47.3	0
01666500	179	42.4	51.5	2.0	4.0	0	0	.1	0	3	96	0	3.2	0	0	36.0	0	5.4	0	55.4	0
01667500	472	45.1	49.5	1.7	3.5	.1	0	.1	0	12	88	0	0	0	0	36.0	0	15.0	0	49.0	0
01668000	1,600	44.4	50.3	1.9	3.0	.1	0	.3	0	12	87	1	0	0	0	30.3	0	16.0	0	53.6	0
01673000	1,081	35.0	59.2	1.9	1.5	.1	0	2.3	0	2	89	9	0	0	0	0	0	8.9	0	5.1	86.1
01674500	601	28.0	68.7	1.7	1.0	0	.1	.5	0	0	31	68	0	0	0	0	0	0	0	39.4	60.6
02012500	411	19.0	77.9	1.0	.6	.3	0	1.2	51	47	0	0	0	100.0	0	0	0	0	0	0	0
02013100	614	16.1	81.0	1.4	.5	.2	0	.8	41	53	0	0	0	100.0	0	0	0	0	0	0	0
02016000	461	16.8	81.8	.8	.3	0	0	.2	40	60	0	0	0	100.0	0	0	0	0	0	0	0
02017500	104	10.0	89.5	.2	.2	0	0	0	44	52	0	0	0	100.0	0	0	0	0	0	0	0
02019500	2,100	16.4	80.6	1.9	.7	.1	0	.5	35	51	0	0	0	79.0	19.7	1.2	0	0	0	0	0
02021500	329	13.3	84.1	1.8	.4	0	0	.3	36	64	0	0	0	98.8	1.2	0	0	0	0	0	0
02026000	3,680	18.5	75.9	4.2	.9	0	0	.6	41	40	17	0	0	8.4	43.8	23.2	0	0	0	24.6	0
02035000	6,260	23.0	71.6	3.6	1.2	0	0	.6	24	26	50	0	0	7.9	31.1	40.6	0	3.2	0	17.1	0
02037500	6,760	23.8	70.5	3.7	1.2	0	0	.7	52	24	0	0	0	4.9	25.9	33.7	0	4.8	0	30.6	.1
02041650	1,340	33.9	62.5	1.9	.8	0	0	.9	0	9	90	1	0	0	0	0	0	29.8	0	68.1	2.1

APPENDIX 10. LIST OF LOAD SITES IN BASIN ORDER IN THE CHESAPEAKE BAY BASIN

[This table corresponds to figure 18 on page 40.]

Appendix 10. *List of load sites in basin order in the Chesapeake Bay Basin*

Site number	Latitude	Longitude
Basin 1 - Susquehanna - North Branch		
01503000	420207	754812
01509150	423004	760738
01520500	420143	770757
01531000	420008	763806
01518000	415430	770747
01518700	415709	770656
01520000	415948	770825
01531500	414555	762628
01534000	413330	755342
01536000	412133	754441
01536500	411503	755252
01537000	411651	755346
01540500	405729	763710
WQN0308	404952	762825
WQN0310	410417	760802
WQN0318	414245	762814
Basin 2 - Susquehanna - West Branch		
01541000	405349	784038
01541200	405741	783110
01541500	405818	782422
01543000	412448	781150
01543500	411902	780612
01544000	412406	780128
01545600	412322	774128
01547500	410306	773617
01547950	410642	774209
01548408	413851	771826
01548500	413118	772652
01549700	411625	771928
01551500	411410	765949
01552000	411930	765446
01553500	405803	765236
01553700	410342	764050
01554000	405115	764821
WQN0407	412125	763205
WQN0415	405323	774740
WQN0434	411910	775225
Basin 3 - Susquehanna - Juniata		
01558000	403645	780827
01562000	401257	781556
01567000	402842	770746
Basin 4 - Susquehanna - Lower Susquehanna		
01568000	401924	771009
01570000	401508	770117
01570500	401517	765311
01571000	401830	765100
01571500	401329	765354
01572000	403215	762240
01573560	401754	764005
01573810	394906	770626
01574000	400456	764313
01575000	395514	764457
01575500	395646	764520
01575585	400107	764136
01576000	400316	763152
0157608335	400847	755537
01576085	400841	755920
01576500	400300	761639
01576754	395647	762205
01576788	395327	761813
01577400	394454	762750
01578310	393926	761031
Basin 5 - Choptank		
01491000	385950	754710
01493500	391648	760054
Basin 6 - Patuxent		
01591000	391418	770323
01594000	390806	764858
01594440	385721	764136
01594526	384852	764452
01594670	383502	763620
01594710	382837	764408
LXT0200	391005	765105
PXT0809	390700	765231
Basin 7 - Western Shore		
GWN0115	392046	764404
JON0184	392345	763946
NPA0165	393000	765257
PAT0285	391844	764733
WGP0050	393039	764039

Appendix 10. List of load sites in basin order in the Chesapeake Bay Basin—Continued

Site number	Latitude	Longitude
Basin 8 - Upper Potomac		
01610200	390318	784331
ANT0044	392700	774355
CON0180	394256	774931
GEO0009	392936	790242
NBP0196	393717	784626
NBP0326	393359	785021
NBP0689	392321	791047
POT1184	385735	770833
POT1830	392605	774811
POT2386	394149	781036
POT2766	393218	782717
SAV0037	393011	790729
WIL0013	393941	784650
1AABR000.78	391045	780510
1ADIF000.86	385833	771446
Basin 9 - Lower Potomac		
01639000	394043	771406
01643020	392316	772240
01646580	385546	770702
01647720	390659	770609
01650450	390527	770311
A7	385730	765600
BPC0035	393642	771419
CAC0148	392532	773333
MON0155	392349	772107
POT1595	391624	773238
ST05	384048	771725
ST10	384219	772646
ST20	383658	773316
ST30	384456	773350
ST40	384559	772452
ST50	384916	772757
ST60	385321	773414
ST70	384650	774022
Basin 10 - Shenandoah		
1AABR000.78	391045	780510
1BCDR013.29	390440	781934
1BMDL001.83	381543	785144
1BNFS010.34	385836	782013
1BSSF003.56	385449	781236

Site number	Latitude	Longitude
Basin 11 - Rappahonock		
01664000	383150	774850
01668000	381920	773105
3-RAP030.21	382132	775825
3-ROB001.90	381921	780544
Basin 12 - York		
01673000	374603	771957
01674500	375316	770948
Basin 13 - James		
02012500	375236	795839
02019500	373150	794045
02035000	374015	780510
02041650	371330	772832
2-CWP002.58	374731	794534
2-JKS023.61	374719	800003
2-JMS117.35	373341	773237
2-JMS229.14	373211	784939
2-JOB000.39	373023	800618
2-MRY038.10	375412	792500