2012 NUTRIENTS AND SUSPENDED SEDIMENT IN THE SUSQUEHANNA RIVER BASIN

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SUSQUEHANNA RIVER BASIN COMMISSION

The Susquehanna River Basin Commission was created as an independent agency by a federal-interstate compact* among the states of Maryland and New York, the Commonwealth of Pennsylvania, and the federal government. In creating the Commission, the Congress and state legislatures formally recognized the water resources of the Susquehanna River Basin as a regional asset vested with local, state, and national interests for which all the parties share responsibility. As the single federal-interstate water resources agency with basinwide authority, the Commission's goal is to coordinate the planning, conservation, management, utilization, development, and control of basin water resources among the public and private sectors.

**Statutory Citations: Federal - Pub. L. 91-575, 84 Stat. 1509 (December 1970); Maryland - Natural Resources Sec. 8-301 (Michie 1974); New York - ECL Sec. 21-1301 (McKinney 1973); and Pennsylvania - 32 P.S. 820.1 (Supp. 1976).*

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ABSTRACT

In 1985, the Susquehanna River Basin Commission (SRBC) along with the United States Geological Survey (USGS), the Pennsylvania Department of Environmental Protection (PADEP), and United States Environmental Protection Agency (USEPA) began an intensive study of nutrient and sediment transport in the Susquehanna River Basin. Funding for the program was provided by grants from the PADEP and the USEPA's Chesapeake Bay Program Office. The long-term focus of the project was to quantify the amount of nutrients and suspended sediment (SS) transported in the basin and determine changes in flow-adjusted concentration trends at 12 sites. Several modifications were made to the network including reducing the original 12 sites to six long-term sites then adding 13 sites in 2004, four sites in 2005, and four sites in 2012. The current network consists of 27 sites throughout the Susquehanna River Basin varying in watershed size and land use.

Samples were collected monthly with eight additional samples collected during four storm events throughout the year. An extra sample was collected each month at the six long-term sites including Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga. Sample collection was conducted using approved USGS methods including vertical and horizontal integration across the water column to insure collection of a representative sample. Samples were analyzed for various nitrogen and phosphorus species, total organic carbon (TOC), total suspended solids (TSS), and SS. Data were used to calculate nutrient and sediment loads and trends using the USGS estimator model. Results for annual, seasonal, and monthly loads were compared to long-term means (LTM) and to baseline data. Trends for all parameters and discharge were calculated over the entire time period for each dataset and compared to previous years' results to identify changes.

2012 precipitation was fairly distributed with annual amounts below LTMs. Furthest departure below LTM occurred during winter at all sites while furthest departure above LTM was during the fall at all sites except Newport, where summer had the most rain. The most significant storm event of 2012 was Hurricane Sandy, which recorded the 10th highest historical flow at Conestoga with 8.73 inches of rain during the month. Smaller events also occurred during December, June, and January.

Annual nutrient and sediment loads were dramatically lower than LTMs at all sites. Although there were several individual months with above LTM flows, only Newport and Conestoga had above LTM loads for any parameter. Total nitrogen (TN) loads were above LTMs at Newport during the top three flow months while SS was only above the LTM during October, the fourth highest flow month, due to the influence of Hurricane Sandy. Sandy's effects were most dramatic at Conestoga with October's flow at 215 percent of the LTM resulting in TN, total phosphorus (TP) and SS at 166, 296, and 300 percent of LTM, respectively. 2012 yields for TN, TP, and SS were below all baselines for all sites.

The majority of 2012 trends remained unchanged from 2011. Two new downward trends were found for TP at Towanda and dissolved phosphorus (DP) at Danville. Downward trends were found at all sites for TN, dissolved nitrogen (DN), total organic nitrogen (TON), dissolved organic nitrogen (DON), and TP. Mainstem Susquehanna trends at Towanda, Danville, and Marietta were downward for total ammonia nitrogen (TNH_3), total nitrate plus nitrite (TNO_x), dissolved nitrate plus nitrite (DNO_x), DP, and TOC. Ten of 12 long-term

downward trends in TON and DON at long-term sites were lost when short-term trends were analyzed. There were no trends in flow at any site.

BACKGROUND

Nutrients and SS entering the Chesapeake Bay (Bay) from the Susquehanna River Basin contribute to nutrient enrichment problems in the Bay (USEPA, 1982). Several studies in the late 1970s and early 1980s showed high nutrient concentration in both stream water and groundwater and high SS yields within the Lower Susquehanna River Basin (Ott et al., 1991). Subsequently, much of the excessive nutrients and SS that entered the Bay were thought to originate from the Lower Susquehanna Basin. Results from these studies concluded that the sources and quantities of the loads warranted determination. In 1985, the PADEP Bureau of Laboratories, USEPA, USGS, and SRBC conducted a five-year study to quantify nutrients and SS transported to the Bay from the Susquehanna River Basin.

The initial network consisted of two mainstem sites on the Susquehanna and 10 tributary sites with the goal of developing baseline nutrient loading data. After 1989, several modifications to the network occurred, including reduction of the number of stations to five in 1990, and additions of one station in 1994, 13 stations in 2004, four stations in 2005, and four stations in 2012. The current network consists of six sites on the mainstem of the Susquehanna River and 21 tributary sites. The 27 site network contains six sites in New York, 20 in Pennsylvania, and one in Maryland. Table 1 lists the individual sites grouped as long-term sites (Group A) and enhanced sites (Group B) along with subbasin, drainage area, USGS gage number, and land use. Actual locations of current sites are shown in Figure 1.

All site additions from 2004 onward were added as part of the Chesapeake Bay Program's Non-tidal Water Quality Monitoring Workgroup's effort to develop a non-tidal monitoring network uniform in site selection criteria, parameters analyzed, and collection and analysis methodology. Objectives for the network included the following: to measure and assess the actual nutrient and sediment concentration and load reductions in the tributary strategy basins across the watershed; to improve calibration and verification of the partners' watershed models; and to help assess the factors affecting nutrient and sediment distributions and trends. Specific site selection criteria included location at outlets of major streams draining the tributary strategy basins, location in areas within the tributary strategy basins that have the highest nutrient delivery to the Bay, and to insure the various conditions in the Bay watershed among land use type, physiographic/geologic setting, and watershed size were adequately represented. This project involves monitoring efforts conducted by all six Bay state jurisdictions, the District of Columbia, USEPA, USGS, and SRBC. The purpose of this report is to present basic information on annual and seasonal loads and yields of nutrients and SS measured during calendar year 2012 at the six SRBC-monitored long-term sites, and summary statistics for the additional 21 sites, and to determine if changes in water quality have occurred. Load, yield, and trends at 14 of the 21 enhanced sites also will be provided.

DESCRIPTION OF THE SUSQUEHANNA RIVER BASIN

The Susquehanna River drains an area of 27,510 square miles (Susquehanna River Basin Study Coordination Committee, 1970), and is the largest tributary to the Chesapeake Bay. The Susquehanna River originates in the Appalachian Plateau of southcentral New York, flows into the Valley and Ridge and Piedmont Provinces of Pennsylvania and Maryland, and joins the Bay at Havre de Grace, Md. The climate in the Susquehanna River Basin varies considerably from the low lands adjacent to the Bay in Maryland to the high elevations, above 2,000 feet, of the northern headwaters in central New York State. The annual mean temperature ranges from 53^{o} F (degrees Fahrenheit) near the Pennsylvania-Maryland border to 45^{o} F in the northern part of the basin. Annual precipitation in the basin averages 40 inches and is fairly well distributed throughout the year.

Land use in the Susquehanna River Basin, shown in Table 1, is predominantly rural with woodland accounting for 69 percent; agriculture, 21 percent; and urban, 7 percent. Woodland occupies the higher elevations of the northern and western parts of the basin and much of the mountain and ridge land in the Juniata and Lower Susquehanna Subbasins. Woods and grasslands occupy areas in the lower part of the basin that are unsuitable for cultivation because the slopes are too steep, the soils are too stony, or the soils are poorly drained. The Lower Susquehanna Subbasin contains the highest density of agriculture operations within the watershed. However, extensive areas are cultivated along the river valleys in southern New York and along the West Branch Susquehanna River from Northumberland, Pa., to Lock Haven, Pa., including the Bald Eagle Creek Valley.

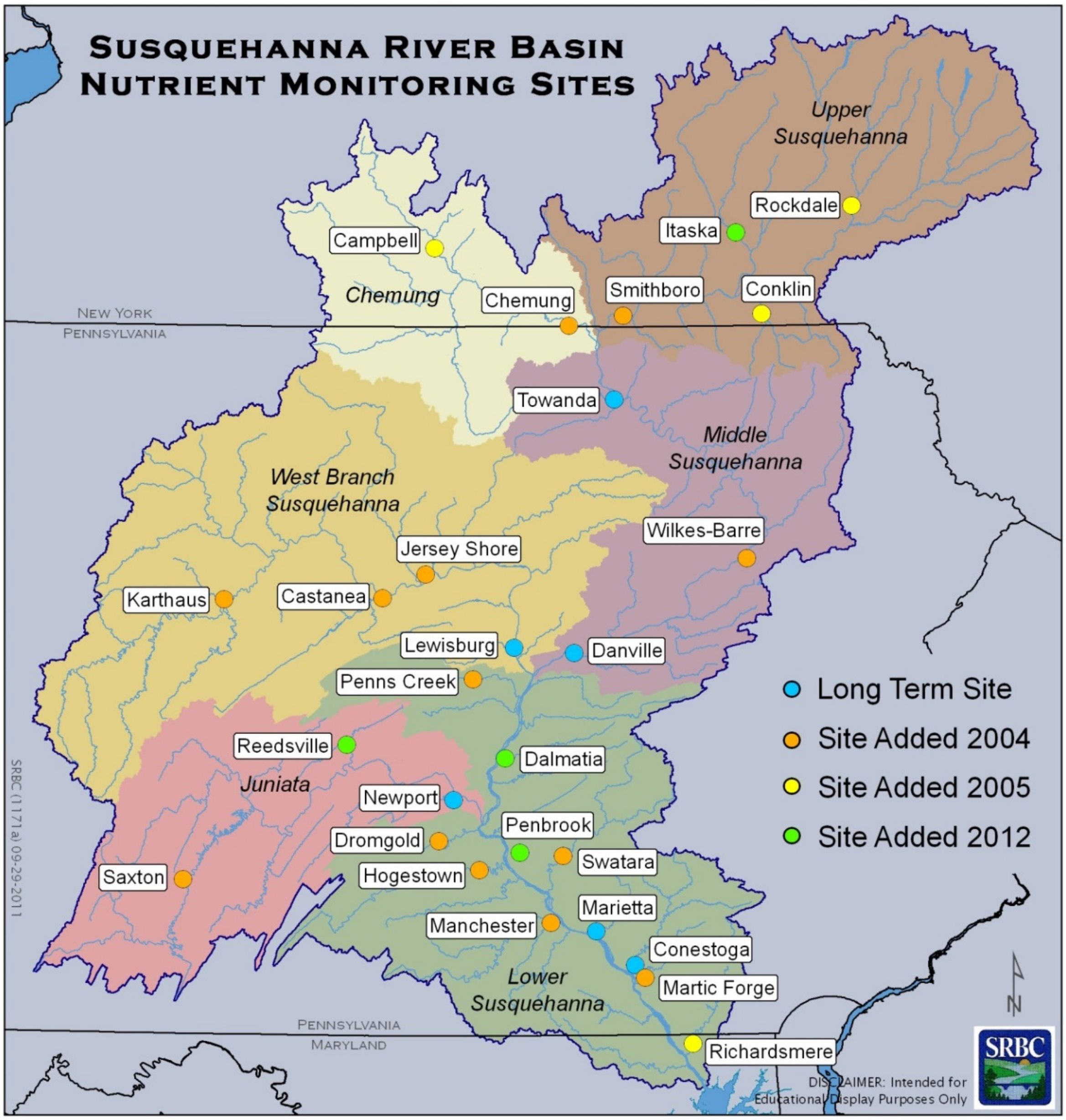

Figure 1. Locations of Sampling Sites Within the Susquehanna River Basin

Table 1. Data Collection Sites and Their Drainage Areas and 2000 Land Use Percentages

Site Location	USGS Site ID	Subbasin	Waterbody	Drainage Area (Sq. Mi.)	Water/ Wetland	Urban	Agricultural			Forest	Other
							Row Crops	Pasture Hay	Total		
Group A: Long-term Sites											
Towanda	01531500	Middle Susquehanna	Susquehanna	7,797	2	5	17	5	22	71	0
Danville	01540500	Middle Susquehanna	Susquehanna	11,220	2	6	16	5	21	70	1
Lewisburg	01553500	W Branch Susquehanna	W Branch Susquehanna	6,847	1	5	8	2	10	84	0
Newport	01567000	Juniata	Juniata	3,354	1	6	14	4	18	74	1
Marietta	01576000	Lower Susquehanna	Susquehanna	25,990	2	7	14	5	19	72	0
Conestoga	01576754	Lower Susquehanna	Conestoga	470	1	24	12	36	48	26	1
Group B: Enhanced Sites											
Rockdale	01502500	Upper Susquehanna	Unadilla	520	3	2	22	6	28	66	1
Conklin	01503000	Upper Susquehanna	Susquehanna	2,232	3	3	18	4	22	71	1
Itaska	01511500	Upper Susquehanna	Tioughnioga	730	2	4	22	5	27	66	1
Smithboro	01515000	Upper Susquehanna	Susquehanna	4,631	3	5	17	5	22	70	0
Campbell	01529500	Chemung	Cohocton	470	3	4	13	6	19	74	0
Chemung	01531000	Chemung	Chemung	2,506	2	5	15	5	20	73	0
Wilkes-Barre	01536500	Middle Susquehanna	Susquehanna	9,960	2	6	16	5	21	71	0
Karthaus	01542500	W Branch Susquehanna	W Branch Susquehanna	1,462	1	6	11	1	12	80	1
Castanea	01548085	W Branch Susquehanna	Bald Eagle	420	1	8	11	3	14	76	1
Jersey Shore	01549760	W Branch Susquehanna	W Branch Susquehanna	5,225	1	4	6	1	7	87	1
Saxton	01562000	Juniata	Raystown Branch Juniata	756	< 0.5	6	18	5	23	71	0
Reedsville	01565000	Juniata	Kishacoquillas	164	<0.5	5	20	6	26	67	2
Dalmatia	01555500	Lower Susquehanna	East Mahantango	162	1	6	20	6	26	66	1
Penbrook	01571000	Lower Susquehanna	Paxton	11	<0.5	50	9	11	20	29	1
Penns Creek	01555000	Lower Susquehanna	Penns	301	1	3	16	4	20	75	1
Dromgold	01568000	Lower Susquehanna	Shermans	200	1	4	15	6	21	74	0
Hogestown	01570000	Lower Susquehanna	Conodoguinet	470	1	11	38	6	44	43	1
Hershey	01573560	Lower Susquehanna	Swatara	483	2	14	18	10	28	56	0
Manchester	01574000	Lower Susquehanna	West Conewago	510	2	13	12	36	48	36	1
Martic Forge	01576787	Lower Susquehanna	Pequea	155	1	12	12	48	60	25	2
Richardsmere	01578475	Lower Susquehanna	Octoraro	177	1	10	16	47	63	24	2
Entire Susquehanna River Basin				27,510	2	7	14	7	21	69	1

Major urban areas in the basin, many of which are located along river valleys, include: Binghamton, N.Y., in the Upper Susquehanna Subbasin; Corning and Elmira, N.Y., in the Chemung Subbasin; Scranton and Wilkes-Barre, Pa., in the Middle Susquehanna Subbasin; Clearfield, Lock Haven, and Williamsport, Pa., in the West Branch Subbasin; Altoona and Lewisburg, Pa., in the Juniata Subbasin; and Harrisburg, Lancaster, Sunbury, and York, Pa., in the Lower Susquehanna Subbasin.

SAMPLE COLLECTION

2012 sampling efforts at the six long-term (Group A) sites included sampling during monthly base flow conditions, monthly flow-independent conditions, and seasonal storm conditions. This resulted in two samples collected per month: one with a set date near the twelfth of each month independent of flow and one based on targeting monthly base flow conditions. The mid-monthly samples were intended to be flow independent with the intention that the data would help to quantify long-term trends. Additionally, due to the linkage of high flow and nutrient and sediment loads, it was necessary to target storm events for additional sampling to adequately quantify loads. Long-term site sampling goals included targeting one storm per season with a second storm collected during the spring season. Spring storms were planned to collect samples before and after agricultural crops had been planted.

All storm samples were collected during the rising and falling limbs of the hydrograph with goals of three samples on each side and one sample as close to the peak as possible. The enhanced sites (Group B) targeted a mid-monthly flow independent sample and two storm samples per season. Storm samples were planned to have one sample on the rising limb and one on the falling limb of the hydrograph with the goal that one of the two be as close to the peak as possible. Due to the quick nature of the hydrograph on several of the smaller streams, sometimes the two storm samples per season were taken from two different storms with the goal of having samples as close to the peak of each storm as possible.

The goal of sample collection was to collect a sample representative of the entire water column. Due to variations in stream width and depth and subsequent lack of natural mixture of the stream, it was necessary to composite several individual samples across the water column into one representative sample. The number of individual verticals at each site varied from three to ten dependent upon the stream width. Based on USGS depth integrated sampling methodology at each vertical location, the sampler was lowered at a consistent rate from the top of the water surface to the stream bottom and back to insure water from the entire vertical column was represented (Myers, 2006). Instream water quality readings were taken at each vertical to insure accurate dissolved oxygen and temperature values.

All samples were processed onsite and included whole water samples analyzed for nitrogen and phosphorus species, TOC, TSS, and SS. For Group B sites, SS samples were only collected during storm events. Additionally, filtered samples were processed onsite to analyze for DN and DP species. Several sites included additional parameters pertinent to the natural gas industry.

SAMPLE ANALYSIS

Samples were either hand-delivered or shipped directly to the appropriate laboratory for analysis on the day following collection. When storm events occurred over the weekend, samples collected were analyzed on the following Monday. Samples collected in Pennsylvania and at the Octoraro Creek site near Richardsmere, Md., were delivered to PADEP's Bureau of Laboratories in Harrisburg, Pa. Samples collected at New York sites were shipped to Columbia Analytical Services in Rochester, N.Y. Parameters for all samples at all sites included various nitrogen and phosphorus species, TOC, and TSS. Specific parameters, methodology, and detection limits are listed in Table 2.

Due to the high influence of stormflow on sediment concentrations, SS samples were collected during storm events at all sites with the goal of two samples for each event and one event per quarter. Of the two samples per storm, the more sediment laden sample was analyzed for both sediment concentration and sand/fine particle percentage. The additional sample was submitted for sediment concentration only. Sediment samples were shipped to the USGS sediment laboratory in Louisville, Ky., for analysis. Additional SS samples also were collected at all Group A sites as part of each sampling round. These samples were analyzed at the SRBC laboratory for sediment concentration alone.

Table 2. Water Quality Parameters, Laboratory Methods, and Detection Limits

Parameter	Storet	Laboratory	Methodology	Detection Limit (mg/l)	References
Total Ammonia (TNH_3)	610	PADEP	Colorimetry	0.020	USEPA 350.1
		CAS*	Colorimetry	0.010	USEPA 350.1R
Dissolved Ammonia (DNH_3)	608	PADEP	Block Digest, Colorimetry	0.020	USEPA 350.1
		CAS*	Block Digest, Colorimetry	0.010	USEPA 350.1R
Total Nitrogen (TN)	600	PADEP	Persulfate Digestion for TN	0.040	Standard Methods #4500-N_{org}-D
Dissolved Nitrogen (DN)	602	PADEP	Persulfate Digestion	0.040	Standard Methods #4500-N_{org}-D
Total Organic Nitrogen (TON)	605	N/A	TN minus TNH_3 and TNO_x	N/A	N/A
Dissolved Organic Nitrogen (DON)	607	N/A	DN minus DNH_3 and DNO_x	N/A	N/A
Total Kjeldahl Nitrogen (TKN)	625	CAS*	Block Digest, Flow Injection	0.050	USEPA 351.2
Dissolved Kjeldahl Nitrogen (DKN)	623	CAS*	Block Digest, Flow Injection	0.050	USEPA 351.2
Total Nitrite plus Nitrate (TNO_x)	630	PADEP	Cd-reduction, Colorimetry	0.010	USEPA 353.2
		CAS*	Colorimetric by LACHAT	0.002	USEPA 353.2
Dissolved Nitrite plus Nitrate (DNO_x)	631	PADEP	Cd-reduction, Colorimetry	0.010	USEPA 353.2
		CAS*	Colorimetric by LACHAT	0.002	USEPA 353.2
Dissolved Orthophosphate (DOP)	671	PADEP	Colorimetry	0.010	USEPA 365.1
		CAS*	Colorimetric Determination	0.002	USEPA 365.1
Dissolved Phosphorus (DP)	666	PADEP	Block Digest, Colorimetry	0.010	USEPA 365.1
		CAS*	Colorimetric Determination	0.002	USEPA 365.1
Total Phosphorus (TP)	665	PADEP	Persulfate Digest, Colorimetry	0.010	USEPA 365.1
		CAS*	Colorimetric Determination	0.002	USEPA 365.1
Total Organic Carbon (TOC)	680	PADEP	Combustion/Oxidation	0.50	SM 5310D
		CAS*	Chemical Oxidation	0.05	GEN 415.1/9060
Total Suspended Solids (TSS)	530	PADEP	Gravimetric	5.0	USGS I-3765
		CAS*	Residue, non-filterable	1.1	SM2540D
Suspended Sediment Fines	70331	USGS	**		
Suspended Sediment (SS)	80154	SRBC	**		
		USGS	**		

* Columbia Analytical Services, Rochester, N.Y. (New York sites only)
** TWRI Book 3, Chapter C2 and Book 5, Chapter C1, Laboratory Theory and Methods for Sediment Analysis (Guy and others, 1969)

PRECIPITATION AND DISCHARGE

Precipitation data were obtained from long-term monitoring stations operated by the U.S. Department of Commerce. The data are published as Climatological Data–Pennsylvania, and as Climatological Data–New York by the National Oceanic and Atmospheric Administration at the National Climatic Data Center in Asheville, N.C. Monthly data from these online sources were compiled across the subbasins of the Susquehanna River Basin. Discharge values were obtained from the USGS gaging network system. All sites were collocated with USGS gages so that discharge amounts could be matched with each sample. Average daily discharge values for each site were used as input to the estimator model used to estimate nutrient and sediment loads and trends. Average monthly flow values were used to check for trends in discharge.

DATA ANALYSIS

Sample results were compiled into an existing database including all years of the program. These data were then listed on SRBC's web site as well as submitted to various partners for use with models and individual analyses. Specific analyses completed by SRBC staff include load and trend estimation, yields, LTM comparisons, and baseline comparisons.

Loads and Yields

Loads and yields represent two methods for describing nutrient and SS amounts within a basin. Loads refer to the actual amount of the constituent being transported in the water column past a given point over a specific duration of time and are expressed in pounds. Yields compare the transported load with the acreage of the watershed and are expressed in lbs/acre. This allows for easy watershed comparisons regardless of size. This project reports loads and yields for the constituents listed in Table 2 as computed by the Minimum Variance Unbiased Estimator (ESTIMATOR) described by Cohn and others (1989). This estimator relates the constituent concentration to water discharge, seasonal effects, and long-term trends, and computes the best-fit regression equation. Daily loads of the constituents were then calculated from the daily mean water discharge records. The loads were reported along with the estimates of accuracy. Average concentrations were reached by taking the total load and dividing by the total amount of flow during the time period and were reported in mg/L. 2012 yield, load and calculated concentration data are listed in Appendix A.

Summary statistics are listed in Appendix E and include minimum, maximum, median, mean, and standard deviation values taken from the 2012 dataset. In addition, due to increasing length of datasets, loads were conducted at 14 of 21 Group B sites and are listed in Appendix B.

Long-term Mean Ratios

Due to the relationship between stream discharge and nutrient and SS loading, it can be difficult to determine whether the changes observed were related to land use, nutrient availability, or simply fluctuations in water discharge. Although the relationship is not always linear at higher flows, in general, increases in flows coincide with increases in constituent loads (Ott and others, 1991; Takita, 1996, 1998). In an attempt to determine annual changes from previous years, 2012 nutrient and SS loads, yields, and concentrations were compared to LTMs. LTM load and discharge ratios were calculated for a variety of time frames, including annual, seasonal, and monthly, by dividing the 2012 value by the LTM for the same time frame and reported as a percentage or ratio. It was thought that identifying sites where the percentage of LTM for a constituent, termed the load ratio, was different than the corresponding percentage of LTM for discharge, termed the water-discharge ratio or discharge ratio, would suggest areas where improvements or degradations may have occurred for that particular constituent. Specifically, annual discharge ratio at Conestoga was 88 percent while annual TN, TP, and SS ratios were 77, 46, 27 percent, respectively. At odds with the conclusion is that individual high flow events tend to produce higher loads, especially for TP and SS, than would be predicted by a simple comparison with the LTM. This was seen for October at Conestoga where the discharge ratio was 215 percent and the TN, TP, and SS ratios were 166, 296, and 300 percent, respectively. Thus, apparent changes in water quality based on LTM comparison may be masked by the presence or absence of significant storm events.

Baseline Comparisons

As a means to determine whether the annual fluctuations of nutrient and SS loads were due to water discharge, Ott and others (1991) used the relationship between annual loads and annual water discharge. This was accomplished by plotting the annual yields against the water-discharge ratio for a given year to calculate a baseline regression line. Data from the initial five-year study (1985-89) were used to provide a best-fit linear regression trend line to be used as the baseline relationship between annual yields and water discharge. It was hypothesized that as future yields and water-discharge ratios were plotted against the baseline, any significant deviation from the baseline would indicate that some change in the annual yield had occurred, and that further evaluations to determine the reason for the change were warranted.

Due to the size of the current dataset, the opportunity exists for there to be non-linear changes in the yield versus water discharge plot as more years are added. Therefore, this report included comparisons to baselines created from different time frames including the initial five-year period of the dataset for each station, the first half of the entire dataset, the second half of the entire dataset, and the entire dataset. Although the tendency was for increasing loads to be associated with increasing flows, this relationship was not strictly linear, especially regarding TP and SS.

All comparisons include an associated R^2 value representing the strength of the correlation between the two parameters in the regression. The closer the R^2 is to a value of one, the better the regression line is for accurately using one variable (flow) to predict the other. An R^2 of one indicates that there is perfect correlation between the two variables. For example, R^2 values for TN tend to be close to one as the relationship between TN and flow is very strong and consistent through various ranges of flows. R^2 values for TP and SS tend to vary more, especially towards higher flows. Thus, when regression graphs include high flow events, the resulting correlation tends to be weaker as indicated by a low R^2 value. This is an indication that single high flow events, and not necessarily a high flow year, are the highest contributors to loads in TP and SS and that these contributions do not necessarily follow a strictly linear increase.

Figure 2 shows the baseline regression line developed for TN at Marietta using the first half of the dataset where each hollow circle represents an individual year during that time period. Each was plotted using an individual year's yield and discharge ratio. The discharge ratio was calculated by dividing the year's annual flow by the average flow for the baseline years used. A regression line was plotted through these data points and the equation of the regression line was used to calculate a baseline prediction for the 2012 yield given the 2012 discharge ratio. The baseline prediction for 2012 TN yield is shown as a black triangle at 6.9 lbs/ac. The actual 2012 yield at the same discharge ratio, 4.63 lbs/ac, is shown as the black underscore (Figure 2). Since the actual 2012 yield was lower than the prediction made by the first 13 years of data, the comparison suggests that improvements have occurred.

Figure 3 shows the baseline regression lines that were developed using the initial five years at Marietta, the first 13 years at Marietta, and the most recent 13 years at Marietta. Using multiple regression lines developed from different time periods within that dataset also can show whether changes occurred. For example, at a discharge ratio of 0.93, the initial five-year baseline predicts the 2012 yield to be 8.54 lbs/ac, while the actual 2012 yield was 4.63 lbs/ac). Comparison to the regression from the most recent 13 years, which predicted the 2012 TN yield to be 5.32 lbs/ac, implies that yields during the first five years were higher than the most recent yields. Additional support for improvements can be seen when comparing regression lines to each other. As more recent years were added to the baseline, the slope of the regression line decreased. This suggested that the more recent 13-year dataset included lower yield values as compared to the initial 13-year dataset. Thus, a regression line that predicts lower yields for the same water discharge ratio directly implies improved water quality between the two timeframes. 2012 baseline data is listed in Appendix A.

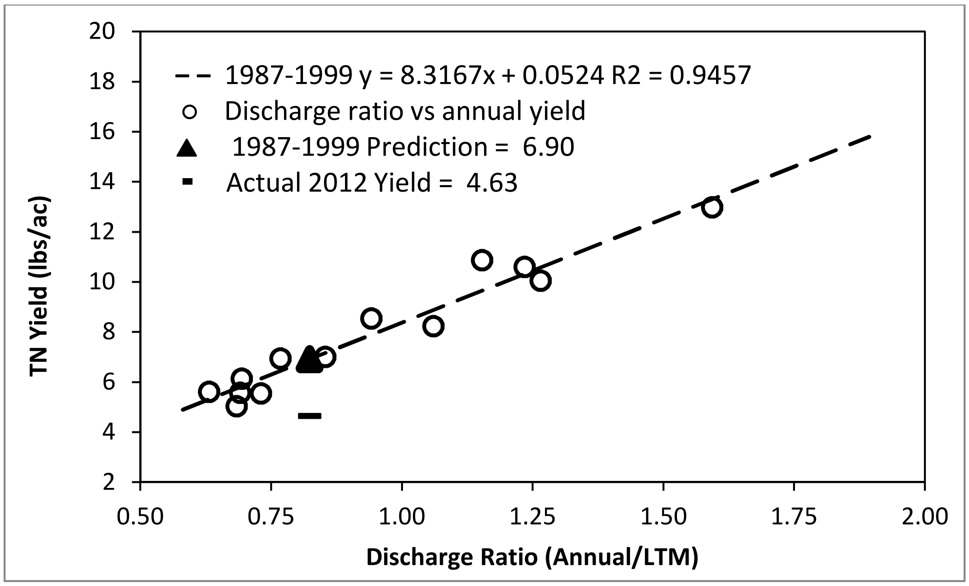

Figure 2. First Half Baseline Regression Line, 2012 TN Yield Prediction, and Actual 2011 Yield for TN at Marietta

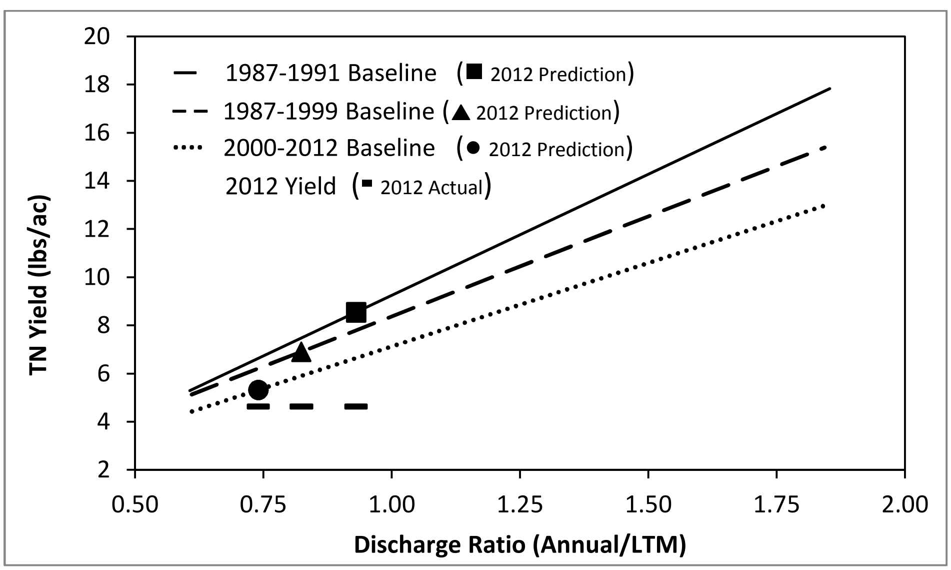

Figure 3. Initial, First Half, and Second Half Baseline Regression Lines, Yield Predictions, and Actual 2012 Yields for TN at Marietta

Flow-Adjusted Trends

Flow-Adjusted Concentration (FAC) trend analyses of water quality and flow data collected at Danville, Lewisburg, Newport, and Conestoga were completed for the period January 1984 through December 2012. Sample collection at Marietta and Towanda began later and their respective trend periods are 1986-2012 and 1988-2012. Trends were estimated based on the USGS water year, October 1 to September 30, using the USGS 7-parameter, log-linear regression model (ESTIMATOR) developed by Cohn and others (1989) and described in Langland and others (1999). ESTIMATOR relates the constituent concentration to water discharge, seasonal effects, and long-term trends, and computes the best-fit regression equation. These tests were used to estimate the direction and magnitude of trends for SS, TOC, and several forms of nitrogen and phosphorus. Slope, p-value, and sigma (error) values are taken directly from ESTIMATOR output. These values are then used to calculate flow-adjusted trends using the following equations:

Trend =
100*(exp(Slope *(end yr – begin yr)) – 1)

Trend minimum =
100*(exp((Slope – (1.96*sigma)) *(end yr – begin yr)) – 1)

Trend maximum =
100*(exp((Slope + (1.96*sigma)) *(end yr – begin yr)) – 1)

The computer program S-Plus with the USGS ESTREND library addition was used to conduct Seasonal Kendall trend analysis on flows (Schertz and others, 1991). Trend results were reported for monthly mean discharge (FLOW) and individual parameter FACs. Trends in discharge indicate any natural changes in hydrology. Changes in flow and the cumulative sources of flow (base flow and overland runoff) affect the observed concentrations and the estimated loads of nutrients and SS. The FAC is the concentration after the effects of flow are removed from the concentration time series. Trends in FAC indicate that changes have occurred in the processes that deliver constituents to the stream system. After the effects of flow are removed, this is the concentration that relates to the effects of nutrient-reduction activities and other actions taking place in the watershed. A description of the methodology is included in Langland and others (1999).

With the addition of 2012, the majority of Group B have grown to between seven and eight years of data allowing for FAC trends to be completed. Due to the shorter duration, it is difficult to connect the results with the longer term trends conducted at Group A sites. Therefore, trends at all six long-term sites also were completed at the shortened time frame. This allowed for inferences to be made between both the long-term and short term trend results at Group A sites and between the short term trend results at Group A and Group B sites.

It is critical to note that the accepted dataset length for using ESTIMATOR to analyze trends has previously been set at 10 years by USGS (Langland, 2006). Careful scrutiny is required when using shorter datasets to insure validity of results. The recommended 10 years of data before trend analysis can be completed is intended to insure that all potential flow patterns are adequately represented. Although the estimator model does make flow adjustments, a preponderance of low or high flow data at either end of the dataset can confound trend results. Although Tropical Storm Lee (T.S. Lee) occurred near the end of the dataset, it does not appear to have adversely affected trends results. Long-term trends are listed in Appendix A and short-term trends results are listed in Appendix C.

INDIVIDUAL SITES

The following discussion of individual long-term Group A sites includes comparison to LTMs, baseline regression lines, and short- and long-term trends. LTM comparisons were intended to identify variations between discharge and individual parameters. Differences between the discharge ratio (2012 flow divided by the LTM) and the parameter LTM ratio imply changes from the historical means. Additional historical comparisons include baseline data predictions. Plotting yields versus discharge ratios for different periods allows a view of the current year from the context of previous historical periods. It also allows different time periods to be compared. Baselines from the initial five years of data at a site, the first half of the dataset, the second half of the dataset, and the full dataset have been used.

Towanda

2012 precipitation at Towanda was below LTM for the winter, spring, and summer. Precipitation was two inches above LTM for fall driven by above average rainfall in December. Annual flow was 66 percent of LTM, ranging from 35 percent during summer to 79 percent during winter. This resulted in all loads being less than 55 percent of corresponding LTMs including SS loads that were 10 percent of LTM. Peak high flow months included January, December, March, and May. Collectively, they accounted for 59 percent of the annual flow and 63, 62, and 74 percent of the annual TN, TP, and SS load, respectively. 2012 yields for TN, TP, and SS were below all four baseline comparisons.

Long-term trends at Towanda remained unchanged from last year with the exception of TP, which had a downward trend through 2012. TNO_x had no trend, DOP had an increasing trend, and all other trends were downward. Short-term trend (2004-2012) results at Towanda indicated no trends for DN, TON, and SS. Since all three parameters had long-term downward trends, the implication was that reductions occurred somewhere between 1989 and 2004, at which point they leveled off. The short-term DON trend was upward indicating that it has actually reversed direction between 2004 and 2012 but not drastically enough to remove the long-term trend. The shorter term trend also showed larger reductions in TP and DP from 2004-2012 than from 1989-2012 suggesting that the rate of phosphorus reductions increased. Short-term DOP trends were downward in contradiction to the upward long-term trend. This finding will be scrutinized in the discussion section.

Danville

2012 precipitation was evenly distributed with December, October, and May receiving the highest amounts while January, May, and December were above LTM flow. Highest peak flow occurred during December followed by January. Seasonal flow ranged from 40 percent of the LTM during summer to 82 percent during fall. While annual flow was 71 percent of the LTM, all loads were less than 60 percent of their respective LTMs including TN, TP, and SS at 49, 26, and 15 percent, respectively. The low values for TP and SS indicate that although December's storm event was the largest for the year, it did not result in significantly erosive flows. The top four flow months including January, December, May, and March accounted for 58 percent of flow and 62, 64, and 76 percent of TN, TP, and SS, respectively. As with Towanda, 2012 yields were below all baseline comparisons.

2012 trends remained downward, except for DP which changed from no trend to a downward trend. Both TNO_x and DOP had no trends due to more than 20 percent of the values being below the method detection limit (BMDL). Short-term trend runs resulted in loss of all nitrogen and SS trends. Again the implication was that any reductions that have occurred did so prior to 2005 and have since leveled off over the past eight years. As at Towanda, the short-term DON trend was upwards, indicating that, although the overall trend was downward, the last eight years have seen increases in flow-adjusted concentrations. TP and DP both show downward trends that have increased in magnitude during the second half of the dataset, suggesting that the rates of reduction have increased over the past eight years.

Marietta

2012 precipitation at Marietta was highest during October, May, and September, while January and May had the highest average flow and were the only months above their respective LTMs. Highest daily average flow occurred during December followed by January and October. December's daily average peak was 23 percent of the daily average peak during T.S. Lee in 2011. Annual flow was 78 percent of the

LTM and all loads were less than 67 percent of their LTMs with TN, TP, and SS at 61, 33, and 17 percent, respectively. The highest flow months, January, May, December, and March, accounted for 54, 57, 57, and 62 percent of flow, TN, TP, and SS, respectively. Comparison to all four baselines indicated 2012 yields were lower than expected for TN, TP, and SS.

2012 trends remained unchanged from 2011 with all trends downward, except for dissolved ammonia nitrogen (DNH_3) and dissolved orthophosphorus (DOP) due to BMDL. There were no short-term trends for TON, DON, DP, and SS, but there was a downward trend for DNH_3 which was formerly a BMDL. Although TON and DON trends were not present, TNH_3, TNO_x, and DNO_x trend slopes were larger for the 2004-2012 trends as compared to the full dataset trend. The implication being that in the past eight years, organic nitrogen improvements have leveled off while ammonia and nitrate/nitrite improvements have increased. A potential reason for this is explored in the discussion section.

Lewisburg

2012 monthly precipitation was highest during May followed by December and July with high flow events occurring in January, December, and October. Highest average monthly flows occurred during January, March, May, and December. January, May, and June were above LTMs. Annual flow was 81 percent of the LTM and all loads were less than 70 percent of their LTMs with 60, 26, and 22 percent for TN, TP, and SS, respectively. The high average months, January, March, May, and December, accounted for 58 percent of the annual flow and 59, 62, and 70 percent of the annual TN, TP, and SS loads, respectively. 2012 yields were below all four baseline predictions.

2012 long-term trends at Lewisburg remained unchanged from 2011 with no trends for TNH_3, DNH_3, DP, DOP, and TOC and downward trends for all other parameters. Short-term eight-year trends show no trends for TON, DON, DN, and SS, while showing an increase in the magnitude of the TP trend in addition to downward DP, DOP, and TOC trends.

Newport

2012 precipitation was below the LTM for all seasons except summer, which had evenly distributed rain across all three months. Highest monthly precipitation occurred during May followed by October and September, although October's rainfall was largely due to T.S. Sandy, which was Newport's most significant event of 2012. Average daily flow was highest in October followed by June, May, and December. Annual flow was 85 percent of the LTM with all loads below 76 percent of their LTMs including 67, 32, and 20 percent for TN, TP, and SS, respectively. January, May, March, and June accounted for 53 percent of the annual flow and 53, 52, and 56 percent of the annual TN, TP, and SS, respectively.

Flow remained below 3,000 cfs throughout October before Hurricane Sandy caused flow to spike to 40,000 cfs on October 31. Although the river stage had only decreased halfway from its peak by the end of the month, October accounted for 6 percent of the annual flow and 6, 14, and 21 percent of the TN, TP, and SS load, respectively. Although there were storms at the previously mentioned sites, none reached the threshold that Hurricane Sandy did such that the time period contributed substantially more TP and SS loads as compared to the respective flow contribution, with regards to LTMs. 2012 yields for TN, TP, and SS remained below all four baselines despite the significant contribution of Hurricane Sandy.

2012 long-term trends at Newport remained unchanged from 2011. TNH_3, DNH_3, TNO_x, and DNO_x had no trends, DOP had an upward trend, and all other parameters had downward trends. Short-term eight-year trends identified several changes including no trend for TON and DON and for DOP due to BMDL. Additionally, two downward trends were found in TNO_x and DNO_x, which had shown no trends since the trend period 1985-2002. Coupled with a downward trend for 2004-2012 and no long-term trend, we can conclude that as found at Marietta, TNO_x and DNO_x concentrations likely increased somewhere in the middle of the dataset.

Conestoga

2012 precipitation at Conestoga was below LTM for all seasons except fall due to the strong influence of Hurricane Sandy and two other events that reached 4,140 and 3,390 cfs before Sandy crested at 16,500 cfs on October 31. Precipitation amounts were highest for October followed by September, July, and May. Peak average daily flow in October was more than double the next highest month. Top flow months included October, June, December, and November. Annual flow was 88 percent of the LTM and all loads were less than 90 percent. Annual loads of TN, TP, and SS were 77, 46, and 27 percent of their respective LTMs. The top flow months, October, January, November, and June, accounted for 48 percent of the annual flow and 45, 73, and 90 percent of the SS loads. October alone accounted for 16 percent of the annual flow and 13, 49, and 69 percent of the annual TN, TP, and SS loads, respectively. 2012 TN, TP, and SS yields were below all four baseline predictions.

2012 long-term trends at Conestoga remained unchanged from 2011. TNO_x and DNO_x had no trends while all other parameters had downward trends. Many trends were lost when looking at the shorter eight-year trend period including TNH_3, DNH_3, TP, DP, DOP, and SS. An additional downward trend was found for TNO_x.

GROUP B SITES

2012 loads, yields, and calculated concentrations for each site are listed in Appendix B. Nutrient yields and calculated concentrations also are listed in Appendix D sorted by subbasin for comparison. Lower Susquehanna tributaries were found to have the highest yield values for TN and TP for 2012 and LTMs, including eight of the top nine TN yield sites. 2012 TN yields at Conestoga and Pequea were the highest with 28.25 and 26.32 lbs/ac, respectively. Both sites also have the highest LTM TN yields of all sites. West Conewago had the highest TOC yields for 2012, nearly double the next highest site, while LTM yields for TOC were highest for Swatara and West Conewago. 2012 yields of TN for the Juniata basin, including sites at Newport and Saxton, ranged from 5.52–6.47 lbs/ac. The Upper basin, including all NY sites, Middle basin, and the West Branch, were in the bottom half of all sites regarding long-term TN and DN yields. 2012 TN yields for these sites ranged from 2.3 to 3.85 lbs/ac. The Susquehanna mainstem had increasing 2012 TN yields moving down river with 2.31 lbs/ac at Conklin and 4.88 lbs/ac at Marietta.

TP LTM yields were more variable among subbasins. The top four sites included the lower basin sites Pequea, Conestoga, Swatara, and West Conewago, all with LTM yields above 1 lb/ac. These were followed by the Upper and Middle Susquehanna sites, and then the remainder of the lower sites intermixed with the Chemung sites. The Juniata and West Branch sites had the lowest LTM TP yields. Specifically, Karthaus had the lowest 2012 TP yield at 0.046 lbs/ac and a LTM yield at 0.143 lbs/ac. Karthaus also had the lowest LTM yields for all other parameters, except for TNH_3 and DNH_3, which both seem to be elevated when compared to other parameters and sites.

SHORT-TERM TRENDS

Short-term trend results are listed in Appendix C. In the northern basin, NY sites showed downward trends in TN, TON, and DON at all sites except Cohocton, which had no trends for any nitrogen species. Cohocton did have downward trends for TP, DP, and DOP. Downward trends also were found at Unadilla, Conklin, and Smithboro for TP and DP, both of which continued to be downward at Towanda, Wilkes-Barre, and Danville, while only TP was downward at Marietta. Conklin trends were all downward except for TOC, which had no trends at all NY sites. Downward TOC trends were found at Towanda and continued to be present at all downstream Susquehanna sites.

West Branch and Juniata subbasin sites had few trends including downward trends for TNO_x, DNO_x, TP, and DP at Newport, TN and

TOC at Saxton, and no trends at Karthaus. Lower Susquehanna trends were downward at seven of eight sites for TN and DN, while only two of eight had downward trends for TP, including Penns Creek and Marietta. Pequea had downward trends for TN, DN, TON, and DON but upward trends for DP and DOP. The only downward trends for TNH_3 and DNH_3 were at Marietta while an upward trend was found at West Conewago for DNH_3. Lack of TNH_3 and DNH_3 trends throughout the basin was most likely due to a large part of the dataset being BMDL. Downward trends in TNO_x and DNO_x were found at Shermans, West Conewago, and Swatara.

DISCUSSION

2012 was a near average year for both precipitation and flow on the heels of T.S. Lee, the most significant event to hit the basin since Hurricane Agnes. Although the majority of the basin did not have a dramatic event during 2012, Conestoga, Newport, and several of the lower Group B sites were influenced by Hurricane Sandy in October resulting in the 10th highest historical event at Conestoga; T.S. Lee was the second highest. The lack of significant events at other sites, and perhaps the flushing effects of T.S. Lee, contributed to exceptionally low loads of TP and SS, which are the parameters most closely associated with storm events. Since Hurricane Sandy was a significant event at Conestoga, those parameters were elevated as expected. Specifically, when comparing LTMs for high precipitation and flow months at Marietta with their respective nutrient loads and yields, the 2012 precipitation events appear to have had little effect. The same comparison at Conestoga showed the significant impact of Hurricane Sandy with October accounting for 69 percent of the annual SS load and only 16 percent of the annual flow. This suggests that although storm events may be present during a given year, there seems to be a discharge threshold over which we see an exponential-like increase of TP and SS loads. This threshold could be linked to watershed Best Management Practices (BMPs) and their respective efficiencies and design capacities. An additional causal factor could be changes in hydrograph dynamics due to stormwater management focused on quickly delivering runoff to streams. Increased rate of hydrograph rise and peak reached during storm events could lead to increased streambank erosion and stream bed scour.

Additional analyses that were completed on both the long-term Group A sites and new analyses that were completed on the maturing Group B sites identified several key points. Comparison of full term trends at Group A sites to trends run on the shorter time period 2004-2012 showed that several linear trends for the long-term look quite different during more recent periods. Specifically, there were no short-term trends in TON at Towanda, Danville, Lewisburg, Newport, and Marietta, while downward trends were found at four NY sites and three lower basin sites, including Pequea and Conestoga. The same pattern occurred for DON except at Towanda and Danville.

Increasing short-term trends included DON at Towanda and Danville, DNH_3 at West Conewago, and DP and DOP at Pequea. Newport and Towanda had increasing long-term DOP trends, both of which changed when the short-term trends were analyzed. The Towanda trend was downward and the Newport trend became an insignificant trend due to BMDL. Closer inspection of the long-term trend indicated the presence of a step trend, due to a change in reporting limit that occurred around 1999/2000, which likely accounted for the long-term increasing trend. The shorter term trend period, beginning in 2004, only uses data after the reporting limit change and subsequently appears to be a better indicator of a formal trend in DOP. In spite of the detection limit change, visual inspection of both Towanda and Newport datasets clearly indicate that high concentrations of DOP occurred more frequently after 1999. Likewise, the dataset at Pequea began after the change in reporting limit and detected an upward trend in DOP for 2004-2012.

The most significant implication taken from the long-term and short-term trend comparison was that, in general, the rate of reductions in nitrogen appeared to slow or stop while the rate or reductions in phosphorus appear to have increased. One possible causal factor includes the timing and focus of nutrient management efforts in the watershed, which focused on nitrogen early and evolved to focus on phosphorus.

Another possible cause to consider became apparent with the comparison of TNO_x trends results at Marietta. Closer scrutiny of TNO_x showed that periods 1987-2004 and 2004-2012 showed a downward trend, while the period 1996-2005 showed an upward trend. The indication is that although a linear trend exists for the entire dataset, non-linear fluctuations exist within the dataset. Subsequently, the linear trend may be effective at identifying the presence and overall magnitude of a trend, but it is not effective at identifying where fluctuations occurred within, which is critical to identifying effective and/or ineffective management actions and practices.

A more simplistic analysis of the baseline regression lines supports the conclusion that early improvements appear to be larger than more recent ones. This observation exists for TN, TP, and SS, and is most apparent when the initial five-year baseline regression is compared to the most recent baseline.

The last two years in the basin were very different. As previously stated, 2012 represented a relatively normal flow year while 2011 represented one of the highest flow years containing the largest event to hit the basin during the duration of the monitoring program. For comparison, 2012's highest daily average flow at Marietta was only 23 percent of the highest daily average during T.S. Lee in 2011. While TP and SS yield values were below all baselines in 2012, the opposite was true for 2011. The conclusion being that we find better water quality conditions under relatively normal water years as opposed to those years containing even one significant storm event.

Jarnagin (2007) found that when either impervious surfaces cross a 10 percent threshold or urban development crosses 20 percent in a watershed, the watershed hydrograph can become flashier. Although only Conestoga and Paxton have urban land use above 20 percent, another major influence on runoff that should be considered is agricultural BMPs, including waterways, diversions, and tile drainage, which are all meant to channel water away from fields and into waterways. Thus, the cumulative impact of urban impervious surfaces and agricultural BMPs that channel water off of farm fields could collectively alter streamflow dynamics.

Regardless of whether flow patterns have been altered, the data clearly indicate that high flow events are the driving force behind extremely high loads of both TP and SS. Given that these events continue to occur, focusing management efforts on retaining stormwater in the watershed as opposed to channeling it to the rivers could help reduce both nutrient and SS loads and flood impacts.

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APPENDIX A

Individual Long-Term Site Data

INDIVIDUAL SITES: TOWANDA

Table A1. 2012 Annual and Seasonal Precipitation and Discharge at Towanda

Season	Precipitation (inches)			Discharge (cfs)		
	2012	LTM	LTM Departure	2012	LTM	% LTM
January-March (Winter)	6.72	7.61	-0.89	13,074	16,553	79
April-June (Spring)	10.05	10.77	-0.72	8,151	15,405	53
July-September (Summer)	10.68	11.32	-0.64	1,671	4,835	35
October-December (Fall)	11.58	9.37	2.22	8,576	10,953	78
Annual Total	39.04	39.06	-0.02	7,817	11,905	66

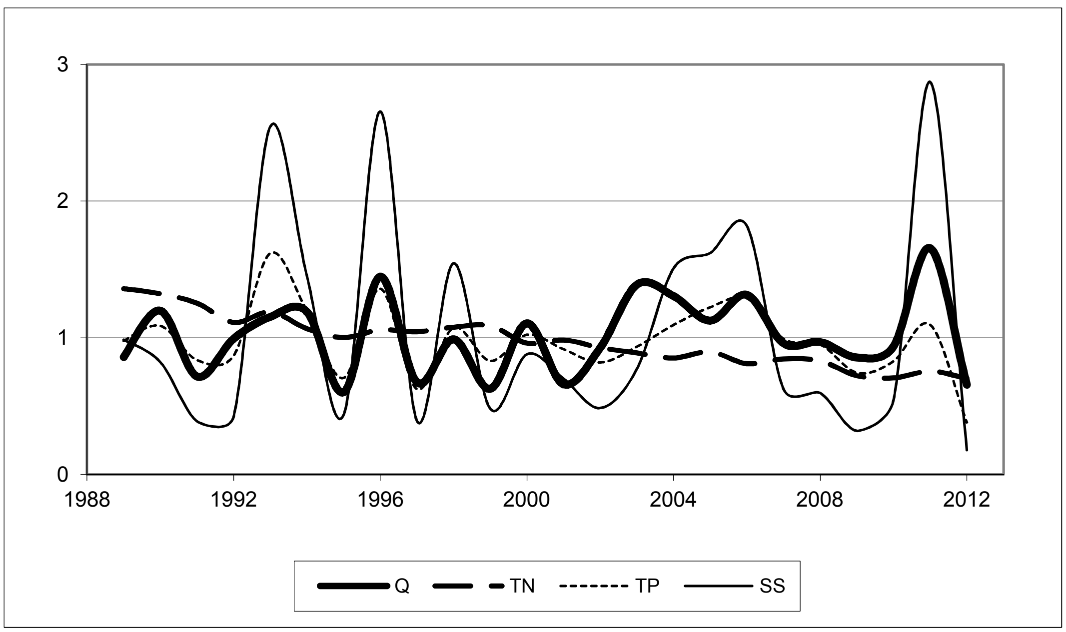

Figure A1. Annual Discharge and Calculated Annual TN, TP, and SS Concentrations Expressed as LTM Ratio

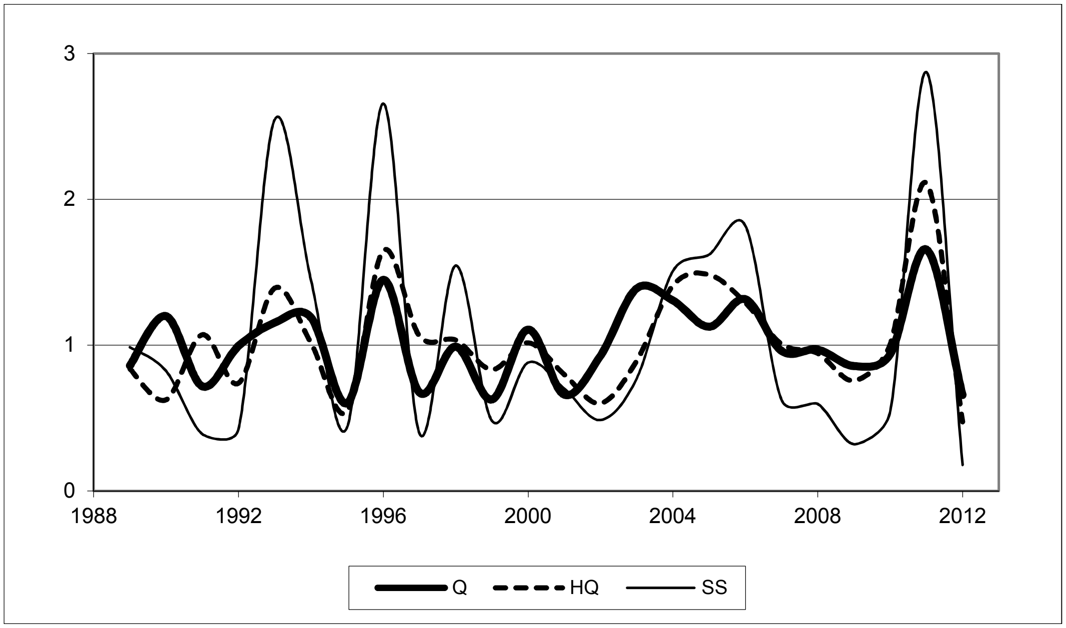

Figure A2. Annual Discharge and Annual Daily Mean High Discharge and Calculated Annual SS Concentration Expressed as LTM Ratio

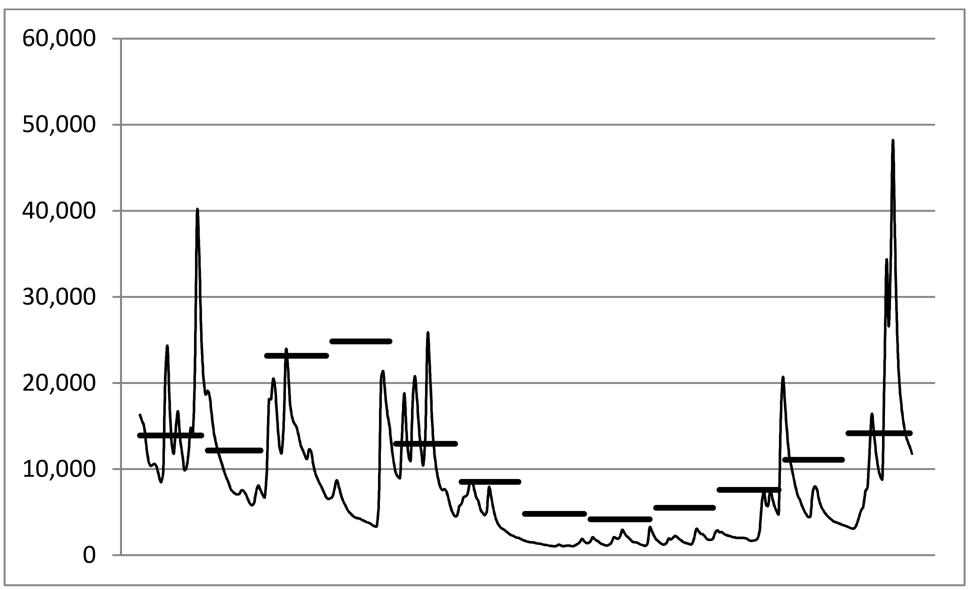

Figure A3. 2012 Daily Average Flow and Monthly LTM at Towanda

Table A2. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Towanda

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	12,435	47%	3%	2.49	5.33	0.81	70%
TON	3,832	39%	7%	0.77	1.98	0.25	58%
TNH_3	485	37%	10%	0.10	0.26	0.03	55%
TNO_x	8,318	52%	6%	1.67	3.18	0.54	79%
DN	12,185	52%	4%	2.44	4.66	0.79	79%
DON	3,391	49%	7%	0.68	1.38	0.22	74%
DNH_3	482	46%	10%	0.10	0.21	0.03	70%
DNO_x	8,486	54%	6%	1.70	3.15	0.55	82%
TP	554	24%	8%	0.111	0.466	0.036	35%
DP	244	31%	9%	0.049	0.157	0.016	47%
DOP	198	44%	11%	0.040	0.090	0.013	66%
TOC	36,436	45%	3%	7.30	16.31	2.36	67%
SS	322,331	10%	14%	64.6	645.2	20.9	15%

Table A3. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Towanda

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	5,489	1.10	3,074	0.62	534	0.11	3,338	0.67
TON	1,295	0.26	1,174	0.24	353	0.07	1,010	0.20
TNH_3	207	0.04	124	0.02	23	0.00	131	0.03
TNO_x	4,216	0.84	1,730	0.35	158	0.03	2,214	0.44
DN	5,589	1.12	2,851	0.57	433	0.09	3,312	0.66
DON	1,239	0.25	975	0.20	250	0.05	927	0.19
DNH_3	205	0.04	123	0.02	23	0.00	131	0.03
DNO_x	4,301	0.86	1,762	0.35	158	0.03	2,265	0.45
TP	204	0.041	166	0.033	38	0.008	146	0.029
DP	96	0.019	71	0.014	18	0.004	59	0.012
DOP	79	0.016	56	0.011	14	0.003	49	0.010
TOC	13,088	2.62	10,041	2.01	2,469	0.49	10,838	2.17
SS	105,271	21.1	106,830	21.4	5,919	1.2	104,311	20.9

Table A4. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Towanda

Month	Flow		TN			TP			SS		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	15,731	113%	2,279	0.46	77%	92	0.019	40%	53,124	10.6	15%
February	9,656	79%	1,302	0.26	55%	41	0.008	32%	15,099	3.0	17%
March	13,193	57%	1,908	0.38	41%	71	0.014	19%	37,048	7.4	8%
April	7,829	32%	1,023	0.21	21%	45	0.009	10%	26,386	5.3	4%
May	11,741	91%	1,513	0.30	65%	89	0.018	51%	67,797	13.6	31%
June	4,763	56%	538	0.11	40%	32	0.006	22%	12,647	2.5	5%
July	1,309	27%	143	0.03	20%	11	0.002	14%	1,450	0.3	2%
August	1,788	43%	190	0.04	31%	14	0.003	20%	2,414	0.5	4%
September	1,924	35%	201	0.04	26%	13	0.003	8%	2,055	0.4	0%
October	4,343	57%	504	0.10	40%	26	0.005	20%	11,713	2.3	10%
November	6,404	58%	753	0.15	38%	31	0.006	18%	12,784	2.6	8%
December	14,911	105%	2,081	0.42	77%	89	0.018	45%	79,814	16.0	49%
Annual[#]	7,817		12,435	2.49		554	0.343		322,331	64.6	

Table A5. 2012 Annual Comparison to Baselines at Towanda

Parameter	2011	Period	Y'	Q ratio	R^2
TN	2.49	89-93	4.737	0.68	0.86
		89-00	4.359	0.69	0.86
		01-12	2.929	0.62	0.89
		89-12	3.791	0.66	0.61
TP	0.111	89-93	0.211	0.68	0.70
		89-00	0.246	0.69	0.88
		01-12	0.238	0.62	0.85
		89-12	0.241	0.66	0.83
SS	65	89-93	151	0.68	0.54*
		89-00	176	0.69	0.81*
		01-12	109	0.62	0.75*
		89-12	129	0.66	0.79*

Q = discharge ratio
R^2 = correlation coefficient
* indicates where an exponential regression was used as it yields a better fit to the data

Table A6. Trend Statistics for the Susquehanna River at Towanda, Pa., October 1988 Through September 2012

Parameter	STORET Code	Time Series/Test	Slope	P-Value	Slope Magnitude (%)			Trend % Change	Trend Direction
					Min	Trend	Max		
FLOW	60	SK	-	0.347	-	-	-	-	NS
TN	600	FAC	-0.025	<0.001	-48	-45	-43	43-48	Down
TON	605	FAC	-0.026	<0.001	-53	-47	-40	40-53	Down
TNH_3	610	FAC	-0.027	<0.001	-56	-47	-37	37-56	Down
TKN	625	FAC	-0.027	<0.001	-53	-47	-41	41-53	Down
TNOx	630	FAC	-0.026	<0.001	-51	-47	-41	41-51	Down
DN	602	FAC	-0.023	<0.001	-45	-42	-38	38-45	Down
DON	607	FAC	-0.020	<0.001	-46	-38	-30	30-46	Down
DNH_3	608	FAC	-0.016	<0.001	-43	-32	-19	N/A	BMDL
DKN	623	FAC	-0.021	<0.001	-46	-40	-33	33-46	Down
DNOx	631	FAC	-0.025	<0.001	-50	-45	-40	40-50	Down
TP	665	FAC	-0.008	0.004	-28	-18	-6	6-28	Down
DP	666	FAC	-0.012	<0.001	-35	-24	-12	12-35	Down
DOP	671	FAC	0.072	<0.001	351	465	609	351-609	Up
TOC	680	FAC	-0.006	<0.001	-19	-14	-9	9-19	Down
SS	80154	FAC	-0.016	0.001	-45	-32	-15	15-45	Down

Down = downward/improving trend
Up = Upward/degrading trend
BMDL = Greater than 20% of values were Below Method Detection Limit
NS = No significant trend

INDIVIDUAL SITES: DANVILLE

Table A7. 2012 Annual and Seasonal Precipitation and Discharge at Danville

Season	Precipitation (inches)			Discharge (cfs)		
	2012	LTM	LTM Departure	2012	LTM	% LTM
January-March (Winter)	6.70	7.76	-1.06	18,512	22,940	81
April-June (Spring)	10.25	10.90	-0.65	13,241	21,372	62
July-September (Summer)	10.68	11.54	-0.86	2,882	7,214	40
October-December (Fall)	11.48	9.45	2.03	13,178	15,977	82
Annual Total	39.11	39.65	-0.54	11,881	16,834	71

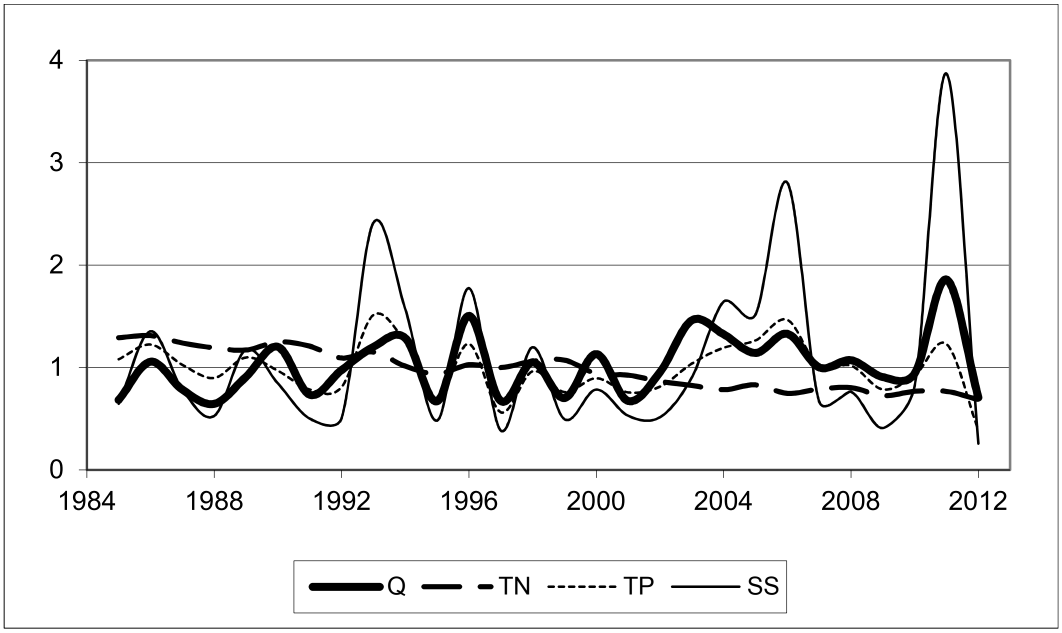

Figure A4. Annual Discharge and Calculated Annual TN, TP, and SS Concentrations Expressed as LTM Ratio

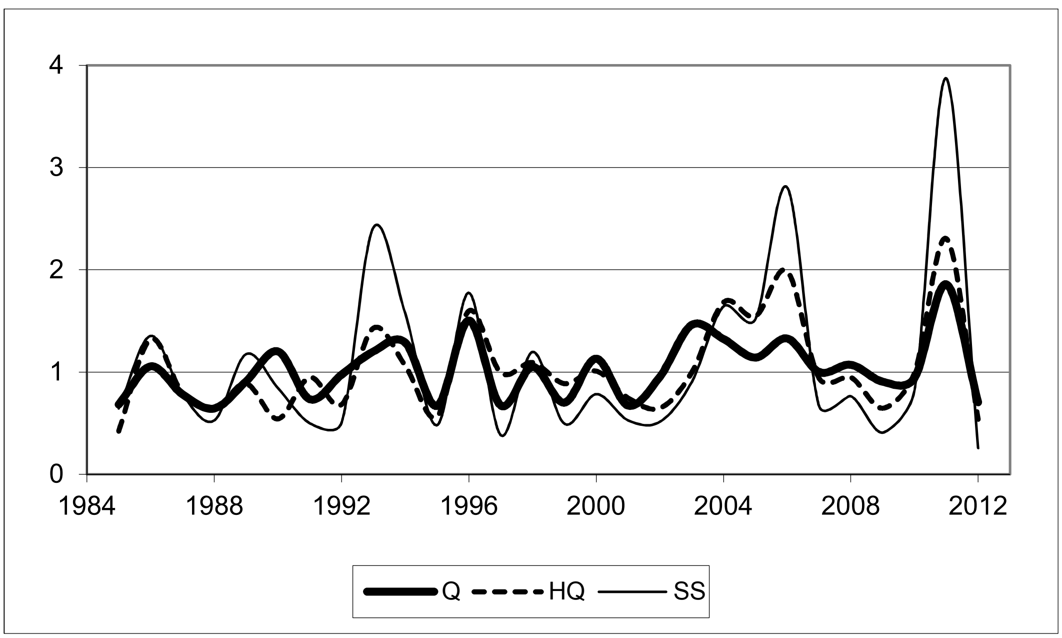

Figure A5. Annual Discharge and Annual Daily Mean High Discharge and Calculated Annual SS Concentration Expressed as LTM Ratio

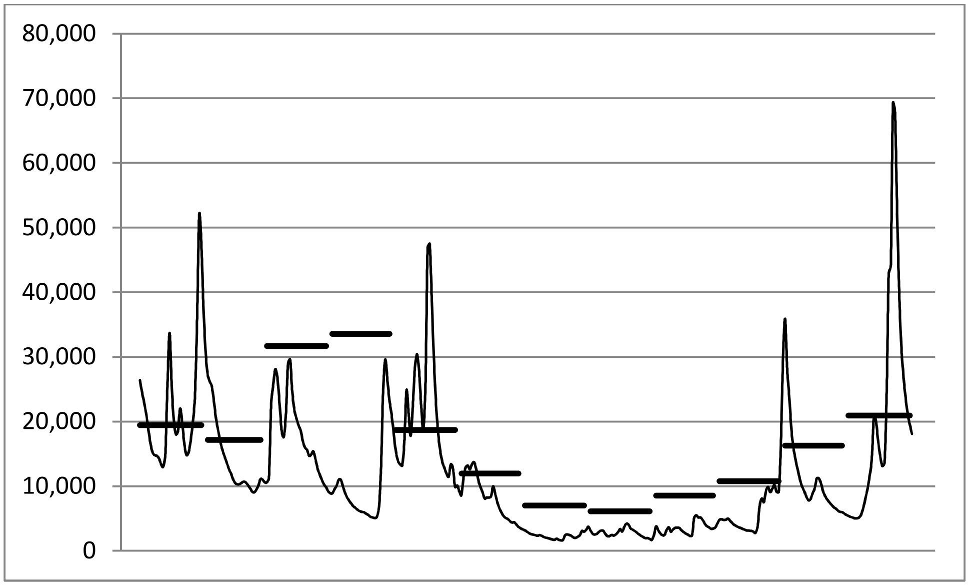

Figure A6. 2012 Daily Average Flow and Monthly LTM at Danville

Table A8. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Danville

Parameter	Load	Load % of LTM	Error %	Yield lbs	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	20,851	49%	3%	2.90	5.87	0.89	70%
TON	5,957	38%	7%	0.83	2.19	0.25	54%
TNH_3	936	44%	10%	0.13	0.29	0.04	63%
TNO_x	14,411	58%	5%	2.01	3.47	0.62	82%
DN	20,043	56%	4%	2.79	5.00	0.86	79%
DON	4,655	48%	9%	0.65	1.36	0.20	68%
DNH_3	919	49%	11%	0.13	0.26	0.04	70%
DNO_x	14,489	59%	5%	2.02	3.45	0.62	83%
TP	946	26%	9%	0.132	0.508	0.040	37%
DP	336	32%	11%	0.047	0.145	0.014	46%
DOP	212	36%	16%	0.030	0.083	0.009	51%
TOC	54,815	48%	4%	7.63	16.03	2.34	67%
SS	581,204	15%	13%	80.9	527.6	24.8	22%

Table A9. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Danville

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	8,713	1.21	5,455	0.76	947	0.13	5,736	0.80
TON	1,944	0.27	2,005	0.28	487	0.07	1,521	0.21
TNH_3	399	0.06	257	0.04	38	0.01	242	0.03
TNO_x	6,658	0.93	3,167	0.44	394	0.05	4,192	0.58
DN	8,697	1.21	4,916	0.68	824	0.11	5,606	0.78
DON	1,650	0.23	1,389	0.19	368	0.05	1,248	0.17
DNH_3	398	0.06	242	0.03	38	0.01	241	0.03
DNO_x	6,714	0.94	3,162	0.44	392	0.05	4,221	0.59
TP	333	0.046	301	0.042	48	0.007	264	0.037
DP	128	0.018	102	0.014	23	0.003	83	0.012
DOP	84	0.012	63	0.009	12	0.002	53	0.007
TOC	18,237	2.54	16,266	2.27	3,917	0.55	16,395	2.28
SS	164,842	23.0	204,519	28.5	7,226	1.0	204,617	28.5

Table A10. 2012 Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Danville

MONTH	Flow		TN			TP			SS		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	22,397	115%	3,665	0.51	77%	156	0.022	44%	87,353	12.2	29%
February	14,547	85%	2,199	0.31	58%	72	0.010	36%	28,254	3.9	26%
March	17,738	56%	2,849	0.40	40%	105	0.015	18%	49,235	6.9	9%
April	10,854	32%	1,545	0.22	22%	64	0.009	10%	31,946	4.4	4%
May	20,519	110%	2,929	0.41	83%	185	0.026	65%	153,002	21.3	59%
June	8,106	68%	981	0.14	49%	52	0.007	22%	19,571	2.7	5%
July	2,361	34%	261	0.04	23%	13	0.002	11%	1,680	0.2	2%
August	2,754	45%	299	0.04	31%	16	0.002	15%	2,321	0.3	4%
September	3,552	41%	387	0.05	35%	19	0.003	7%	3,225	0.4	<1%
October	6,717	62%	844	0.12	44%	39	0.005	20%	15,980	2.2	12%
November	11,267	69%	1,482	0.21	43%	66	0.009	23%	36,436	5.1	21%
December	21,489	103%	3,410	0.47	73%	159	0.022	45%	152,201	21.2	13%
Annual[#]	11,881		20,851	2.90		946	0.343		581,204	80.9	

Table A11. 2012 Annual Comparison to Baselines at Danville

Parameter	2012	Period	Y'	Q ratio	R^2
TN	2.90	85-89	6.853	0.89	0.95
		85-98	5.396	0.76	0.87
		99-12	3.565	0.66	0.896
		85-12	4.62	0.71	0.59
TP	0.13	85-89	0.493	0.89	0.974
		85-98	0.338	0.76	0.8635
		99-12	0.205	0.66	0.904
		85-12	0.275	0.71	0.878
SS	81	85-89	418.1	0.89	0.99
		85-98	231.74	0.76	0.77
		99-12	115.77	0.66	0.86*
		85-12	154.38	0.71	0.83*

Q = discharge ratio
R^2 = correlation coefficient
* indicates where an exponential regression was used as it yields a better fit to the data

Table A12. Trend Statistics for the Susquehanna River at Danville, Pa., October 1984 Through September 2012

Parameter	STORET Code	Time Series/Test	Slope	P-Value	Slope Magnitude (%)			Trend % Change	Trend Direction
					Min	Trend	Max		
FLOW	60	SK	-	0.186	-	-	-	-	NS
TN	600	FAC	-0.024	<0.001	-52	-49	-47	47-52	Down
TON	605	FAC	-0.031	<0.001	-63	-58	-53	53-63	Down
TNH_3	610	FAC	-0.025	<0.001	-59	-51	-42	42-59	Down
TKN	625	FAC	-0.030	<0.001	-62	-58	-53	53-62	Down
TNO_x	630	FAC	-0.020	<0.001	-47	-43	-38	38-47	Down
DN	602	FAC	-0.020	<0.001	-46	-43	-39	39-46	Down
DON	607	FAC	-0.025	<0.001	-56	-50	-44	44-56	Down
DNH_3	608	FAC	-0.020	<0.001	-52	-42	-31	N/A	BMDL
DKN	623	FAC	-0.024	<0.001	-54	-49	-43	43-54	Down
DNOx	631	FAC	-0.019	<0.001	-47	-42	-36	36-47	Down
TP	665	FAC	-0.016	<0.001	-45	-36	-27	27-45	Down
DP	666	FAC	-0.008	0.004	-33	-21	-7	7-33	Down
DOP	671	FAC	0.069	<0.001	389	540	738	N/A	BMDL
TOC	680	FAC	-0.010	<0.001	-28	-24	-19	19-28	Down
SS	80154	FAC	-0.027	<0.001	-62	-54	-45	45-62	Down

Down = downward/improving trend
Up = Upward/degrading trend
BMDL = Greater than 20% of values were Below Method Detection Limit
NS = No significant trend

INDIVIDUAL SITES: MARIETTA

Table A13. 2012 Annual and Seasonal Precipitation and Discharge at Marietta

Season	Precipitation (inches)			Discharge (cfs)		
	2012	LTM	LTM Departure	2012	LTM	% LTM
January-March (Winter)	6.78	8.16	-1.38	48,329	55,117	88
April-June (Spring)	10.79	10.99	-0.20	34,769	50,091	69
July-September (Summer)	12.51	11.90	0.61	9,730	18,370	53
October-December (Fall)	10.88	9.69	1.19	32,326	36,433	89
Annual Total	40.96	40.74	0.22	31,100	39,903	78

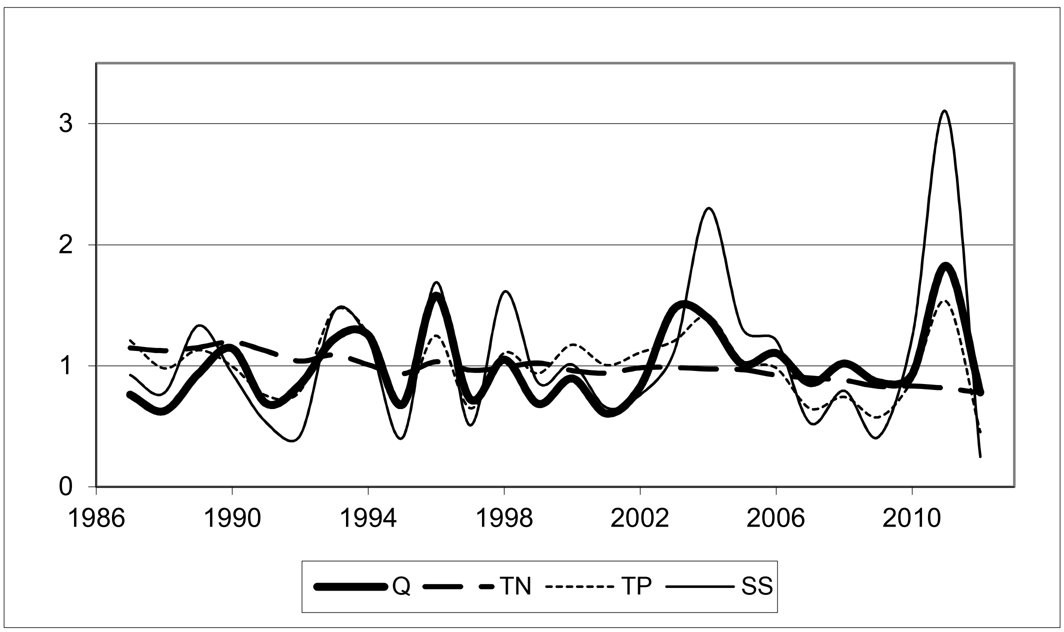

Figure A7. Annual Discharge and Calculated Annual TN, TP, and SS Concentrations Expressed as LTM Ratio

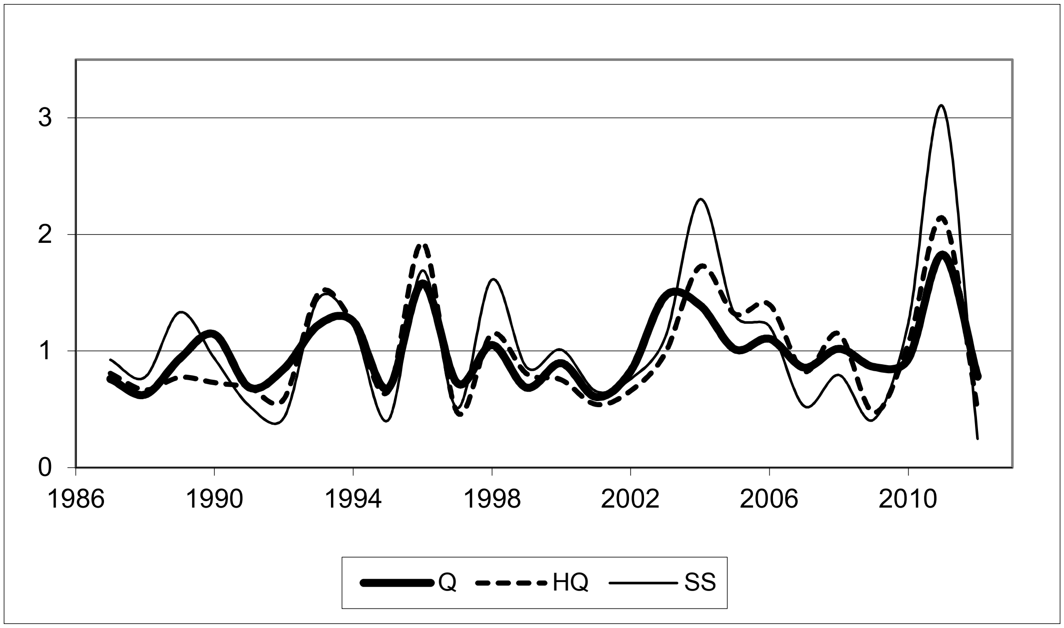

Figure A8. Annual Discharge and Annual Daily Mean High Discharge and Calculated Annual SS Concentration Expressed as LTM Ratio

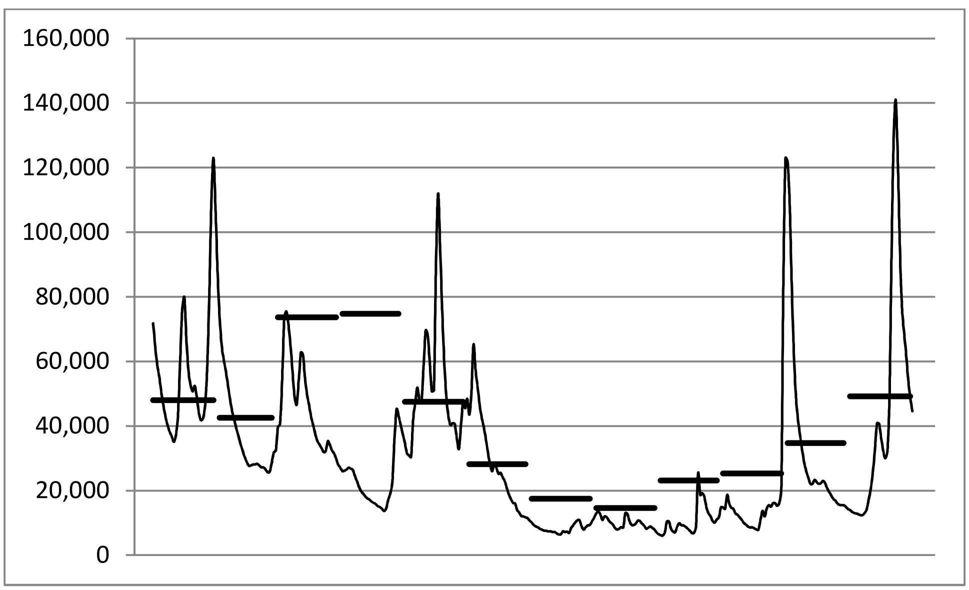

Figure A9. 2012 Daily Average Flow and Monthly LTM at Marietta

Table A14. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Marietta

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	77,054	61%	4%	4.63	7.60	1.26	78%
TON	15,933	47%	9%	0.96	2.05	0.26	60%
TNH_3	2,227	50%	9%	0.13	0.27	0.04	64%
TNO_x	58,025	65%	4%	3.49	5.36	0.95	83%
DN	70,305	64%	4%	4.23	6.62	1.15	82%
DON	10,563	56%	12%	0.64	1.13	0.17	72%
DNH_3	2,081	53%	9%	0.13	0.23	0.03	68%
DNO_x	58,180	66%	4%	3.50	5.33	0.95	84%
TP	2,587	33%	7%	0.156	0.467	0.042	43%
DP	904	41%	8%	0.054	0.132	0.015	53%
DOP	733	60%	9%	0.044	0.074	0.012	76%
TOC	143,055	59%	4%	8.60	14.47	2.34	76%
SS	1,226,717	17%	10%	73.7	443.5	20.0	21%

Table A15. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Marietta

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	30,790	1.85	18,988	1.14	5,172	0.31	22,104	1.33
TON	5,003	0.30	4,932	0.30	1,511	0.09	4,487	0.27
TNH_3	921	0.06	579	0.03	142	0.01	585	0.04
TNO_x	24,531	1.47	13,352	0.80	3,491	0.21	16,651	1.00
DN	28,774	1.73	16,459	0.99	4,677	0.28	20,395	1.23
DON	3,548	0.21	2,684	0.16	1,161	0.07	3,170	0.19
DNH_3	856	0.05	535	0.03	134	0.01	556	0.03
DNO_x	24,603	1.48	13,391	0.81	3,500	0.21	16,686	1.00
TP	797	0.05	764	0.05	165	0.01	861	0.05
DP	283	0.02	214	0.01	85	0.01	322	0.02
DOP	218	0.01	162	0.01	71	0.00	282	0.02
TOC	46,533	2.80	41,864	2.52	13,457	0.81	41,201	2.48
SS	347,442	20.9	402,917	24.2	30,591	1.8	445,767	26.8

Table A16. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Marietta

Month	Flow		TN			TP			SS		
	2011	% LTM	Load	Yield	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	58,626	122%	13,505	0.81	90%	392	0.024	53%	186,864	11.2	27%
February	38,797	91%	7,884	0.47	70%	171	0.010	41%	63,778	3.8	25%
March	45,390	62%	9,401	0.57	49%	234	0.014	20%	96,800	5.8	9%
April	23,370	31%	4,224	0.25	23%	96	0.006	7%	30,136	1.8	2%
May	52,155	110%	9,849	0.59	89%	460	0.028	66%	278,257	16.7	44%
June	28,203	100%	4,915	0.30	80%	208	0.013	48%	94,524	5.7	23%
July	8,440	48%	1,413	0.08	35%	44	0.003	19%	7,503	0.5	5%
August	9,894	68%	1,748	0.11	52%	58	0.004	28%	10,769	0.6	8%
September	10,892	47%	2,011	0.12	44%	63	0.004	7%	12,319	0.7	1%
October	18,730	74%	4,038	0.24	61%	179	0.011	42%	93,077	5.6	30%
November	32,807	94%	7,230	0.43	74%	303	0.018	58%	158,951	9.6	47%
December	45,458	92%	10,836	0.65	74%	379	0.023	52%	193,739	11.6	13%
Annual	31,100		77,054	4.63		2,587	0.343		1,226,717	73.7	

Table A17. 2012 Annual Comparison to Baselines at Marietta

Parameter	2012	Period	Y'	Q ratio	R^2
TN	4.63	87-91	8.54	0.93	1.00
		85-99	6.90	0.82	0.95
		00-12	5.32	0.74	0.92
		87-12	6.13	0.78	0.86
TP	0.156	87-91	0.425	0.93	0.79
		85-99	0.356	0.82	0.91
		00-12	0.212	0.74	0.90
		87-12	0.290	0.78	0.89
SS	74	87-91	338	0.93	0.70
		85-99	268	0.82	0.88
		00-12	159	0.74	0.79*
		87-12	189	0.78	0.79*

Q = discharge ratio
R^2 = correlation coefficient
* indicates where an exponential regression was used as it yields a better fit to the data

Table A18. Trend Statistics for the Susquehanna River at Marietta, Pa., October 1986 Through September 2012

Parameter	STORET Code	Time Series/Test	Slope	P-Value	Slope Magnitude (%) Min	Slope Magnitude (%) Trend	Slope Magnitude (%) Max	Trend % Change	Trend Direction
FLOW	60	SK	-	0.632	-	-	-	-	NS
TN	600	FAC	-0.016	<0.001	-37	-34	-30	30-37	Down
TON	605	FAC	-0.027	<0.001	-57	-51	-44	44-57	Down
TNH_3	610	FAC	-0.014	<0.001	-42	-32	-20	20-42	Down
TKN	625	FAC	-0.025	<0.001	-55	-49	-42	42-55	Down
TNO_x	630	FAC	-0.010	<0.001	-28	-23	-18	18-28	Down
DN	602	FAC	-0.022	<0.001	-48	-44	-41	41-48	Down
DON	607	FAC	-0.030	<0.001	-61	-54	-47	47-61	Down
DNH_3	608	FAC	-0.012	<0.001	-38	-28	-15	N/A	BMDL
DKN	623	FAC	-0.027	<0.001	-57	-51	-45	45-57	Down
DNO_x	631	FAC	-0.010	<0.001	-28	-23	-18	18-28	Down
TP	665	FAC	-0.018	<0.001	-44	-37	-28	28-44	Down
DP	666	FAC	-0.026	<0.001	-55	-49	-42	42-55	Down
DOP	671	FAC	0.067	<0.001	318	434	581	N/A	BMDL
TOC	680	FAC	-0.007	<0.001	-21	-16	-11	11-21	Down
SS	80154	FAC	-0.022	<0.001	-53	-43	-32	32-53	Down

Down = downward/improving trend
Up = Upward/degrading trend
BMDL = Greater than 20% of values were Below Method Detection Limit
NS = No significant trend

INDIVIDUAL SITES: LEWISBURG

Table A19. 2012 Annual and Seasonal Precipitation and Discharge at Lewisburg

Season	Precipitation (inches) 2012	Precipitation (inches) LTM	Precipitation (inches) LTM Departure	Discharge (cfs) 2012	Discharge (cfs) LTM	Discharge (cfs) % LTM
January-March (Winter)	7.20	8.37	-1.18	15,353	15,433	99
April-June (Spring)	11.57	11.24	0.33	9,668	13,101	74
July-September (Summer)	13.19	12.79	0.41	2,580	5,055	51
October-December (Fall)	10.55	9.94	0.61	8,049	10,371	78
Annual Total	42.51	42.35	0.16	8,851	10,963	81

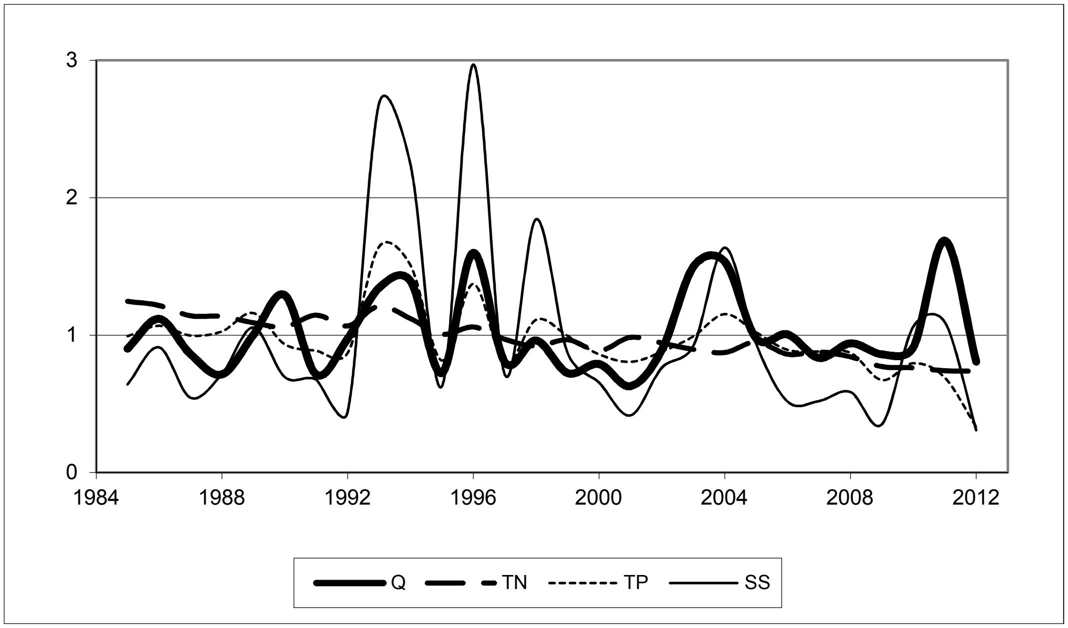

Figure A10. Annual Discharge and Calculated Annual TN, TP, and SS Concentrations Expressed as LTM Ratio

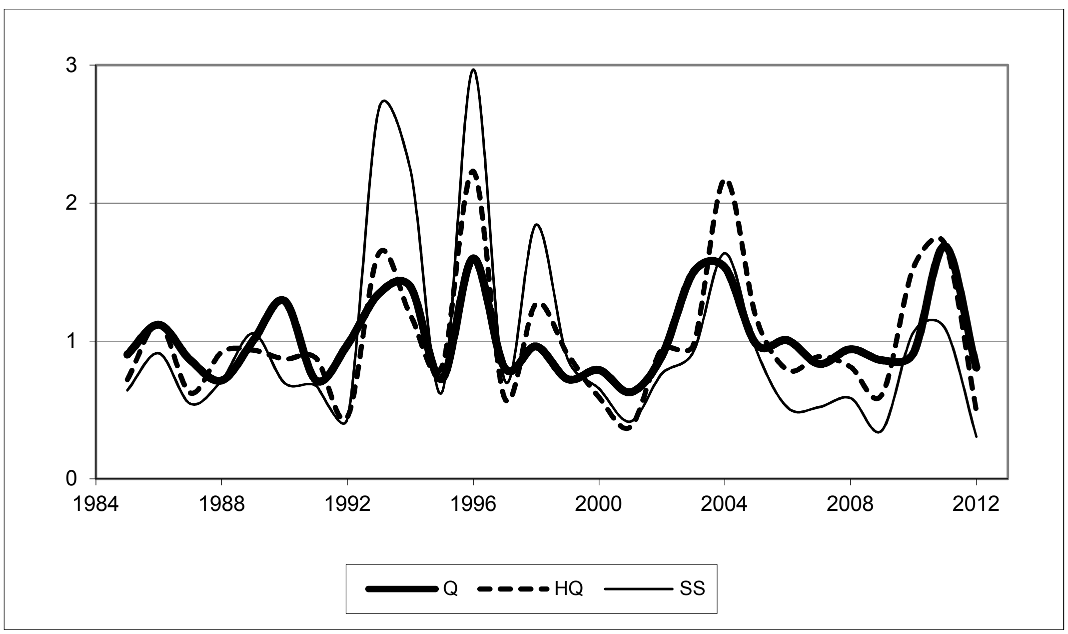

Figure A11. Annual Discharge and Annual Daily Mean High Discharge and Calculated Annual SS Concentration Expressed as LTM Ratio

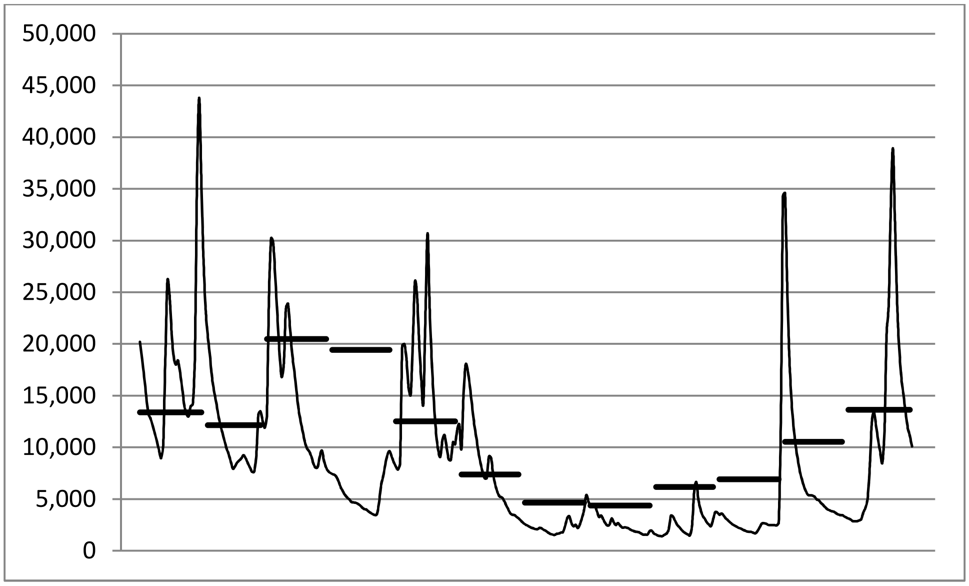

Figure A12. 2012 Daily Average Flow and Monthly LTM at Lewisburg

Table A20. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Lewisburg

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	13,521	60%	4%	3.09	5.16	0.78	74%
TON	3,069	43%	12%	0.70	1.62	0.18	54%
TNH_3	634	61%	9%	0.14	0.24	0.04	76%
TNO_x	9,829	67%	4%	2.24	3.35	0.56	83%
DN	12,862	64%	4%	2.94	4.57	0.74	80%
DON	2,204	46%	10%	0.50	1.09	0.13	57%
DNH_3	624	69%	9%	0.14	0.21	0.04	85%
DNO_x	9,849	68%	4%	2.25	3.33	0.57	84%
TP	311	26%	10%	0.071	0.274	0.018	32%
DP	88	19%	17%	0.020	0.103	0.005	24%
DOP	61	27%	24%	0.014	0.052	0.004	34%
TOC	26,778	59%	4%	6.11	10.32	1.54	73%
SS	246,889	22%	15%	56.3	256.2	14.2	27%

Table A21. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acres) at Lewisburg

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	6,026	1.38	3,331	0.76	980	0.22	3,184	0.73
TON	1,192	0.27	884	0.20	288	0.07	705	0.16
TNH_3	292	0.07	168	0.04	40	0.01	134	0.03
TNO_x	4,517	1.03	2,280	0.52	668	0.15	2,364	0.54
DN	5,779	1.32	3,120	0.71	934	0.21	3,029	0.69
DON	885	0.20	620	0.14	211	0.05	488	0.11
DNH_3	296	0.07	159	0.04	36	0.01	133	0.03
DNO_x	4,525	1.03	2,276	0.52	672	0.15	2,376	0.54
TP	129	0.029	98	0.022	21	0.005	63	0.014
DP	35	0.008	32	0.007	8	0.002	13	0.003
DOP	26	0.006	21	0.005	5	0.001	9	0.002
TOC	10,196	2.33	7,419	1.69	2,395	0.55	6,768	1.54
SS	107,610	24.6	67,987	15.5	5,807	1.3	65,485	14.9

Table A22. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Lewisburg

Monthly	Flow		TN			TP			SS		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	18,385	137%	2,500	0.57	93%	58	0.013	42%	53,576	12.2	30%
February	11,669	96%	1,515	0.35	70%	26	0.006	31%	17,250	3.9	30%
March	15,271	75%	2,011	0.46	56%	45	0.010	22%	36,784	8.4	18%
April	5,744	30%	738	0.17	23%	12	0.003	6%	5,217	1.2	2%
May	15,156	121%	1,729	0.39	91%	59	0.013	57%	47,059	10.7	56%
June	7,921	107%	864	0.20	78%	27	0.006	47%	15,711	3.6	53%
July	2,466	53%	312	0.07	42%	7	0.002	18%	1,793	0.4	11%
August	2,522	58%	320	0.07	47%	7	0.002	16%	1,879	0.4	7%
September	2,757	45%	348	0.08	41%	7	0.002	10%	2,135	0.5	2%
October	3,811	55%	506	0.12	46%	11	0.003	18%	9,872	2.3	23%
November	7,746	73%	973	0.22	52%	21	0.005	22%	19,704	4.5	25%
December	12,581	92%	1,705	0.39	68%	31	0.007	27%	35,909	8.2	21%
Annual#	8,851		13,521	3.09		311	0.343		246,889	56.3	

Table A23. 2012 Annual Comparison to Baselines at Lewisburg

Parameter	2012	Period	Y’	Q ratio	R^2
TN	3.09	85-89	5.56	0.90	0.91
		85-98	4.66	0.80	0.922
		99-12	3.79	0.81	0.9
		85-12	4.26	0.81	0.74
TP	0.071	85-89	0.259	0.90	0.916
		85-98	0.205	0.80	0.868
		99-12	0.186	0.81	0.71
		85-12	0.200	0.81	0.6869
SS	56	85-89	165	0.90	0.71
		85-98	115	0.80	0.74
		99-12	121	0.81	0.79
		85-12	121	0.81	0.69*

Q = discharge ratio
R^2 = correlation coefficient
* indicates where an exponential regression was used as it yields a better fit to the data

Table A24. Trend Statistics for the West Branch Susquehanna River at Lewisburg, Pa., October 1984 Through September 2012

Parameter	STORET Code	Time Series/Test	Slope	P-Value	Slope Magnitude (%) Min	Slope Magnitude (%) Trend	Slope Magnitude (%) Max	Trend % Change	Trend Direction
FLOW	60	SK	-	0.956	-	-	-	-	NS
TN	600	FAC	-0.017	<0.001	-43	-39	-34	34-43	Down
TON	605	FAC	-0.038	<0.001	-71	-66	-60	60-71	Down
TNH_3	610	FAC	-0.015	<0.001	-45	-34	-22	N/A	BMDL
TKN	625	FAC	-0.032	<0.001	-65	-60	-53	53-65	Down
TNO_x	630	FAC	-0.008	0.003	-26	-21	-15	15-26	Down
DN	602	FAC	-0.015	<0.001	-38	-34	-29	29-38	Down
DON	607	FAC	-0.033	<0.001	-66	-60	-54	54-66	Down
DNH_3	608	FAC	-0.009	<0.001	-35	-23	-9	N/A	BMDL
DKN	623	FAC	-0.031	<0.001	-64	-59	-53	53-64	Down
DNO_x	631	FAC	-0.008	<0.001	-26	-21	-15	15-26	Down
TP	665	FAC	-0.024	<0.001	-57	-49	-39	39-57	Down
DP	666	FAC	-0.036	<0.001	-71	-64	-56	N/A	BMDL
DOP	671	FAC	0.045	<0.001	148	241	369	N/A	BMDL
TOC	680	FAC	<0.001	0.732	-9	-1	6	N/A	NS
SS	80154	FAC	-0.019	<0.001	-53	-41	-26	26-53	Down

Down = downward/improving trend
Up = Upward/degrading trend
BMDL = Greater than 20% of values were Below Method Detection Limit
NS = No significant trend

INDIVIDUAL SITES: NEWPORT

Table A25. 2012 Annual and Seasonal Precipitation and Discharge at Newport

Season	Precipitation (inches)			Discharge (cfs)		
	2012	LTM	LTM Departure	2012	LTM	% LTM
January-March (Winter)	6.87	7.66	-0.79	5,685	6,513	87
April-June (Spring)	10.85	10.12	0.74	4,853	5,577	87
July-September (Summer)	12.49	10.44	2.05	1,133	2,021	56
October-December (Fall)	9.14	9.26	-0.11	3,714	3,859	96
Annual Total	39.36	37.47	1.89	3,823	4,480	85

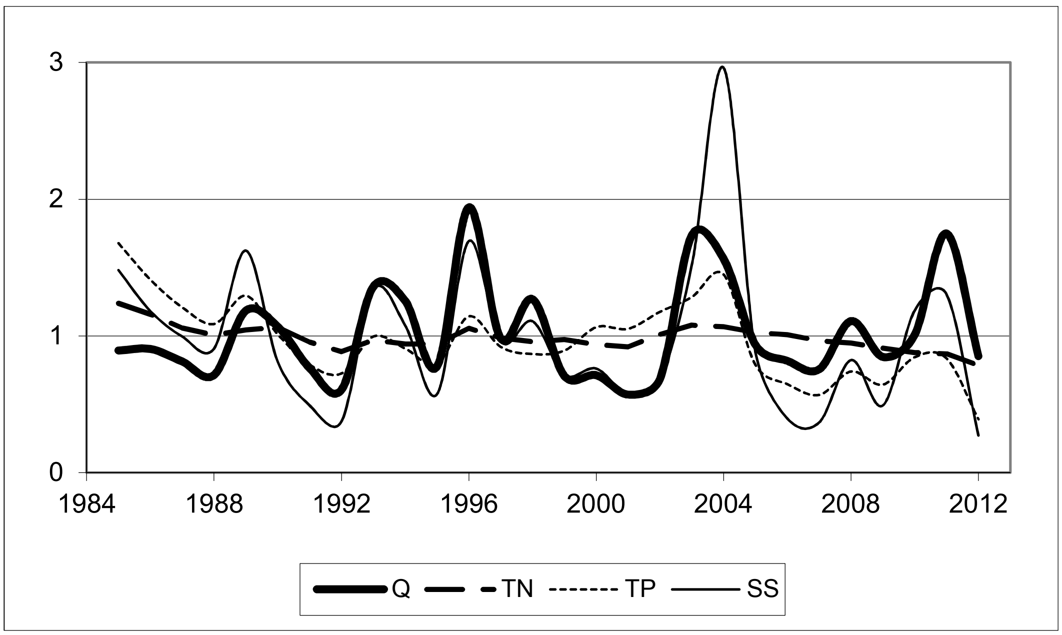

Figure A13. Annual Discharge and Calculated Annual TN, TP, and SS Concentrations Expressed as LTM Ratio

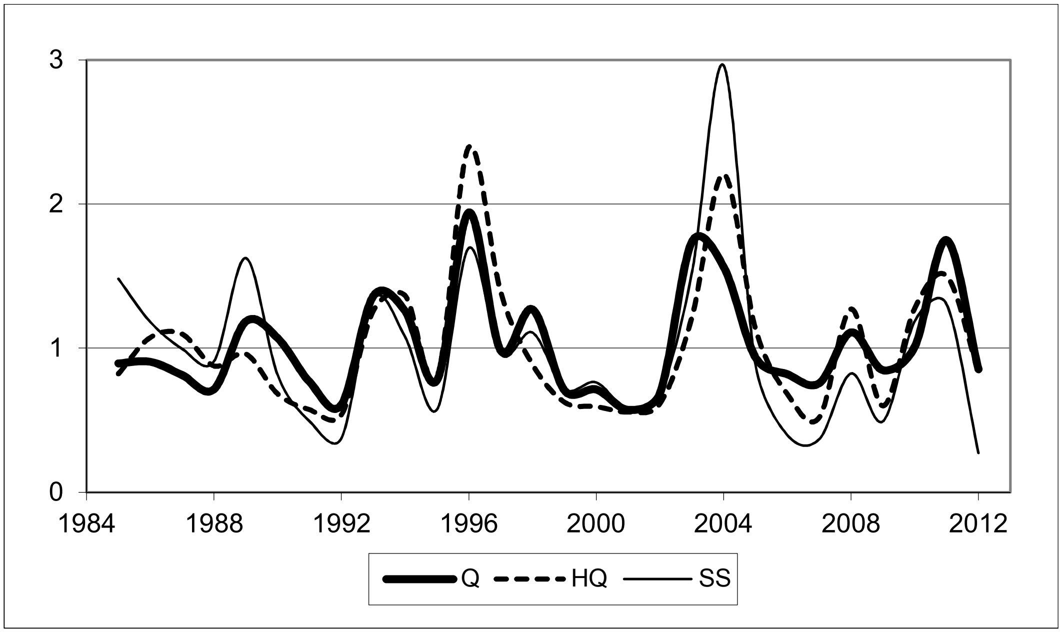

Figure A14. Annual Discharge and Annual Daily Mean High Discharge and Calculated Annual SS Concentration Expressed as LTM Ratio

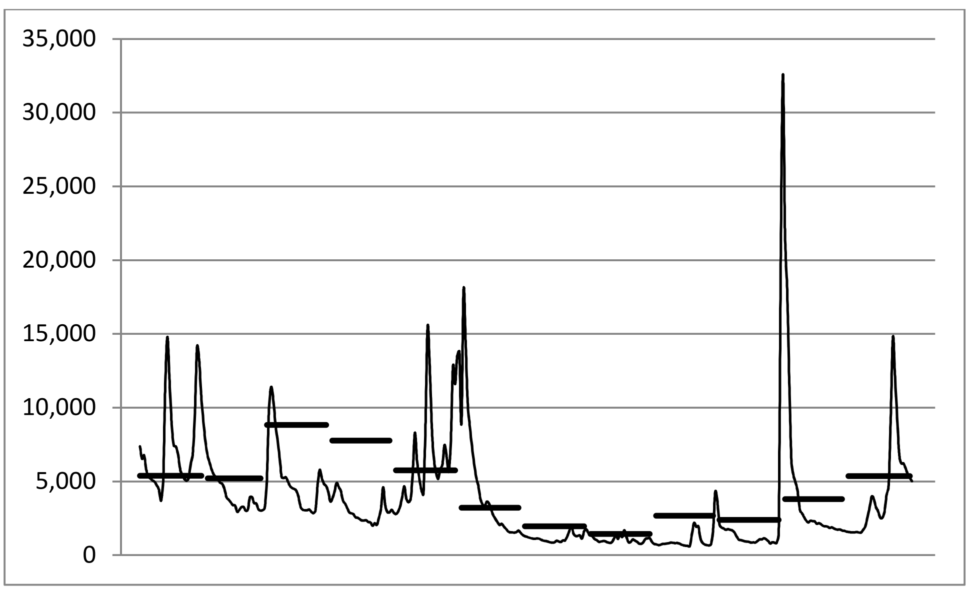

Figure A15. 2012 Daily Average Flow and Monthly LTM at Newport

Table A26. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Newport

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	10,691	67%	3%	4.98	7.45	1.42	78%
TON	1,773	46%	11%	0.83	1.81	0.24	54%
TNH_3	183	49%	10%	0.09	0.17	0.02	57%
TNO_x	8,884	74%	3%	4.14	5.56	1.18	87%
DN	10,181	70%	3%	4.74	6.73	1.35	83%
DON	1,286	53%	11%	0.60	1.14	0.17	62%
DNH_3	162	50%	10%	0.08	0.15	0.02	59%
DNO_x	8,902	75%	3%	4.15	5.52	1.18	88%
TP	244	32%	9%	0.114	0.351	0.033	38%
DP	113	32%	9%	0.053	0.162	0.015	38%
DOP	97	47%	10%	0.045	0.097	0.013	55%
TOC	16,217	58%	4%	7.55	13.02	2.15	68%
SS	103,317	20%	14%	48.1	235.2	13.7	24%

Table A27. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Newport

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	4,147	1.93	3,143	1.46	634	0.30	2,767	1.29
TON	520	0.24	641	0.30	143	0.07	469	0.22
TNH_3	54	0.03	71	0.03	16	0.01	42	0.02
TNO_x	3,602	1.68	2,489	1.16	494	0.23	2,299	1.07
DN	3,993	1.86	2,935	1.37	620	0.29	2,633	1.23
DON	391	0.18	421	0.20	133	0.06	341	0.16
DNH_3	47	0.02	63	0.03	14	0.01	38	0.02
DNO_x	3,607	1.68	2,500	1.16	493	0.23	2,302	1.07
TP	60	0.028	87	0.041	18	0.008	79	0.037
DP	31	0.014	36	0.017	12	0.006	34	0.016
DOP	26	0.012	30	0.014	10	0.005	31	0.015
TOC	5,079	2.37	5,417	2.52	1,329	0.62	4,392	2.05
SS	20,681	9.6	41,637	19.4	1,842	0.9	39,157	18.2

Table A28. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Newport

Month	Flow		TN			TP			SS		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	7,430	138%	1,969	0.92	109%	32	0.015	52%	12,222	5.7	32%
February	4,151	80%	945	0.44	63%	11	0.005	22%	2,682	1.2	12%
March	5,192	59%	1,233	0.57	48%	17	0.008	15%	5,777	2.7	7%
April	3,059	39%	633	0.29	30%	9	0.004	9%	1,969	0.9	3%
May	7,015	122%	1,581	0.74	104%	47	0.022	58%	23,926	11.1	47%
June	4,413	137%	929	0.43	112%	31	0.015	66%	15,742	7.3	57%
July	1,194	61%	216	0.10	40%	6	0.003	18%	635	0.3	3%
August	1,049	73%	192	0.09	51%	6	0.003	26%	487	0.2	8%
September	1,156	43%	226	0.11	32%	6	0.003	8%	720	0.3	1%
October	2,855	119%	694	0.32	98%	35	0.016	96%	22,020	10.3	114%
November	3,956	104%	967	0.45	78%	28	0.013	48%	12,477	5.8	36%
December	4,339	81%	1,106	0.52	61%	16	0.008	23%	4,660	2.2	7%
Annual	3,823		10,691	4.98		244	0.343		103,317	48.1	

Table A29. 2012 Annual Comparison to Baselines at Newport

Parameter	2012	Period	Y'	Flow ratio	R^2
TN	4.98	85-89	8.10	0.97	0.84
		85-98	6.51	0.84	0.95
		99-12	6.28	0.87	0.94
		85-12	6.40	0.85	0.94
TP	0.114	85-89	0.468	0.97	0.68
		85-98	0.315	0.84	0.72
		99-12	0.266	0.87	0.75
		85-12	0.288	0.85	0.73
SS	48	85-89	291	0.97	0.94
		85-98	165	0.84	0.89
		99-12	116	0.87	0.78*
		85-12	129	0.85	0.75*

Q = discharge ratio
R^2 = correlation coefficient
* indicates where an exponential regression was used as it yields a better fit to the data

Table A30. Trend Statistics for the Juniata River at Newport, Pa., October 1984 Through September 2012

Parameter	STORET Code	Time Series/Test	Slope	P-Value	Slope Magnitude (%)			Trend % Change	Trend Direction
					Min	Trend	Max		
FLOW	60	SK	-	0.363	-	-	-	-	NS
TN	600	FAC	-0.008	<0.001	-23	-20	-16	16-23	Down
TON	605	FAC	-0.031	<0.001	-65	-59	-52	52-65	Down
TNH_3	610	FAC	-0.017	<0.001	-48	-39	-27	N/A	BMDL
TKN	625	FAC	-0.028	<0.001	-60	-54	-47	47-60	Down
TNO_x	630	FAC	-0.002	0.067	-9	-5	0	N/A	NS
DN	602	FAC	-0.005	<0.001	-18	-14	-10	10-18	Down
DON	607	FAC	-0.030	<0.001	-63	-57	-50	50-63	Down
DNH_3	608	FAC	-0.017	<0.001	-49	-38	-26	N/A	BMDL
DKN	623	FAC	-0.030	<0.001	-63	-57	-50	50-63	Down
DNO_x	631	FAC	-0.001	0.404	-7	-2	3	N/A	NS
TP	665	FAC	-0.027	<0.001	-60	-53	-46	46-60	Down
DP	666	FAC	-0.029	<0.001	-62	-57	-50	50-62	Down
DOP	671	FAC	0.026	<0.001	59	105	164	59-164	Up
TOC	680	FAC	-0.012	<0.001	-34	-28	-22	22-34	Down
SS	80154	FAC	-0.026	<0.001	-62	-52	-40	40-62	Down

Down = downward/improving trend
Up = Upward/degrading trend
BMDL = Greater than 20% of values were Below Method Detection Limit
NS = No significant trend

INDIVIDUAL SITES: CONESTOGA

Table A31. 2012 Annual and Seasonal Precipitation and Discharge at Conestoga

Season	Precipitation (inches)			Discharge (cfs)		
	2012	LTM	LTM Departure	2012	LTM	% LTM
January-March (Winter)	5.49	8.67	-3.18	724	891	81
April-June (Spring)	10.33	10.94	-0.61	545	729	75
July-September (Summer)	11.89	12.93	-1.03	310	485	64
October-December (Fall)	12.54	10.79	1.75	849	656	129
Annual Total	40.25	43.33	-3.08	605	689	88

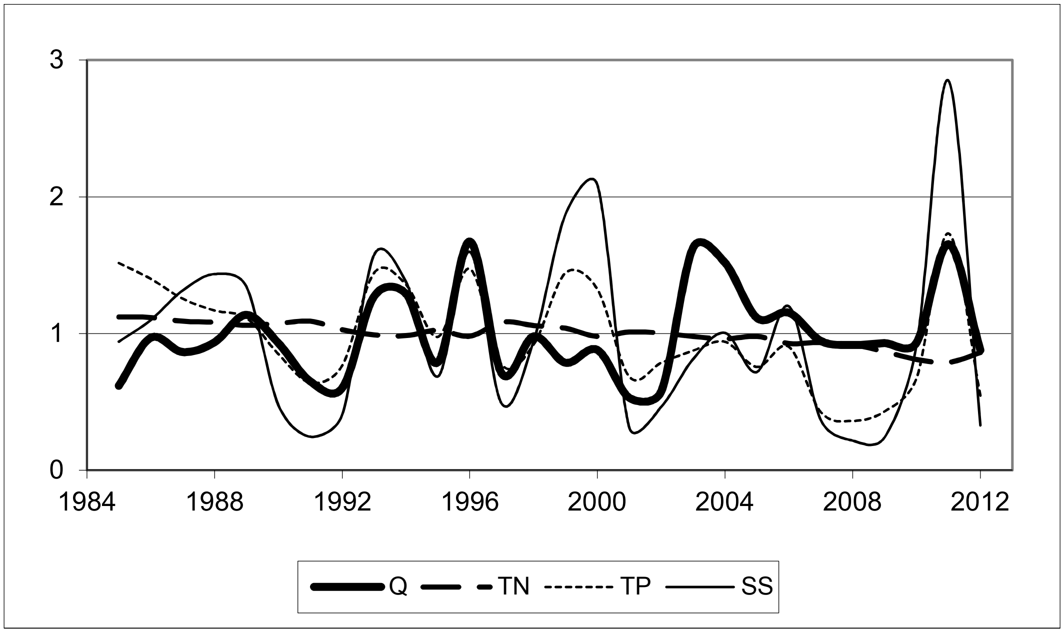

Figure A16. Annual Discharge and Calculated Annual TN, TP, and SS Concentrations Expressed as LTM Ratio

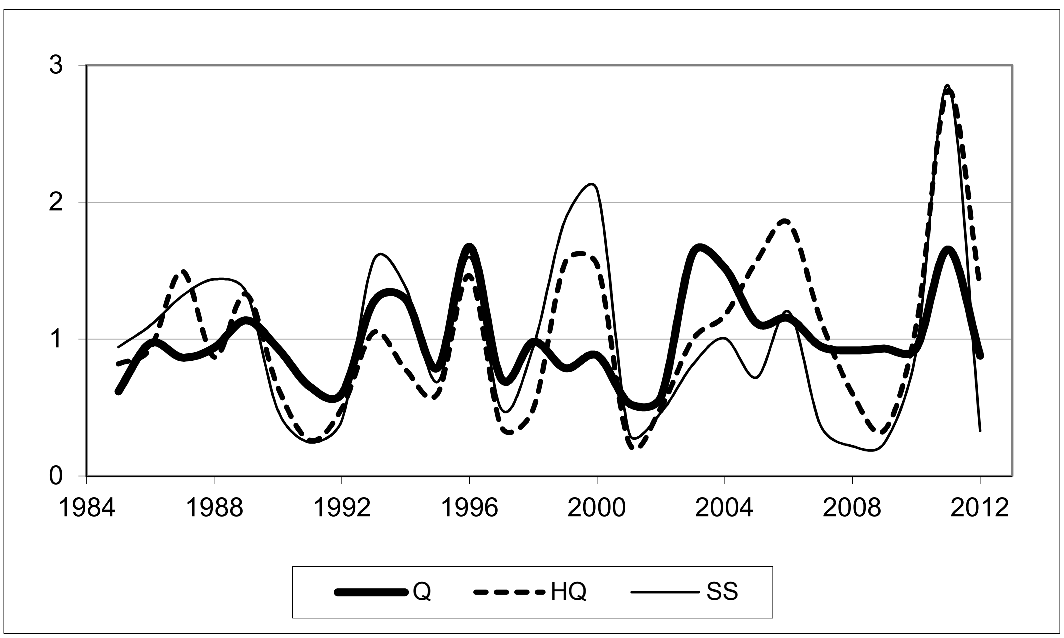

Figure A17. Annual Discharge and Annual Daily Mean High Discharge and Calculated Annual SS Concentration Expressed as LTM Ratio

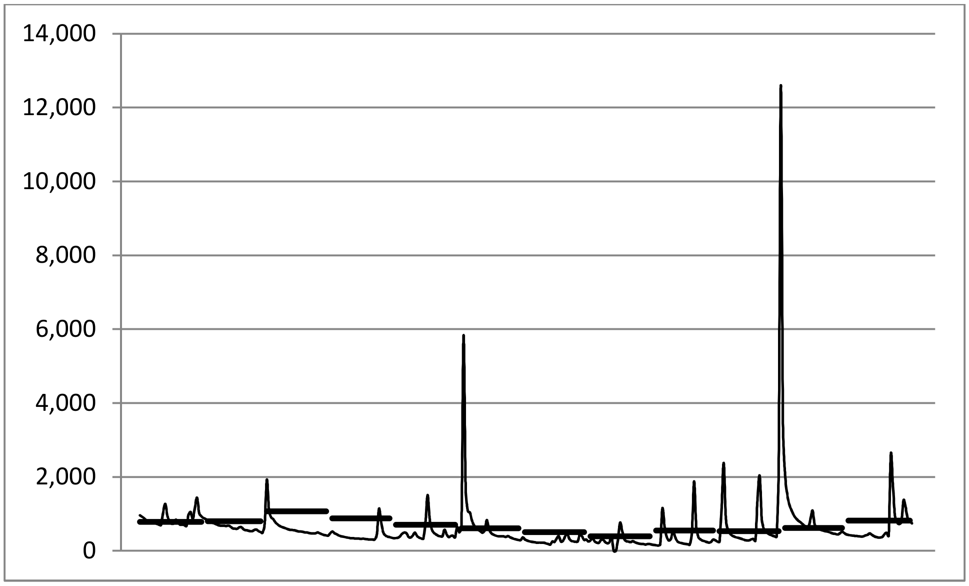

Figure A18. 2012 Daily Average Flow and Monthly LTM at Conestoga

Table A32. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Conestoga

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	7,798	77%	3%	25.92	33.80	6.55	87%
TON	662	37%	13%	2.20	5.91	0.56	42%
TNH_3	77	32%	13%	0.26	0.80	0.06	36%
TNO_x	7,227	87%	4%	24.03	27.63	6.07	99%
DN	7,623	81%	3%	25.34	31.28	6.40	92%
DON	432	39%	12%	1.44	3.65	0.36	45%
DNH_3	71	32%	13%	0.24	0.73	0.06	37%
DNO_x	7,261	89%	4%	24.14	27.14	6.10	101%
TP	305	46%	10%	1.014	2.188	0.256	53%
DP	157	62%	8%	0.522	0.842	0.132	71%
DOP	140	66%	8%	0.465	0.702	0.118	76%
TOC	3,564	49%	5%	11.85	24.28	2.99	56%
SS	93,998	27%	22%	312.5	1,175.4	79.0	30%

Table A33. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Conestoga

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	2,534	8.42	1,650	5.49	971	3.23	2,643	8.79
TON	170	0.57	143	0.48	66	0.22	283	0.94
TNH_3	21	0.07	18	0.06	6	0.02	32	0.11
TNO_x	2,403	7.99	1,514	5.03	921	3.06	2,389	7.94
DN	2,522	8.38	1,615	5.37	963	3.20	2,523	8.39
DON	142	0.47	102	0.34	53	0.18	135	0.45
DNH_3	20	0.07	16	0.05	5	0.02	30	0.10
DNO_x	2,401	7.98	1,517	5.04	927	3.08	2,416	8.03
TP	37	0.123	56	0.186	28	0.093	184	0.612
DP	26	0.087	30	0.101	23	0.078	78	0.259
DOP	22	0.074	26	0.088	21	0.071	71	0.235
TOC	803	2.67	830	2.76	433	1.44	1,498	4.98
SS	4,969	16.5	17,177	57.1	2,321	7.7	69,531	231.2

Table A34. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Conestoga

Month	Flow		TN			TP			SS		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	875	112%	1,043	3.47	96%	17	0.057	33%	2,353	7.8	10%
February	647	80%	749	2.49	74%	9	0.031	21%	1,088	3.6	6%
March	623	58%	742	2.47	54%	11	0.035	12%	1,528	5.1	3%
April	413	47%	469	1.56	43%	7	0.022	12%	709	2.4	3%
May	490	70%	528	1.75	59%	11	0.036	23%	1,400	4.7	5%
June	733	120%	653	2.17	95%	38	0.126	72%	15,068	50.1	46%
July	280	55%	296	0.98	49%	7	0.024	16%	429	1.4	1%
August	270	69%	287	0.95	64%	8	0.025	25%	442	1.5	4%
September	382	69%	388	1.29	74%	13	0.044	14%	1,450	4.8	2%
October	1,140	215%	1,005	3.34	166%	148	0.492	296%	65,290	217.1	300%
November	741	120%	822	2.73	112%	21	0.070	48%	2,330	7.7	15%
December	662	81%	816	2.71	79%	15	0.050	25%	1,911	6.4	4%
Annual	605		7,798	25.92		305	0.343		93,998	312.5	

Table A35. 2012 Annual Comparison to Baselines at Conestoga

Parameter	2012	Period	Y'	Q ratio	R^2
TN	25.92	85-89	36.49	0.97	0.99
		85-98	33.43	0.91	0.98
		99-12	27.67	0.85	0.93
		85-12	30.55	0.88	0.91
TP	1.014	85-89	2.603	0.97	0.67
		85-98	2.249	0.91	0.89
		99-12	1.402	0.85	0.60
		85-12	1.820	0.88	0.66
SS	313	85-89	1,461	0.97	0.87
		85-98	1,111	0.91	0.89
		99-12	797	0.85	0.45
		85-12	953	0.88	0.57

Q = discharge ratio
R^2 = correlation coefficient
* indicates where an exponential regression was used as it yields a better fit to the data

Table A36. Trend Statistics for the Conestoga River at Conestoga, Pa., October 1984 Through September 2012

Parameter	STORET Code	Time Series/Test	Slope	P-Value	Slope Magnitude (%)			Trend % Change	Trend Direction
					Min	Trend	Max		
FLOW	60	SK	-	0.513	-	-	-	-	NS
TN	600	FAC	-0.010	<0.001	-27	-24	-20	20-27	Down
TON	605	FAC	-0.037	<0.001	-69	-65	-60	60-69	Down
TNH_3	610	FAC	-0.052	<0.001	-81	-78	-74	74-81	Down
TKN	625	FAC	-0.042	<0.001	-74	-70	-66	66-74	Down
TNO_x	630	FAC	-0.001	0.343	-8	-3	3	N/A	NS
DN	602	FAC	-0.003	<0.001	-12	-8	-4	4-12	Down
DON	607	FAC	-0.015	<0.001	-43	-35	-25	25-43	Down
DNH_3	608	FAC	-0.050	<0.001	-80	-77	-73	73-80	Down
DKN	623	FAC	-0.023	<0.001	-54	-48	-41	41-54	Down
DNO_x	631	FAC	0.000	0.940	-6	0	7	N/A	NS
TP	665	FAC	-0.033	<0.001	-65	-61	-55	55-65	Down
DP	666	FAC	-0.025	<0.001	-55	-51	-46	46-55	Down
DOP	671	FAC	-0.011	<0.001	-36	-27	-15	15-36	Down
TOC	680	FAC	-0.026	<0.001	-56	-52	-48	48-56	Down
SS	80154	FAC	-0.052	<0.001	-82	-78	-73	73-82	Down

Down = downward/improving trend
Up = Upward/degrading trend
BMDL = Greater than 20% of values were Below Method Detection Limit
NS = No significant trend

APPENDIX B

Individual Enhanced Site Loads

INDIVIDUAL SITES: Unadilla River at Rockdale, N.Y.

Table B1. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Rockdale

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	1,084	53%	6%	3.26	6.10	0.85	86%
TON	238	25%	16%	0.72	2.86	0.19	45%
TNH_3	35	39%	19%	0.10	0.27	0.03	63%
TNO_x	913	74%	8%	2.74	3.71	0.71	120%
DN	1,108	64%	7%	3.33	5.23	0.86	103%
DON	256	47%	13%	0.77	1.63	0.20	76%
DNH_3	27	34%	18%	0.08	0.23	0.02	56%
DNO_x	886	74%	8%	2.66	3.61	0.69	119%
TP	37	14%	20%	0.110	0.762	0.029	23%
DP	15	24%	18%	0.047	0.193	0.012	39%
DOP	8	15%	24%	0.024	0.161	0.006	25%
TOC	3,449	47%	5%	10.36	21.86	2.69	77%

Table B2. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Rockdale

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	508.2	1.527	271.8	0.817	40.3	0.121	263.5	0.792
TON	89.3	0.268	73.1	0.220	19.8	0.059	56.2	0.169
TNH_3	13.9	0.042	9.9	0.030	2.1	0.006	8.8	0.026
TNO_x	467.5	1.405	218.1	0.655	18.3	0.055	209.2	0.628
DN	524.6	1.576	279.4	0.840	34.5	0.104	269.3	0.809
DON	98.8	0.297	79.1	0.238	15.1	0.046	63.3	0.190
DNH_3	10.8	0.032	8.8	0.027	1.5	0.005	5.6	0.017
DNO_x	455.6	1.369	209.6	0.630	17.8	0.054	203.4	0.611
TP	15.4	0.046	11.7	0.035	1.7	0.005	8.0	0.024
DP	6.5	0.020	5.0	0.015	0.6	0.002	3.4	0.010
DOP	3.8	0.011	2.7	0.008	0.2	0.001	1.5	0.004
TOC	1,306.2	3.925	1,036.0	3.113	204.4	0.614	902.7	2.713

Table B3. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Rockdale

Month	Flow		TN			TP		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	1,270	102%	201	0.60	89%	6.4	0.019	48%
February	799	88%	112	0.34	78%	2.5	0.008	36%
March	1,306	61%	195	0.59	51%	6.4	0.019	16%
April	633	36%	81	0.24	28%	2.5	0.008	7%
May	1,076	135%	140	0.42	127%	7.0	0.021	105%
June	461	58%	51	0.15	44%	2.1	0.006	4%
July	133	26%	14	0.04	20%	0.6	0.002	6%
August	134	33%	14	0.04	27%	0.6	0.002	11%
September	110	18%	12	0.04	14%	0.5	0.001	1%
October	283	28%	35	0.10	22%	1.0	0.003	6%
November	439	38%	56	0.17	31%	1.4	0.004	9%
December	1,141	91%	173	0.52	82%	5.6	0.017	50%
Annual	651	62%	1,084	3.26	53%	36.7	0.110	14%

INDIVIDUAL SITES: Susquehanna River at Conklin, N.Y.

Table B4. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Conklin

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	3,307	46%	7%	2.31	5.03	0.60	71%
TON	911	26%	15%	0.64	2.48	0.16	44%
TNH_3	121	35%	14%	0.08	0.24	0.02	54%
TNO_x	2,613	67%	7%	1.83	2.74	0.47	103%
DN	3,273	56%	7%	2.29	4.12	0.59	86%
DON	936	48%	12%	0.65	1.37	0.17	74%
DNH_3	108	35%	16%	0.08	0.22	0.02	53%
DNO_x	2,580	68%	6%	1.81	2.67	0.47	104%
TP	155	13%	18%	0.108	0.831	0.028	20%
DP	73	26%	16%	0.051	0.195	0.013	40%
DOP	40	18%	23%	0.028	0.159	0.007	27%
TOC	13,989	50%	5%	9.79	19.41	2.52	78%

Table B5. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Conklin

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	1,372	0.960	874	0.612	140.0	0.098	920	0.644
TON	289	0.202	277	0.194	86.4	0.060	258	0.181
TNH_3	47	0.033	37	0.026	6.9	0.005	30	0.021
TNO_x	1,247	0.873	627	0.439	49.3	0.034	690	0.483
DN	1,378	0.964	899	0.630	124.6	0.087	871	0.610
DON	284	0.199	285	0.199	81.3	0.057	285	0.200
DNH_3	42	0.030	33	0.023	6.7	0.005	26	0.018
DNO_x	1,222	0.856	606	0.424	56.2	0.039	696	0.487
TP	52	0.037	53	0.037	9.5	0.007	40	0.028
DP	24	0.017	25	0.018	5.1	0.004	18	0.013
DOP	14	0.010	14	0.010	2.1	0.001	10	0.007
TOC	4,697	3.288	4,014	2.810	960.4	0.672	4,318	3.023

Table B6. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Conklin

Month	Flow		TN			TP		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	5,113	96%	546	0.38	68%	21.7	0.015	35%
February	3,315	83%	308	0.22	61%	9.3	0.007	31%
March	4,921	58%	518	0.36	40%	21.2	0.015	14%
April	2,644	37%	247	0.17	22%	10.9	0.008	6%
May	4,696	130%	488	0.34	112%	34.6	0.024	93%
June	1,642	51%	139	0.10	28%	7.8	0.005	2%
July	485	24%	38	0.03	14%	2.9	0.002	5%
August	619	36%	49	0.03	25%	3.5	0.002	11%
September	687	26%	53	0.04	15%	3.1	0.002	2%
October	1,934	50%	172	0.12	34%	8.1	0.006	14%
November	2,648	58%	232	0.16	40%	9.0	0.006	18%
December	4,983	95%	516	0.36	77%	22.5	0.016	53%
Annual	2,814	65%	3,307	2.31	46%	154.8	0.108	13%

INDIVIDUAL SITES: Susquehanna River at Smithboro, N.Y.

Table B7. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Smithboro

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	9,755	53%	5%	3.29	6.17	0.84	87%
TON	3,224	40%	10%	1.09	2.71	0.28	73%
TNH_3	574	63%	17%	0.19	0.31	0.05	102%
TNO_x	6,484	66%	5%	2.19	3.31	0.56	108%
DN	9,763	64%	5%	3.29	5.15	0.84	105%
DON	2,378	49%	12%	0.80	1.64	0.20	80%
DNH_3	485	58%	17%	0.16	0.28	0.04	95%
DNO_x	6,498	67%	6%	2.19	3.27	0.56	110%
TP	482	22%	13%	0.163	0.731	0.042	36%
DP	228	40%	14%	0.077	0.192	0.020	65%
DOP	163	39%	18%	0.055	0.139	0.014	64%
TOC	32,816	51%	4%	11.07	21.75	2.83	83%

Table B8. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Smithboro

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	3,974	1.341	2,542	0.858	553	0.187	2,686	0.906
TON	1,031	0.348	1,018	0.343	305	0.103	870	0.294
TNH_3	221	0.075	101	0.034	22	0.007	230	0.077
TNO_x	3,059	1.032	1,474	0.497	242	0.082	1,708	0.576
DN	4,099	1.383	2,542	0.858	490	0.165	2,632	0.888
DON	793	0.267	707	0.239	182	0.061	696	0.235
DNH_3	188	0.063	126	0.043	25	0.008	145	0.049
DNO_x	3,085	1.041	1,536	0.518	238	0.080	1,638	0.553
TP	173	0.058	137	0.046	36	0.012	136	0.046
DP	86	0.029	63	0.021	14	0.005	64	0.022
DOP	66	0.022	37	0.012	8	0.003	51	0.017
TOC	11,181	3.772	9,225	3.112	2,346	0.791	10,065	3.396

Table B9. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Smithboro

Month	Flow		TN			TP		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	11,316	92%	1,625	0.55	77%	80	0.027	52%
February	7,102	78%	939	0.32	68%	34	0.011	42%
March	9,910	53%	1,410	0.48	44%	59	0.020	18%
April	5,620	35%	754	0.25	28%	33	0.011	10%
May	9,555	119%	1,305	0.44	111%	78	0.026	92%
June	3,809	59%	483	0.16	48%	25	0.009	10%
July	1,030	24%	148	0.05	22%	10	0.003	10%
August	1,534	43%	208	0.07	41%	14	0.005	24%
September	1,480	26%	197	0.07	23%	12	0.004	3%
October	3,233	37%	431	0.15	33%	22	0.007	15%
November	4,952	47%	644	0.22	41%	28	0.010	19%
December	11,042	93%	1,611	0.54	88%	86	0.029	66%
Annual	5,896	61%	9,755	3.29	53%	482	0.163	22%

INDIVIDUAL SITES: Cohocton River at Campbell, N.Y.

Table B10. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Campbell

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	1,159	66%	7%	3.85	5.85	1.78	106%
TON	262	41%	16%	0.87	2.11	0.40	74%
TNH_3	21	43%	16%	0.07	0.16	0.03	69%
TNO_x	871	79%	7%	2.90	3.64	1.34	128%
DN	1,050	71%	6%	3.49	4.91	1.62	115%
DON	187	48%	10%	0.62	1.28	0.29	78%
DNH_3	21	47%	17%	0.07	0.15	0.03	76%
DNO_x	903	82%	6%	3.00	3.68	1.39	132%
TP	23	23%	16%	0.078	0.345	0.036	36%
DP	11	31%	14%	0.037	0.120	0.017	49%
DOP	7	26%	21%	0.025	0.097	0.012	41%
TOC	2,446	50%	5%	8.13	16.12	3.76	81%

Table B11.   2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Campbell

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	576.2	1.915	243.4	0.809	32.9	0.109	306.1	1.018
TON	114.0	0.379	71.5	0.238	11.0	0.037	65.2	0.217
TNH_3	9.4	0.031	5.4	0.018	0.8	0.003	5.0	0.017
TNO_x	450.8	1.499	167.3	0.556	20.7	0.069	232.5	0.773
DN	517.6	1.721	218.8	0.727	32.8	0.109	281.1	0.934
DON	80.2	0.267	49.2	0.164	10.5	0.035	46.7	0.155
DNH_3	9.4	0.031	5.5	0.018	1.1	0.004	5.1	0.017
DNO_x	466.1	1.549	172.6	0.574	21.4	0.071	242.4	0.806
TP	9.3	0.031	6.3	0.021	1.0	0.003	6.9	0.023
DP	4.3	0.014	3.3	0.011	0.7	0.002	2.7	0.009
DOP	3.1	0.010	2.0	0.007	0.5	0.002	1.9	0.006
TOC	1,027.8	3.417	588.3	1.956	100.1	0.333	729.7	2.426

Table B12.   2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Campbell

Month	Flow		TN			TP		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	780	102%	258	0.86	105%	4.5	0.015	47%
February	466	78%	137	0.46	82%	1.8	0.006	33%
March	598	46%	181	0.60	45%	3.0	0.010	13%
April	451	46%	118	0.39	44%	2.7	0.009	14%
May	374	82%	93	0.31	86%	2.6	0.009	44%
June	159	54%	33	0.11	55%	1.0	0.003	23%
July	61	36%	12	0.04	38%	0.4	0.001	15%
August	57	38%	11	0.04	39%	0.4	0.001	12%
September	47	20%	10	0.03	19%	0.2	0.001	2%
October	163	41%	47	0.16	48%	2.1	0.007	28%
November	195	47%	52	0.17	48%	0.9	0.003	15%
December	606	96%	207	0.69	109%	3.8	0.013	57%
Annual	330	62%	1,159	3.85	66%	23.5	0.078	23%

INDIVIDUAL SITES: Chemung River at Chemung, N.Y.

Table B13. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Chemung

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	4,068	58%	6%	2.54	4.34	1.10	93%
TON	1,206	37%	11%	0.75	2.01	0.33	66%
TNH_3	132	45%	19%	0.08	0.18	0.04	71%
TNO_x	2,874	81%	6%	1.79	2.20	0.78	129%
DN	3,755	67%	6%	2.34	3.48	1.01	107%
DON	914	49%	10%	0.57	1.15	0.25	78%
DNH_3	84	33%	18%	0.05	0.16	0.02	53%
DNO_x	2,827	78%	7%	1.76	2.26	0.76	124%
TP	213	28%	11%	0.133	0.475	0.057	44%
DP	89	42%	12%	0.056	0.131	0.024	67%
DOP	81	50%	15%	0.050	0.100	0.022	79%
TOC	12,216	52%	4%	7.62	14.73	3.30	82%

Table B14. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Chemung

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	1,826	1.139	799	0.498	160.9	0.100	1,281	0.799
TON	455	0.284	275	0.172	70.0	0.044	405	0.253
TNH_3	62	0.039	20	0.013	2.8	0.002	47	0.029
TNO_x	1,389	0.866	542	0.338	91.2	0.057	852	0.531
DN	1,755	1.095	784	0.489	141.8	0.088	1,074	0.670
DON	363	0.227	211	0.131	54.2	0.034	285	0.178
DNH_3	43	0.027	17	0.010	2.4	0.001	22	0.014
DNO_x	1,415	0.882	555	0.346	81.4	0.051	775	0.483
TP	75	0.047	40	0.025	16.7	0.010	81	0.050
DP	36	0.022	20	0.013	8.8	0.005	25	0.015
DOP	30	0.019	16	0.010	9.8	0.006	25	0.016
TOC	4,979	3.104	2,667	1.663	553.0	0.345	4,018	2.505

Table B15. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Chemung

Month	Flow		TN			TP		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	4,325	103%	841	0.52	89%	39.0	0.024	52%
February	2,353	76%	394	0.25	68%	13.1	0.008	31%
March	3,321	46%	591	0.37	38%	22.6	0.014	14%
April	2,204	40%	349	0.22	33%	16.1	0.010	13%
May	2,120	79%	327	0.20	75%	16.6	0.010	42%
June	886	51%	124	0.08	46%	7.8	0.005	22%
July	289	36%	46	0.03	38%	4.9	0.003	34%
August	313	47%	50	0.03	50%	5.7	0.004	39%
September	407	29%	65	0.04	25%	6.2	0.004	9%
October	1,164	50%	242	0.15	56%	26.4	0.016	43%
November	1,404	60%	248	0.15	55%	13.9	0.009	27%
December	3,727	101%	791	0.49	104%	40.5	0.025	57%
Annual	1,881	63%	4,068	2.54	58%	212.8	0.133	28%

INDIVIDUAL SITES: Susquehanna at Wilkes-Barre, Pa.

Table B16. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Wilkes-Barre

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	18,495	61%	5%	2.90	4.77	0.91	95%
TON	5,943	43%	11%	0.93	2.16	0.29	75%
TNH_3	1,070	74%	11%	0.17	0.23	0.05	116%
TNO_x	12,159	71%	9%	1.91	2.68	0.60	111%
DN	16,111	65%	5%	2.53	3.87	0.79	102%
DON	3,396	45%	11%	0.53	1.17	0.17	71%
DNH_3	967	75%	11%	0.15	0.20	0.05	117%
DNO_x	12,301	73%	9%	1.93	2.66	0.61	113%
TP	983	20%	14%	0.154	0.758	0.048	32%
DP	317	35%	11%	0.050	0.143	0.016	55%
DOP	220	30%	13%	0.035	0.113	0.011	47%
TOC	53,424	43%	5%	8.38	19.38	2.63	68%

Table B17. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Wilkes-Barre

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	7,516	1.179	4,862	0.763	922	0.145	5,194	0.815
TON	1,788	0.281	2,080	0.326	574	0.090	1,501	0.235
TNH_3	418	0.066	269	0.042	68	0.011	315	0.049
TNO_x	5,734	0.900	2,273	0.357	325	0.051	3,827	0.600
DN	6,956	1.091	3,803	0.597	726	0.114	4,626	0.726
DON	1,126	0.177	1,007	0.158	349	0.055	914	0.143
DNH_3	367	0.058	248	0.039	65	0.010	286	0.045
DNO_x	5,826	0.914	2,318	0.364	324	0.051	3,833	0.601
TP	297	0.047	301	0.047	58	0.009	327	0.051
DP	109	0.017	103	0.016	19	0.003	86	0.013
DOP	78	0.012	73	0.011	11	0.002	58	0.009
TOC	17,954	2.817	15,207	2.386	3,829	0.601	16,434	2.578

Table B18. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Wilkes-Barre

Month	Flow		TN			TP		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	19,900	94%	3,148	0.49	89%	143	0.022	44%
February	12,497	80%	1,816	0.28	77%	57	0.009	38%
March	15,952	48%	2,552	0.40	43%	98	0.015	13%
April	9,993	36%	1,484	0.23	32%	68	0.011	8%
May	16,224	116%	2,493	0.39	117%	179	0.028	90%
June	6,638	65%	885	0.14	59%	53	0.008	9%
July	2,028	31%	258	0.04	29%	16	0.003	8%
August	2,488	49%	309	0.05	48%	21	0.003	26%
September	2,965	29%	355	0.06	23%	21	0.003	2%
October	6,051	44%	806	0.13	42%	51	0.008	19%
November	9,300	59%	1,244	0.20	57%	66	0.010	30%
December	19,573	97%	3,145	0.49	101%	211	0.033	83%
Annual	10,322	64%	18,495	2.90	61%	983	0.154	20%

INDIVIDUAL SITES: West Branch Susquehanna at Karthaus, Pa.

Table B19. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Karthaus

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	2,153	73%	5%	2.30	3.14	0.61	94%
TON	443	49%	14%	0.47	0.96	0.13	71%
TNH_3	169	80%	11%	0.18	0.23	0.05	102%
TNO_x	1,603	82%	5%	1.71	2.09	0.45	105%
DN	2,029	77%	5%	2.17	2.82	0.57	98%
DON	328	56%	13%	0.35	0.63	0.09	71%
DNH_3	161	85%	10%	0.17	0.20	0.05	108%
DNO_x	1,589	82%	5%	1.70	2.07	0.45	105%
TP	43	29%	17%	0.046	0.161	0.012	37%
DP	5.3	19%	29%	0.006	0.031	0.002	24%
DOP	5.1	20%	31%	0.005	0.027	0.001	26%
TOC	5,416	57%	6%	5.79	10.10	1.53	73%

Table B20. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Karthaus

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	1108.6	1.185	465.0	0.497	120.2	0.128	458.7	0.490
TON	203.1	0.217	121.1	0.129	35.1	0.037	84.2	0.090
TNH_3	89.7	0.096	35.9	0.038	7.6	0.008	36.1	0.039
TNO_x	856.1	0.915	320.4	0.342	78.7	0.084	347.3	0.371
DN	1051.2	1.123	445.4	0.476	112.7	0.120	419.3	0.448
DON	141.3	0.151	87.5	0.093	31.3	0.033	67.8	0.072
DNH_3	85.7	0.092	32.5	0.035	6.6	0.007	36.0	0.038
DNO_x	853.9	0.913	314.3	0.336	76.5	0.082	344.1	0.368
TP	21.1	0.023	10.6	0.011	2.5	0.003	8.8	0.009
DP	2.3	0.002	1.6	0.002	0.6	0.001	0.8	0.001
DOP	2.5	0.003	1.6	0.002	0.5	0.000	0.6	0.001
TOC	2404.9	2.570	1332.0	1.424	454.6	0.486	1224.9	1.309

Table B21. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Karthaus

Month	Flow		TN			TP		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	4,176	110%	499	0.53	109%	10.4	0.011	36%
February	2,484	86%	234	0.25	82%	3.2	0.003	30%
March	3,583	70%	376	0.40	63%	7.4	0.008	22%
April	1,495	45%	121	0.13	37%	1.8	0.002	11%
May	2,379	104%	217	0.23	105%	5.6	0.006	65%
June	1,546	118%	127	0.14	121%	3.3	0.003	65%
July	707	100%	56	0.06	104%	1.4	0.002	58%
August	490	74%	37	0.04	68%	0.7	0.001	28%
September	358	39%	27	0.03	30%	0.4	0.000	8%
October	769	56%	86	0.09	57%	2.8	0.003	35%
November	1,209	64%	120	0.13	57%	2.2	0.002	18%
December	2,282	70%	253	0.27	63%	3.8	0.004	22%
Annual	1,793	78%	2,153	2.30	73%	43.1	0.046	29%

INDIVIDUAL SITES: Penns Creek at Penns Creek, Pa.

Table B22. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Penns Creek

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	1,259	83%	4%	6.53	7.90	1.54	100%
TON	179	52%	15%	0.93	1.79	0.22	70%
TNH_3	31	86%	14%	0.16	0.19	0.04	104%
TNO_x	1,079	92%	4%	5.60	6.07	1.32	112%
DN	1,214	86%	4%	6.30	7.31	1.48	104%
DON	131	61%	12%	0.68	1.12	0.16	74%
DNH_3	28	86%	14%	0.15	0.17	0.03	104%
DNO_x	1,080	93%	4%	5.61	6.04	1.32	112%
TP	28	37%	15%	0.146	0.396	0.034	45%
DP	14	37%	16%	0.073	0.197	0.017	45%
DOP	12	40%	18%	0.063	0.158	0.015	49%
TOC	1,906	61%	7%	9.90	16.34	2.33	73%

Table B23.   2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Penns Creek

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	399.3	2.073	418.6	2.173	104.0	0.540	336.7	1.748
TON	34.9	0.181	89.8	0.466	19.7	0.102	34.7	0.180
TNH_3	6.7	0.035	15.1	0.078	3.4	0.018	5.9	0.031
TNO_x	370.1	1.921	319.3	1.657	81.9	0.425	308.2	1.600
DN	395.4	2.052	395.1	2.051	102.2	0.530	321.4	1.668
DON	30.4	0.158	60.8	0.316	16.5	0.085	23.8	0.124
DNH_3	6.2	0.032	13.8	0.072	3.1	0.016	5.4	0.028
DNO_x	369.8	1.920	319.0	1.656	82.3	0.427	308.9	1.604
TP	4.7	0.025	15.0	0.078	2.2	0.011	6.2	0.032
DP	2.5	0.013	7.2	0.038	1.4	0.007	2.9	0.015
DOP	2.1	0.011	6.3	0.033	1.1	0.006	2.8	0.014
TOC	411.2	2.135	828.2	4.299	213.0	1.106	453.8	2.356

Table B24.   2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Penns Creek

Month	Flow		TN			TP		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	696	105%	199	1.03	109%	2.4	0.013	39%
February	421	85%	100	0.52	88%	1.0	0.005	37%
March	422	42%	101	0.52	39%	1.3	0.007	7%
April	266	37%	54	0.28	32%	0.8	0.004	8%
May	909	130%	229	1.19	136%	8.4	0.044	76%
June	576	162%	136	0.70	177%	5.8	0.030	117%
July	204	115%	43	0.22	122%	1.1	0.005	62%
August	154	115%	31	0.16	118%	0.6	0.003	64%
September	142	46%	30	0.15	38%	0.5	0.003	7%
October	307	78%	87	0.45	77%	3.0	0.016	68%
November	401	98%	111	0.57	99%	1.5	0.008	41%
December	480	74%	139	0.72	73%	1.6	0.009	32%
Annual	416	83%	1,259	6.53	83%	28.2	0.146	37%

INDIVIDUAL SITES: Raystown Branch of Juniata River at Saxton, Pa.

Table B25. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Saxton

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	3,130	87%	4%	6.47	7.42	1.93	99%
TON	469	60%	16%	0.97	1.62	0.29	76%
TNH_3	62	89%	12%	0.13	0.14	0.04	101%
TNO_x	2,599	94%	4%	5.37	5.74	1.61	106%
DN	3,049	92%	4%	6.30	6.81	1.88	105%
DON	385	84%	13%	0.80	0.95	0.24	95%
DNH_3	61	98%	11%	0.13	0.13	0.04	112%
DNO_x	2,620	94%	4%	5.41	5.73	1.62	107%
TP	74	59%	11%	0.153	0.261	0.046	67%
DP	25	71%	12%	0.052	0.074	0.016	81%
DOP	22	90%	16%	0.046	0.051	0.014	102%
TOC	4,023	65%	6%	8.31	12.89	2.49	73%

Table B26. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Saxton

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	1271.3	2.628	786.9	1.626	212.6	0.439	859.1	1.776
TON	155.8	0.322	119.4	0.247	26.0	0.054	167.9	0.347
TNH_3	21.7	0.045	18.4	0.038	4.0	0.008	18.4	0.038
TNO_x	1072.7	2.217	644.4	1.332	186.7	0.386	695.2	1.437
DN	1236.1	2.555	780.3	1.613	218.4	0.451	814.5	1.683
DON	125.5	0.259	119.5	0.247	29.4	0.061	110.9	0.229
DNH_3	20.7	0.043	17.9	0.037	3.9	0.008	18.7	0.039
DNO_x	1083.1	2.239	649.4	1.342	188.5	0.390	698.6	1.444
TP	22.2	0.046	17.1	0.035	2.2	0.005	32.6	0.067
DP	8.5	0.018	7.3	0.015	1.3	0.003	8.4	0.017
DOP	7.3	0.015	6.3	0.013	1.0	0.002	7.5	0.015
TOC	1396.8	2.887	1059.4	2.190	244.8	0.506	1322.2	2.733

Table B27. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Saxton

Month	Flow		TN			TP		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	1,685	126%	536	1.11	118%	9.5	0.020	92%
February	931	89%	268	0.55	88%	2.9	0.006	56%
March	1,492	70%	468	0.97	64%	9.8	0.020	27%
April	668	45%	194	0.40	43%	2.3	0.005	15%
May	1,417	97%	426	0.88	96%	11.7	0.024	58%
June	572	120%	167	0.35	121%	3.1	0.006	119%
July	250	104%	81	0.17	104%	0.9	0.002	81%
August	203	111%	69	0.14	111%	0.7	0.001	78%
September	182	47%	62	0.13	48%	0.6	0.001	6%
October	861	183%	339	0.70	211%	24.3	0.050	455%
November	668	107%	218	0.45	108%	4.2	0.009	86%
December	905	69%	302	0.62	69%	4.1	0.008	28%
Annual	822	88%	3,130	6.47	87%	74.1	0.153	59%

INDIVIDUAL SITES: Sherman's Creek at Dromgold, Pa.

Table B28. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Dromgold

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	964	75%	4%	7.53	10.09	1.75	91%
TON	183	67%	18%	1.43	2.14	0.33	91%
TNH_3	25	55%	26%	0.19	0.35	0.05	67%
TNO_x	806	80%	4%	6.29	7.83	1.47	98%
DN	913	77%	4%	7.13	9.28	1.66	93%
DON	108	65%	15%	0.84	1.30	0.20	79%
DNH_3	27	52%	32%	0.21	0.41	0.05	63%
DNO_x	805	81%	4%	6.29	7.78	1.46	98%
TP	41	54%	17%	0.323	0.600	0.075	65%
DP	21	57%	16%	0.160	0.281	0.037	69%
DOP	20	67%	17%	0.153	0.229	0.036	81%
TOC	1,498	57%	8%	11.70	20.70	2.72	69%

Table B29. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Dromgold

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	296.7	2.318	255.9	1.999	68.1	0.532	343.5	2.684
TON	27.2	0.212	56.0	0.438	13.5	0.106	86.0	0.672
TNH_3	4.4	0.035	7.6	0.059	2.1	0.016	10.7	0.083
TNO_x	275.3	2.151	208.0	1.625	55.9	0.437	266.5	2.082
DN	292.4	2.284	247.0	1.930	66.4	0.518	306.9	2.398
DON	19.1	0.149	38.7	0.303	10.8	0.084	39.5	0.309
DNH_3	4.5	0.035	8.8	0.069	2.2	0.017	11.3	0.088
DNO_x	276.1	2.157	207.6	1.622	55.8	0.436	265.9	2.077
TP	4.3	0.033	7.6	0.059	1.7	0.013	27.8	0.217
DP	2.6	0.020	4.1	0.032	1.1	0.009	12.7	0.099
DOP	2.2	0.017	3.5	0.027	1.0	0.008	12.9	0.101
TOC	255.4	1.995	403.7	3.154	122.1	0.954	716.4	5.597

Table B30. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Dromgold

Month	Flow		TN			TP		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	474	112%	153	1.19	101%	2.5	0.020	59%
February	240	78%	63	0.50	69%	0.7	0.005	46%
March	292	45%	81	0.63	37%	1.1	0.008	7%
April	191	37%	46	0.36	30%	0.6	0.005	8%
May	509	112%	138	1.08	105%	4.3	0.033	48%
June	290	125%	72	0.56	116%	2.7	0.021	48%
July	78	71%	16	0.13	59%	0.4	0.003	42%
August	101	140%	23	0.18	136%	0.5	0.004	106%
September	117	51%	29	0.23	41%	0.8	0.006	6%
October	414	157%	146	1.14	170%	23.4	0.182	387%
November	254	82%	73	0.57	72%	1.4	0.011	27%
December	381	75%	124	0.97	69%	3.0	0.024	47%
Annual	279	82%	964	7.53	75%	41.3	0.323	54%

INDIVIDUAL SITES: Conodoguinet at Hogestown, Pa.

Table B31. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Hogestown

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	4,815	93%	2%	16.01	17.22	3.84	100%
TON	391	68%	14%	1.30	1.92	0.31	82%
TNH_3	54	81%	12%	0.18	0.22	0.04	88%
TNO_x	4,473	97%	3%	14.87	15.28	3.57	105%
DN	4,715	94%	2%	15.68	16.65	3.76	102%
DON	245	62%	14%	0.81	1.32	0.20	67%
DNH_3	53	87%	13%	0.18	0.20	0.04	94%
DNO_x	4,465	98%	3%	14.84	15.22	3.56	105%
TP	61	59%	11%	0.204	0.345	0.049	64%
DP	27	69%	10%	0.091	0.131	0.022	75%
DOP	23	77%	9%	0.077	0.100	0.019	83%
TOC	3,102	66%	6%	10.31	15.70	2.47	71%

Table B32. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Hogestown

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	1487.5	4.945	1200.9	3.992	812.6	2.701	1313.9	4.368
TON	94.0	0.312	117.2	0.390	60.6	0.202	119.5	0.397
TNH_3	12.2	0.041	17.8	0.059	8.9	0.030	14.9	0.049
TNO_x	1410.7	4.690	1079.1	3.587	757.7	2.519	1225.6	4.075
DN	1462.5	4.862	1171.6	3.895	809.8	2.692	1271.3	4.226
DON	62.9	0.209	67.7	0.225	45.0	0.149	69.1	0.230
DNH_3	11.2	0.037	18.0	0.060	9.3	0.031	14.6	0.048
DNO_x	1412.7	4.696	1078.4	3.585	754.0	2.507	1220.2	4.057
TP	10.6	0.035	15.4	0.051	7.4	0.025	27.9	0.093
DP	5.0	0.017	7.3	0.024	4.8	0.016	10.1	0.034
DOP	4.2	0.014	6.0	0.020	4.1	0.014	8.9	0.030
TOC	699.4	2.325	859.5	2.857	530.7	1.764	1012.5	3.366

Table B33. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Hogestown

Month	Flow		TN			TP		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	1,004	119%	648	2.16	114%	5.5	0.018	82%
February	604	88%	373	1.24	89%	1.7	0.006	54%
March	746	65%	466	1.55	68%	3.4	0.011	19%
April	477	50%	292	0.97	53%	1.6	0.005	12%
May	860	97%	506	1.68	97%	7.8	0.026	68%
June	694	117%	402	1.34	115%	6.0	0.020	51%
July	340	92%	223	0.74	91%	1.8	0.006	58%
August	468	165%	309	1.03	158%	3.0	0.010	150%
September	425	97%	280	0.93	103%	2.6	0.009	21%
October	667	130%	416	1.38	119%	19.3	0.064	288%
November	639	110%	420	1.40	109%	5.1	0.017	82%
December	707	75%	477	1.59	76%	3.6	0.012	39%
Annual	637	93%	4,815	16.01	93%	61.4	0.204	59%

INDIVIDUAL SITES: Swatara Creek at Hershey, Pa.

Table B34. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Hershey

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	4,856	74%	3%	15.71	21.32	3.82	106%
TON	410	28%	41%	1.33	4.72	0.32	45%
TNH_3	84	47%	23%	0.27	0.57	0.07	68%
TNO_x	4,428	79%	4%	14.32	18.13	3.48	114%
DN	4,737	76%	3%	15.32	20.07	3.72	110%
DON	287	47%	22%	0.93	2.00	0.23	67%
DNH_3	87	51%	26%	0.28	0.56	0.07	73%
DNO_x	4,437	80%	4%	14.35	17.99	3.49	115%
TP	88	16%	31%	0.285	1.759	0.069	23%
DP	46	34%	20%	0.148	0.437	0.036	49%
DOP	38	35%	21%	0.124	0.357	0.030	50%
TOC	3,391	35%	14%	10.97	30.98	2.66	51%

Table B35. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Hershey

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	1428.0	4.619	1241.3	4.016	567.5	1.836	1619.3	5.238
TON	94.0	0.304	140.7	0.455	43.6	0.141	132.2	0.428
TNH_3	23.6	0.076	27.1	0.088	6.6	0.021	26.4	0.085
TNO_x	1312.0	4.244	1104.0	3.572	536.5	1.735	1475.5	4.773
DN	1392.4	4.504	1203.8	3.894	568.2	1.838	1572.3	5.086
DON	61.2	0.198	87.0	0.281	42.6	0.138	96.6	0.313
DNH_3	24.9	0.081	27.3	0.088	6.7	0.022	28.4	0.092
DNO_x	1326.6	4.291	1110.1	3.591	532.7	1.723	1467.7	4.748
TP	17.8	0.058	28.2	0.091	8.2	0.027	33.7	0.109
DP	9.6	0.031	13.6	0.044	6.0	0.019	16.7	0.054
DOP	7.6	0.024	10.7	0.035	5.2	0.017	14.9	0.048
TOC	747.6	2.418	1083.8	3.506	349.4	1.130	1210.3	3.915

Table B36. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Hershey

Month	Flow		TN			TP		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	1,134	110%	694	2.24	106%	10.3	0.033	92%
February	638	70%	383	1.24	75%	3.9	0.013	44%
March	558	38%	352	1.14	44%	3.6	0.012	12%
April	327	29%	212	0.68	35%	2.0	0.007	11%
May	1,193	141%	651	2.10	135%	18.7	0.060	158%
June	656	78%	379	1.23	82%	7.5	0.024	17%
July	195	42%	150	0.49	50%	1.7	0.006	24%
August	224	54%	174	0.56	63%	2.2	0.007	28%
September	347	28%	244	0.79	35%	4.3	0.014	1%
October	844	107%	549	1.77	107%	17.6	0.057	114%
November	724	89%	483	1.56	92%	7.1	0.023	61%
December	899	73%	588	1.90	77%	9.0	0.029	54%
Annual	646	70%	4,856	15.71	74%	88.0	0.285	16%

INDIVIDUAL SITES: West Conewago at Manchester, Pa.

Table B37. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Manchester

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	3,726	90%	5%	11.42	12.65	2.55	93%
TON	1,137	94%	12%	3.48	3.71	0.78	108%
TNH_3	142	104%	16%	0.44	0.42	0.10	107%
TNO_x	2,752	92%	6%	8.43	9.20	1.88	94%
DN	3,351	91%	5%	10.27	11.30	2.29	94%
DON	569	82%	11%	1.74	2.13	0.39	84%
DNH_3	142	108%	17%	0.44	0.40	0.10	111%
DNO_x	2,744	93%	6%	8.41	9.06	1.88	96%
TP	430	94%	13%	1.317	1.396	0.294	97%
DP	201	88%	12%	0.616	0.702	0.137	90%
DOP	188	92%	13%	0.576	0.624	0.128	95%
TOC	8,509	85%	6%	26.07	30.69	5.82	88%

Table B38. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Manchester

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	1,105	3.39	627	1.92	478	1.46	1,516	4.64
TON	149	0.46	144	0.44	164	0.50	681	2.08
TNH_3	25	0.08	28	0.09	20	0.06	68	0.21
TNO_x	927	2.84	466	1.43	327	1.00	1,031	3.16
DN	1,042	3.19	589	1.80	434	1.33	1,287	3.94
DON	94	0.29	87	0.27	102	0.31	286	0.88
DNH_3	25	0.08	29	0.09	21	0.06	68	0.21
DNO_x	925	2.83	469	1.44	326	1.00	1,024	3.14
TP	38	0.12	39	0.12	59	0.18	294	0.90
DP	23	0.07	24	0.07	36	0.11	118	0.36
DOP	19	0.06	20	0.06	35	0.11	114	0.35
TOC	1,434	4.39	1,269	3.89	1,410	4.32	4,396	13.47

Table B39. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Manchester

Month	Flow		TN			TP		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	1,105	122%	543	1.66	114%	19.8	0.061	94%
February	494	59%	205	0.63	53%	4.8	0.015	31%
March	795	59%	357	1.09	54%	13.0	0.040	26%
April	445	43%	168	0.51	37%	5.8	0.018	13%
May	648	88%	243	0.75	82%	13.1	0.040	48%
June	611	121%	216	0.66	116%	19.8	0.061	67%
July	181	77%	54	0.17	67%	3.8	0.012	52%
August	271	156%	87	0.27	154%	6.1	0.019	111%
September	881	103%	336	1.03	103%	49.4	0.151	36%
October	1,862	250%	793	2.43	244%	265.5	0.813	477%
November	679	98%	284	0.87	92%	12.1	0.037	44%
December	917	83%	439	1.35	78%	16.8	0.051	45%
Annual	743	97%	3,726	11.42	90%	430.0	1.317	94%

INDIVIDUAL SITES: Pequea Creek at Martic Forge, Pa.

Table B40. 2012 Annual Loads (1000's lbs), Yields (lbs/acre), and Concentrations (mg/L) at Martic Forge

Parameter	Load	Load % of LTM	Error %	Yield	LTM Yield	Ave. Conc.	Conc. % of LTM
TN	2,608	85%	3%	26.32	30.89	7.61	102%
TON	202	44%	16%	2.03	4.62	0.59	59%
TNH_3	46	88%	21%	0.47	0.53	0.14	105%
TNO_x	2,451	94%	4%	24.73	26.35	7.15	112%
DN	2,554	88%	3%	25.77	29.23	7.46	106%
DON	116	36%	16%	1.17	3.27	0.34	43%
DNH_3	46	93%	21%	0.46	0.50	0.13	111%
DNO_x	2,455	95%	4%	24.77	26.04	7.17	114%
TP	161	74%	23%	1.621	2.202	0.469	88%
DP	78	81%	19%	0.788	0.974	0.228	97%
DOP	74	84%	20%	0.745	0.884	0.216	101%
TOC	1,366	67%	12%	13.78	20.71	3.99	80%

Table B41. 2012 Seasonal Loads (1000's lbs) and Yields (lbs/acre) at Martic Forge

Parameter	Winter		Spring		Summer		Fall	
	Load	Yield	Load	Yield	Load	Yield	Load	Yield
TN	938.8	9.472	589.3	5.946	310.4	3.132	769.8	7.767
TON	48.2	0.486	44.0	0.444	19.7	0.199	89.9	0.907
TNH_3	9.5	0.096	8.6	0.086	2.6	0.027	25.7	0.260
TNO_x	916.3	9.246	561.6	5.666	304.2	3.069	668.7	6.747
DN	935.2	9.436	590.7	5.960	316.4	3.193	712.0	7.184
DON	30.7	0.310	30.7	0.310	17.9	0.180	36.6	0.370
DNH_3	9.8	0.099	8.1	0.082	2.5	0.026	25.1	0.253
DNO_x	917.8	9.261	562.6	5.677	304.3	3.070	670.2	6.762
TP	15.1	0.152	20.9	0.211	9.0	0.090	115.7	1.167
DP	9.4	0.095	10.9	0.110	7.1	0.071	50.8	0.512
DOP	8.4	0.085	9.8	0.099	6.6	0.067	49.0	0.495
TOC	264.8	2.672	252.4	2.547	125.9	1.270	722.4	7.289

Table B42. 2012 Monthly Flow (cfs), Loads (1000's lbs), and Yields (lbs/acre) at Martic Forge

Month	Flow		TN			TP		
	2012	% LTM	Load	Yield	% LTM	Load	Yield	% LTM
January	276	117%	378	3.82	113%	8	0.08	122%
February	215	89%	290	2.92	91%	4	0.04	68%
March	189	64%	270	2.73	68%	3	0.03	24%
April	157	56%	209	2.11	60%	3	0.03	27%
May	148	73%	190	1.92	75%	4	0.04	53%
June	170	88%	190	1.92	90%	13	0.13	65%
July	90	69%	108	1.09	72%	3	0.03	37%
August	80	71%	95	0.96	76%	2	0.02	18%
September	93	63%	107	1.08	71%	4	0.04	13%
October	331	133%	322	3.24	129%	104	1.05	136%
November	161	92%	204	2.06	96%	5	0.06	53%
December	177	74%	244	2.46	79%	6	0.06	44%
Annual	174	84%	2,608	26.32	84%	161	1.621	74%

APPENDIX C

Short-Term Trends

Table C1. Full Term and Short Term Trend Statistics for the Susquehanna River at Towanda, Pa.

Parameter	STORET Code	Time Series/Test	Slope	P-Value	Slope Magnitude (%)			Trend % Change	Trend Direction
					Min	Trend	Max		
TN	600	2004-2012	-0.020	<0.001	-22	-15	-7	7-22	Down
		1989-2012	-0.025	<0.001	-48	-45	-43	43-48	Down
TON	605	2004-2012	0.008	0.497	-11	7	28	-	NS
		1989-2012	-0.026	<0.001	-53	-47	-40	40-53	Down
TNH_3	610	2004-2012	-0.050	0.002	-49	-34	-14	-	BMDL
		1989-2012	-0.027	<0.001	-56	-47	-37	37-56	Down
TKN	625	2004-2012	0.001	0.923	-14	1	18	-	NS
		1989-2012	-0.027	<0.001	-53	-47	-41	41-53	Down
TNO_x	630	2004-2012	-0.038	<0.001	-37	-27	-15	15-37	Down
		1989-2012	-0.026	<0.001	-51	-47	-41	41-51	Down
DN	602	2004-2012	-0.003	0.641	-13	-3	9	-	NS
		1989-2012	-0.023	<0.001	-45	-42	-38	38-45	Down
DON	607	2004-2012	0.043	0.003	16	40	67	16-67	Up
		1989-2012	-0.020	<0.001	-46	-38	-30	30-46	Down
DNH_3	608	2004-2012	-0.032	0.048	-40	-23	-0.1	-	BMDL
		1989-2012	-0.016	<0.001	-43	-32	-19	-	BMDL
DKN	623	2004-2012	0.040	<0.001	15	37	64	15-64	Up
		1989-2012	-0.021	<0.001	-46	-40	-33	33-46	Down
DNO_x	631	2004-2012	-0.031	0.001	-33	-22	-10	10-33	Down
		1989-2012	-0.025	<0.001	-50	-45	-40	40-50	Down
TP	665	2004-2012	-0.086	<0.001	-61	-51	-40	40-61	Down
		1989-2012	-0.008	0.004	-28	-18	-6	6-28	Down
DP	666	2004-2012	-0.122	<0.001	-72	-65	-55	55-72	Down
		1989-2012	-0.012	<0.001	-35	-24	-12	12-35	Down
DOP	671	2004-2012	-0.131	<0.001	-76	-67	-56	56-76	Down
		1989-2012	0.072	<0.001	351	465	609	351-609	Up
TOC	680	2004-2012	-0.026	<0.001	-26	-18.	-10	10-26	Down
		1989-2012	-0.006	<0.001	-19	-14	-9	9-19	Down
SS	80154	2004-2012	-0.006	0.789	-35	-5	38	-	NS
		1989-2012	-0.016	0.001	-45	-32	-15	15-45	Down

Down = downward/improving trend
Up = Upward/degrading trend
BMDL = Greater than 20% of values were Below Method Detection Limit
NS = No significant trend

Table C2. Full Term and Short Term Trend Statistics for the Susquehanna River at Danville, Pa.

Parameter	STORET Code	Time Series/Test	Slope	P-Value	Slope Magnitude (%)			Trend % Change	Trend Direction
					Min	Trend	Max		
TN	600	2004-2012	-0.002	0.689	-11	-2	8	-	NS
		1989-2012	-0.024	<0.001	-52	-49	-47	47-52	Down
TON	605	2004-2012	0.001	0.909	-17	1	23	-	NS
		1989-2012	-0.031	<0.001	-63	-58	-53	53-63	Down
TNH_3	610	2004-2012	-0.014	0.472	-35	-11	22	-	BMDL
		1989-2012	-0.025	<0.001	-59	-51	-42	42-59	Down
TKN	625	2004-2012	0.008	0.490	-11	6	26	-	NS
		1989-2012	-0.030	<0.001	-62	-58	-53	53-62	Down
TNO_x	630	2004-2012	0.000	0.966	-16	0	18	-	NS
		1989-2012	-0.020	<0.001	-47	-43	-38	38-47	Down
DN	602	2004-2012	0.009	0.200	-4	7	19	-	NS
		1989-2012	-0.020	<0.001	-46	-43	-39	39-46	Down
DON	607	2004-2012	0.031	0.035	2	28	61	2-61	Up
		1989-2012	-0.025	<0.001	-56	-50	-44	44-56	Down
DNH_3	608	2004-2012	-0.006	0.776	-30	-4	31	-	BMDL
		1989-2012	-0.020	<0.001	-52	-42	-31	31-52	BMDL
DKN	623	2004-2012	0.030	0.016	4	26	53	4-53	Up
		1989-2012	-0.024	<0.001	-54	-49	-43	43-54	Down
DNO_x	631	2004-2012	0.002	0.869	-14	1	20	-	NS
		1989-2012	-0.019	<0.001	-47	-42	-36	36-47	Down
TP	665	2004-2012	-0.097	<0.001	-65	-56	-44	44-65	Down
		1989-2012	-0.016	<0.001	-45	-36	-27	27-45	Down
DP	666	2004-2012	-0.156	<0.001	-81	-74	-65	65-81	Down
		1989-2012	-0.008	0.004	-33	-21	-7	7-33	Down
DOP	671	2004-2012	-0.201	<0.001	-89	-83	-75	75-89	BMDL
		1989-2012	0.069	<0.001	389	540	738	-	BMDL
TOC	680	2004-2012	-0.029	<0.001	-28	-21	-14	14-28	Down
		1989-2012	-0.010	<0.001	-28	-24	-19	19-28	Down
SS	80154	2004-2012	0.022	0.354	-18	19	71	-	NS
		1989-2012	-0.027	<0.001	-62	-54	-45	45-62	Down

Down = downward/improving trend
Up = Upward/degrading trend
BMDL = Greater than 20% of values were Below Method Detection Limit
NS = No significant trend

Table C3. Full Term and Short Term Trend Statistics for the Susquehanna River at Marietta, Pa.

Parameter	STORET Code	Time Series/Test	Slope	P-Value	Slope Magnitude (%)			Trend % Change	Trend Direction
					Min	Trend	Max		
TN	600	2004-2012	-0.020	0.001	-23	-15	-6	6-23	Down
		1989-2012	-0.016	<0.001	-37	-34	-30	30-37	Down
TON	605	2004-2012	0.007	0.661	-17	6	35	-	NS
		1989-2012	-0.027	<0.001	-57	-51	-44	44-57	Down
TNH_3	610	2004-2012	-0.038	0.013	-43	-27	-6	6-43	Down
		1989-2012	-0.014	<0.001	-42	-32	-20	20-42	Down
TKN	625	2004-2012	0.006	0.622	-14	5	28	-	NS
		1989-2012	-0.025	<0.001	-55	-49	-42	42-55	Down
TNO_x	630	2004-2012	-0.027	<0.001	-29	-20	-10	10-29	Down
		1989-2012	-0.010	<0.001	-28	-23	-18	18-28	Down
DN	602	2004-2012	-0.023	0.001	-25	-17	-7	7-25	Down
		1989-2012	-0.022	<0.001	-48	-44	-41	41-48	Down
DON	607	2004-2012	-0.012	0.533	-33	-9	23	-	NS
		1989-2012	-0.030	<0.001	-61	-54	-47	47-61	Down
DNH_3	608	2004-2012	-0.039	0.010	-43	-27	-7	7-43	Down
		1989-2012	-0.012	0.000	-38	-28	-15	-	BMDL
DKN	623	2004-2012	-0.001	0.952	-22	-1	27	-	NS
		1989-2012	-0.027	<0.001	-57	-51	-45	45-57	Down
DNO_x	631	2004-2012	-0.024	0.001	-27	-18	-7	7-27	Down
		1989-2012	-0.010	<0.001	-28	-23	-18	18-28	Down
TP	665	2004-2012	-0.031	0.006	-35	-22	-7	7-35	Down
		1989-2012	-0.018	<0.001	-44	-37	-28	28-44	Down
DP	666	2004-2012	-0.027	0.061	-37	-20	1	-	NS
		1989-2012	-0.026	<0.001	-55	-49	-42	42-55	Down
DOP	671	2004-2012	-0.025	0.144	-38	-19	8	-	BMDL
		1989-2012	0.067	<0.001	318	434	581	-	BMDL
TOC	680	2004-2012	-0.019	0.010	-23	-14	-3	3-23	Down
		1989-2012	-0.007	<0.001	-21	-16	-11	11-21	Down
SS	80154	2004-2012	-0.004	0.813	-27	-3	29	-	NS
		1989-2012	-0.022	<0.001	-53	-43	-32	32-53	Down

Down = downward/improving trend
Up = Upward/degrading trend
BMDL = Greater than 20% of values were Below Method Detection Limit
NS = No significant trend

Table C4. Full Term and Short Term Trend Statistics for the West Branch Susquehanna River at Lewisburg, Pa.

Parameter	STORET Code	Time Series/Test	Slope	P-Value	Slope Magnitude (%)			Trend % Change	Trend Direction
					Min	Trend	Max		
TN	600	2004-2012	-0.019	0.019	-24	-14	-2	2-24	Down
		1989-2012	-0.017	<0.001	-43	-39	-34	34-43	Down
TON	605	2004-2012	-0.017	0.383	-37	-13	20	-	NS
		1989-2012	-0.038	<0.001	-71	-66	-60	60-71	Down
TNH_3	610	2004-2012	-0.009	0.536	-27	-7	18	-	BMDL
		1989-2012	-0.015	<0.001	-45	-34	-22	-	BMDL
TKN	625	2004-2012	-0.009	0.579	-28	-7	21	-	NS
		1989-2012	-0.032	<0.001	-65	-60	-53	53-65	Down
TNO_x	630	2004-2012	-0.024	0.002	-27	-18	-7	7-27	Down
		1989-2012	-0.008	<0.001	-26	-21	-15	15-26	Down
DN	602	2004-2012	-0.014	0.068	-21	-11	1	-	NS
		1989-2012	-0.015	<0.001	-38	-34	-29	29-38	Down
DON	607	2004-2012	-0.026	0.168	-40	-19	9	-	NS
		1989-2012	-0.033	<0.001	-66	-60	-54	54-66	Down
DNH_3	608	2004-2012	-0.002	0.872	-23	-2	24	-	BMDL
		1989-2012	-0.009	0.003	-35	-23	-9	-	BMDL
DKN	623	2004-2012	-0.008	0.620	-27	-6	21	-	NS
		1989-2012	-0.031	<0.001	-64	-59	-53	53-64	Down
DNO_x	631	2004-2012	-0.022	0.004	-26	-17	-5	5-26	Down
		1989-2012	-0.008	<0.001	-26	-21	-15	15-26	Down
TP	665	2004-2012	-0.133	<0.001	-75	-68	-59	59-75	Down
		1989-2012	-0.024	<0.001	-57	-49	-39	39-57	Down
DP	666	2004-2012	-0.215	<0.001	-90	-86	-78	-	BMDL
		1989-2012	-0.036	<0.001	-71	-64	-56	-	BMDL
DOP	671	2004-2012	-0.239	<0.001	-93	-89	-81	-	BMDL
		1989-2012	0.045	<0.001	148	241	369	-	BMDL
TOC	680	2004-2012	-0.026	0.001	-28	-19	-8	8-28	Down
		1989-2012	0.000	0.732	-9	-1	6	-	NS
SS	80154	2004-2012	-0.010	0.697	-38	-7	38	-	NS
		1989-2012	-0.019	<0.001	-53	-41	-26	26-53	Down

Down = downward/improving trend
Up = Upward/degrading trend
BMDL = Greater than 20% of values were Below Method Detection Limit
NS = No significant trend

Table C5. Full Term and Short Term Trend Statistics for the Juniata River at Newport, Pa.

Parameter	STORET Code	Time Series/Test	Slope	P-Value	Slope Magnitude (%)			Trend % Change	Trend Direction
					Min	Trend	Max		
TN	600	2004-2012	-0.026	<0.001	-26	-19	-12	12-26	Down
		1989-2012	-0.008	<0.001	-23	-20	-16	16-23	Down
TON	605	2004-2012	-0.031	0.090	-42	-22	4	-	NS
		1989-2012	-0.031	<0.001	-65	-59	-52	52-65	Down
TNH_3	610	2004-2012	-0.074	<0.001	-59	-46	-29	-	BMDL
		1989-2012	-0.017	<0.001	-48	-39	-27	-	BMDL
TKN	625	2004-2012	-0.031	0.054	-40	-22	1	-	NS
		1989-2012	-0.028	<0.001	-60	-54	-47	47-60	Down
TNO_x	630	2004-2012	-0.025	<0.001	-25	-18	-11	11-25	Down
		1989-2012	-0.002	0.067	-9	-5	0	-	NS
DN	602	2004-2012	-0.023	<0.001	-23	-17	-10	10-23	Down
		1989-2012	-0.005	<0.001	-18	-14	-10	10-18	Down
DON	607	2004-2012	-0.010	0.597	-31	-7	24	-	NS
		1989-2012	-0.030	<0.001	-63	-57	-50	50-63	Down
DNH_3	608	2004-2012	-0.070	<0.001	-58	-44	-26	-	BMDL
		1989-2012	-0.017	<0.001	-49	-38	-26	-	BMDL
DKN	623	2004-2012	-0.022	0.201	-36	-16	10	-	NS
		1989-2012	-0.030	<0.001	-63	-57	-50	50-63	Down
DNO_x	631	2004-2012	-0.022	<0.001	-23	-16	-9	9-23	Down
		1989-2012	-0.001	0.404	-7	-2	3	-	NS
TP	665	2004-2012	-0.065	<0.001	-54	-41	-25	25-54	Down
		1989-2012	-0.027	<0.001	-60	-53	-46	46-60	Down
DP	666	2004-2012	-0.080	<0.001	-60	-49	-35	35-60	Down
		1989-2012	-0.029	<0.001	-62	-57	-50	50-62	Down
DOP	671	2004-2012	-0.075	<0.001	-60	-46	-29	29-60	BMDL
		1989-2012	0.026	<0.001	59	105	164	59-164	Up
TOC	680	2004-2012	-0.038	<0.001	-35	-27	-17	17-35	Down
		1989-2012	-0.012	<0.001	-34	-28	-22	22-34	Down
SS	80154	2004-2012	-0.088	<0.001	-68	-52	-28	28-68	Down
		1989-2012	-0.026	<0.001	-62	-52	-40	40-62	Down

Down = downward/improving trend
Up = Upward/degrading trend
BMDL = Greater than 20% of values were Below Method Detection Limit
NS = No significant trend

Table C6. Full Term and Short Term Trend Statistics for the Conestoga River at Conestoga, Pa.

Parameter	STORET Code	Time Series/Test	Slope	P-Value	Slope Magnitude (%)			Trend % Change	Trend Direction
					Min	Trend	Max		
TN	600	2004-2012	-0.016	0.001	-19	-12	-5	5-19	Down
		1989-2012	-0.010	<0.001	-27	-24	-20	20-27	Down
TON	605	2004-2012	-0.084	<0.001	-65	-51	-29	29-65	Down
		1989-2012	-0.037	<0.001	-69	-65	-60	60-69	Down
TNH_3	610	2004-2012	0.003	0.894	-27	2	43	-	NS
		1989-2012	-0.052	<0.001	-81	-78	-74	74-81	Down
TKN	625	2004-2012	-0.074	0.001	-62	-46	-22	22-62	Down
		1989-2012	-0.042	<0.001	-74	-70	-66	66-74	Down
TNO_x	630	2004-2012	-0.013	0.035	-18	-10	-1	1-18	Down
		1989-2012	-0.001	0.343	-8	-3	3	-	NS
DN	602	2004-2012	-0.020	<0.001	-21	-15	-7	7-21	Down
		1989-2012	-0.003	<0.001	-12	-8	-4	4-12	Down
DON	607	2004-2012	-0.132	<0.001	-75	-68	-58	58-75	Down
		1989-2012	-0.015	<0.001	-43	-35	-25	25-43	Down
DNH_3	608	2004-2012	0.001	0.978	-28	0	41	-	NS
		1989-2012	-0.050	<0.001	-80	-77	-73	73-80	Down
DKN	623	2004-2012	-0.149	<0.001	-80	-72	-62	62-80	Down
		1989-2012	-0.023	<0.001	-54	-48	-41	41-54	Down
DNO_x	631	2004-2012	-0.008	0.209	-15	-6	4	-	NS
		1989-2012	0.000	0.940	-6	0	7	-	NS
TP	665	2004-2012	0.018	0.236	-9	15	47	-	NS
		1989-2012	-0.033	0.000	-65	-61	-55	55-65	Down
DP	666	2004-2012	0.017	0.233	-9	15	44	-	NS
		1989-2012	-0.025	<0.001	-55	-51	-46	46-55	Down
DOP	671	2004-2012	0.010	0.494	-14	9	38	-	NS
		1989-2012	-0.011	<0.001	-36	-27	-15	15-36	Down
TOC	680	2004-2012	-0.022	0.019	-28	-16	-3	3-28	Down
		1989-2012	-0.026	<0.001	-56	-52	-48	48-56	Down
SS	80154	2004-2012	0.019	0.478	-24	16	78	-	NS
		1989-2012	-0.052	<0.001	-82	-78	-73	73-82	Down

Down = downward/improving trend
Up = Upward/degrading trend
BMDL = Greater than 20% of values were Below Method Detection Limit
NS = No significant trend

Table C7. Short-term Trend Analysis Results at Enhanced Sites

Site	Subbasin	Years	TN	TON	TNH_3	TNO_x	DN	DON	DNH_3	DNO_x	TP	DP	DIP	TOC
Chemung	Chemung	8	▼	▼	NS	▼	▼	▼	NS	▼	NS	NS	NS	NS
Cohocton	Chemung	7	NS	NS	NS	NS	NS	NS	NS	NS	▼	▼	▼	NS
Conklin	Upper	7	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	NS
Unadilla	Upper	7	▼	▼	NS	NS	NS	▼	NS	NS	▼	▼	B	NS
Smithboro	Upper	8	▼	▼	NS	▼	▼	▼	NS	▼	▼	▼		NS
Towanda	Middle	8	▼	NS	B	▼	NS	▲	B	▼	▼	▼	▼	▼
Wilkes Barre	Middle	8	NS	NS	NS	NS	NS	NS	B	NS	▼	▼	B	▼
Danville	Middle	8	NS	NS	B	NS	NS	▲	B	NS	▼	▼	B	▼
Karthaus	West	8	NS	NS	NS	NS	NS	NS	B	NS	B	B	B	NS
Lewisburg	West	8	▼	NS	B	▼	NS	NS	B	▼	▼	B	B	▼
Newport	Juniata	8	▼	NS	B	▼	▼	NS	B	▼	▼	▼	B	▼
Saxton	Juniata	8	▼	NS	B	NS	NS	NS	B	NS	NS	B	B	▼
Marietta	Lower	8	▼	NS	▼	▼	▼	NS	▼	▼	▼	NS	B	▼
Penns	Lower	8	NS	▼	B	NS	NS	NS	B	NS	▼	▼	B	▼
Shermans	Lower	8	▼	NS	B	▼	▼	▼	B	▼	NS	NS	B	▼
West Conewago	Lower	8	▼	NS	NS	▼	▼	NS	▲	▼	NS	NS	NS	▼
Swatara	Lower	8	▼	NS	NS	▼	▼	NS	NS	▼	NS	NS	NS	NS
Conodoguinet	Lower	8	▼	NS	B	NS	▼	NS	B	NS	NS	▼	B	▼
Pequea	Lower	8	▼	▼	NS	NS	▼	▼	NS	NS	NS	▲	▲	NS
Conestoga	Lower	8	▼	▼	NS	▼	▼	▼	NS	NS	NS	NS	NS	▼

▼ Downward trend over the time period
▲ Upward trend over the time period
NS No significant trend over the time period
B Analysis results not reported due to >20% of the values being below the method detection limit

APPENDIX D

2012 Yields, LTM Yields, and Calculated Annual Concentration

Table D1. 2012 Nitrogen Yields, LTM Yields, and Calculated Annual Concentration

Site	Subbasin	TN			TNO_x			TON			TNH3		
		'12 Y	LTM Y	Conc.	'12 Y	LTM Y	Conc.	'12 Y	LTM Y	Conc.	'12 Y	LTM Y	Conc.
Chemung	Chemung	2.54	3.86	1.10	1.79	1.96	0.78	0.75	1.79	0.33	0.08	0.16	0.04
Cohocton	Chemung	3.85	5.20	1.78	2.90	3.24	1.34	0.87	1.88	0.40	0.07	0.14	0.03
Conklin	Upper	2.31	4.47	0.60	1.83	2.44	0.47	0.64	2.20	0.16	0.08	0.22	0.02
Unadilla	Upper	3.26	5.42	0.85	2.74	3.29	0.71	0.72	2.54	0.19	0.10	0.24	0.03
Smithboro	Upper	3.29	5.49	0.84	2.19	2.94	0.56	1.09	2.41	0.28	0.19	0.27	0.05
Towanda	Middle	2.74	4.78	0.89	1.89	3.07	0.61	0.82	1.76	0.27	0.12	0.24	0.04
Wilkes Barre	Middle	2.90	4.24	0.91	1.91	2.39	0.60	0.93	1.92	0.29	0.17	0.20	0.05
Danville	Middle	3.07	5.23	0.94	2.22	3.25	0.68	0.82	1.95	0.25	0.15	0.26	0.04
Karthaus	West	2.30	2.79	0.61	1.71	1.86	0.45	0.47	0.85	0.13	0.18	0.20	0.05
Lewisburg	West	3.27	4.52	0.82	2.43	3.26	0.61	0.65	1.21	0.16	0.18	0.21	0.04
Newport	Juniata	5.52	7.58	1.57	4.62	5.98	1.32	0.88	1.53	0.25	0.11	0.19	0.03
Saxton	Juniata	6.47	6.59	1.93	5.37	5.10	1.61	0.97	1.44	0.29	0.13	0.13	0.04
Marietta	Lower	4.88	7.46	1.33	3.72	5.44	1.01	0.96	1.94	0.26	0.16	0.26	0.04
Penns	Lower	6.53	7.03	1.54	5.60	5.39	1.32	0.93	1.59	0.22	0.16	0.17	0.04
Shermans	Lower	7.53	8.97	1.75	6.29	6.96	1.47	1.43	1.90	0.33	0.19	0.31	0.05
W Conewago	Lower	11.42	11.24	2.55	8.43	8.18	1.88	3.48	3.30	0.78	0.44	0.37	0.10
Swatara	Lower	15.71	18.95	3.82	14.32	16.12	3.48	1.33	4.19	0.32	0.27	0.51	0.07
Conodoguinet	Lower	16.01	15.30	3.84	14.87	13.58	3.57	1.30	1.71	0.31	0.18	0.20	0.04
Pequea	Lower	24.95	27.30	7.88	24.10	23.35	7.61	1.56	4.05	0.49	0.31	0.46	0.10
Conestoga	Lower	28.25	34.60	7.14	26.29	30.34	6.64	2.68	5.36	0.68	0.29	0.52	0.07

Table D2. 2012 Dissolved Nitrogen Yields, LTM Yields, and Calculated Annual Concentration

Site	Subbasin	DN			DNO_x			DON			DNH3		
		'12 Y	LTM Y	Conc.	'12 Y	LTM Y	Conc.	'12 Y	LTM Y	Conc.	'12 Y	LTM Y	Conc.
Chemung	Chemung	2.34	3.09	1.01	1.76	2.01	0.76	0.57	1.02	0.25	0.05	0.14	0.02
Cohocton	Chemung	3.49	4.37	1.62	3.00	3.27	1.39	0.62	1.14	0.29	0.07	0.13	0.03
Conklin	Upper	2.29	3.66	0.59	1.81	2.38	0.47	0.65	1.21	0.17	0.08	0.19	0.02
Unadilla	Upper	3.33	4.65	0.86	2.66	3.21	0.69	0.77	1.45	0.20	0.08	0.21	0.02
Smithboro	Upper	3.29	4.58	0.84	2.19	2.90	0.56	0.80	1.46	0.20	0.16	0.25	0.04
Towanda	Middle	2.60	4.13	0.84	1.92	3.03	0.62	0.67	1.15	0.22	0.12	0.21	0.04
Wilkes Barre	Middle	2.53	3.44	0.79	1.93	2.36	0.61	0.53	1.04	0.17	0.15	0.18	0.05
Danville	Middle	2.91	4.42	0.89	2.24	3.24	0.69	0.59	1.13	0.18	0.14	0.24	0.04
Karthaus	West	2.17	2.51	0.57	1.70	1.84	0.45	0.35	0.56	0.09	0.17	0.18	0.05
Lewisburg	West	3.06	4.09	0.77	2.43	3.24	0.61	0.49	0.81	0.12	0.17	0.20	0.04
Newport	Juniata	5.21	6.85	1.49	4.62	5.93	1.32	0.60	0.85	0.17	0.10	0.17	0.03
Saxton	Juniata	6.30	6.06	1.88	5.41	5.10	1.62	0.80	0.84	0.24	0.13	0.11	0.04
Marietta	Lower	4.45	6.44	1.21	3.71	5.38	1.01	0.60	0.93	0.16	0.15	0.24	0.04
Penns	Lower	6.30	6.49	1.48	5.61	5.37	1.32	0.68	0.99	0.16	0.15	0.15	0.03
Shermans	Lower	7.13	8.25	1.66	6.29	6.92	1.46	0.84	1.15	0.20	0.21	0.36	0.05
W Conewago	Lower	10.27	10.04	2.29	8.41	8.05	1.88	1.74	1.90	0.39	0.44	0.36	0.10
Swatara	Lower	15.32	17.84	3.72	14.35	15.99	3.49	0.93	1.77	0.23	0.28	0.50	0.07
Conodoguinet	Lower	15.68	14.80	3.76	14.84	13.53	3.56	0.81	1.17	0.20	0.18	0.18	0.04
Pequea	Lower	24.90	25.88	7.86	24.14	23.08	7.62	1.07	2.90	0.34	0.30	0.42	0.10
Conestoga	Lower	27.56	33.31	6.96	26.27	29.72	6.64	1.69	4.04	0.43	0.28	0.49	0.07

Table D3. 2012 Phosphorus and TOC Yields, LTM Yields, and Calculated Annual Concentration

Site	Subbasin	TP			DP			DOP			TOC		
		'12 Y	LTM Y	Conc.	'12 Y	LTM Y	Conc.	'12 Y	LTM Y	Conc.	'12 Y	LTM Y	Conc.
Chemung	Chemung	0.133	0.422	0.057	0.056	0.117	0.024	0.050	0.089	0.022	7.62	13.09	3.30
Cohocton	Chemung	0.078	0.307	0.036	0.037	0.106	0.017	0.025	0.087	0.012	8.13	14.33	3.76
Conklin	Upper	0.108	0.739	0.028	0.051	0.174	0.013	0.028	0.141	0.007	9.79	17.25	2.52
Unadilla	Upper	0.110	0.677	0.029	0.047	0.171	0.012	0.024	0.143	0.006	10.36	19.43	2.69
Smithboro	Upper	0.163	0.650	0.042	0.077	0.171	0.020	0.055	0.124	0.014	11.07	19.33	2.83
Towanda	Middle	0.135	0.555	0.044	0.058	0.191	0.019	0.046	0.153	0.015	7.95	18.34	2.58
Wilkes Barre	Middle	0.154	0.673	0.048	0.050	0.127	0.016	0.035	0.101	0.011	8.38	17.22	2.63
Danville	Middle	0.156	0.667	0.048	0.057	0.218	0.017	0.038	0.188	0.012	8.15	18.77	2.50
Karthaus	West	0.046	0.143	0.012	0.006	0.027	0.002	0.005	0.024	0.001	5.79	8.98	1.53
Lewisburg	West	0.080	0.268	0.020	0.026	0.117	0.006	0.020	0.099	0.005	6.43	11.62	1.62
Newport	Juniata	0.113	0.303	0.032	0.051	0.117	0.014	0.044	0.095	0.013	8.23	13.98	2.35
Saxton	Juniata	0.153	0.232	0.046	0.052	0.066	0.016	0.046	0.045	0.014	8.31	11.45	2.49
Marietta	Lower	0.158	0.523	0.043	0.055	0.107	0.015	0.045	0.080	0.012	9.38	16.97	2.55
Penns	Lower	0.146	0.352	0.034	0.073	0.175	0.017	0.063	0.140	0.015	9.90	14.52	2.33
Shermans	Lower	0.323	0.533	0.075	0.160	0.250	0.037	0.153	0.203	0.036	11.70	18.40	2.72
W Conewago	Lower	1.317	1.241	0.294	0.616	0.624	0.137	0.576	0.554	0.128	26.07	27.28	5.82
Swatara	Lower	0.285	1.563	0.069	0.148	0.388	0.036	0.124	0.318	0.030	10.97	27.54	2.66
Conodoguinet	Lower	0.204	0.307	0.049	0.091	0.117	0.022	0.077	0.089	0.019	10.31	13.95	2.47
Pequea	Lower	0.700	1.855	0.221	0.434	0.827	0.137	0.402	0.748	0.127	9.25	17.90	2.92
Conestoga	Lower	1.008	1.921	0.255	0.571	0.914	0.144	0.530	0.832	0.134	13.07	23.87	3.30

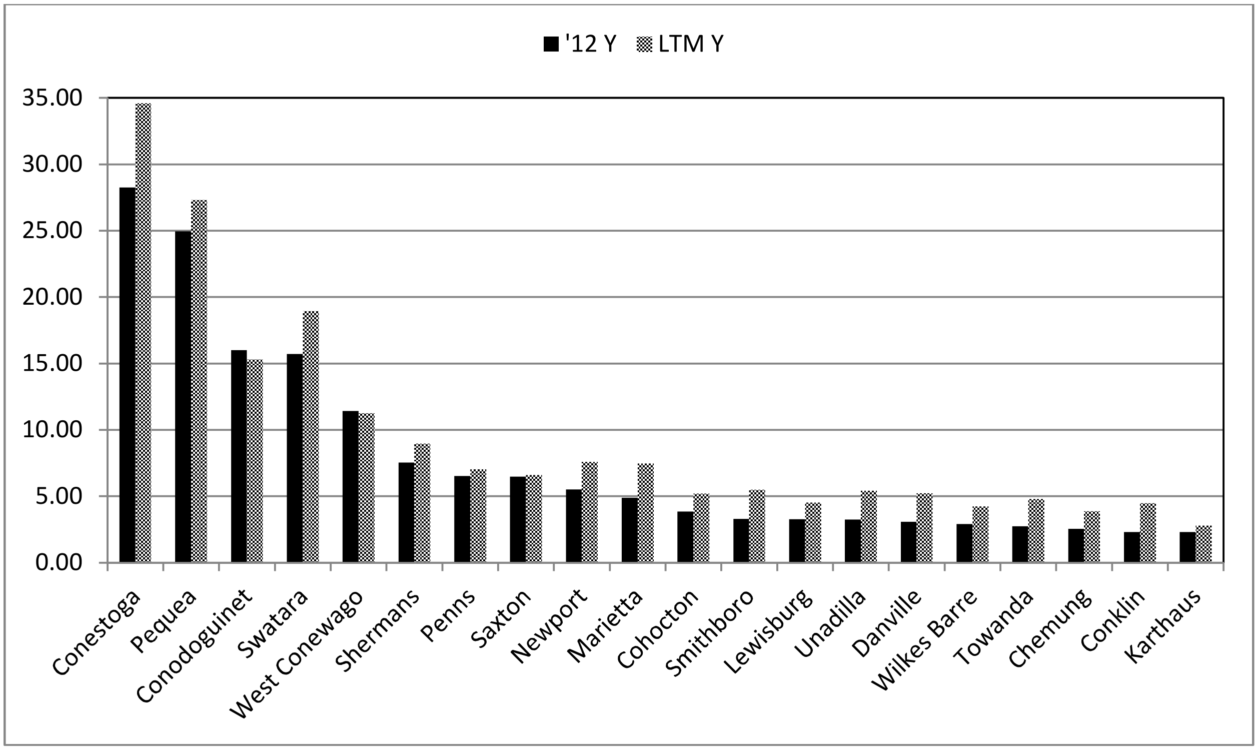

Figure D1. 2012 and Long-term Total Nitrogen Yields in lbs/ac at All Sites

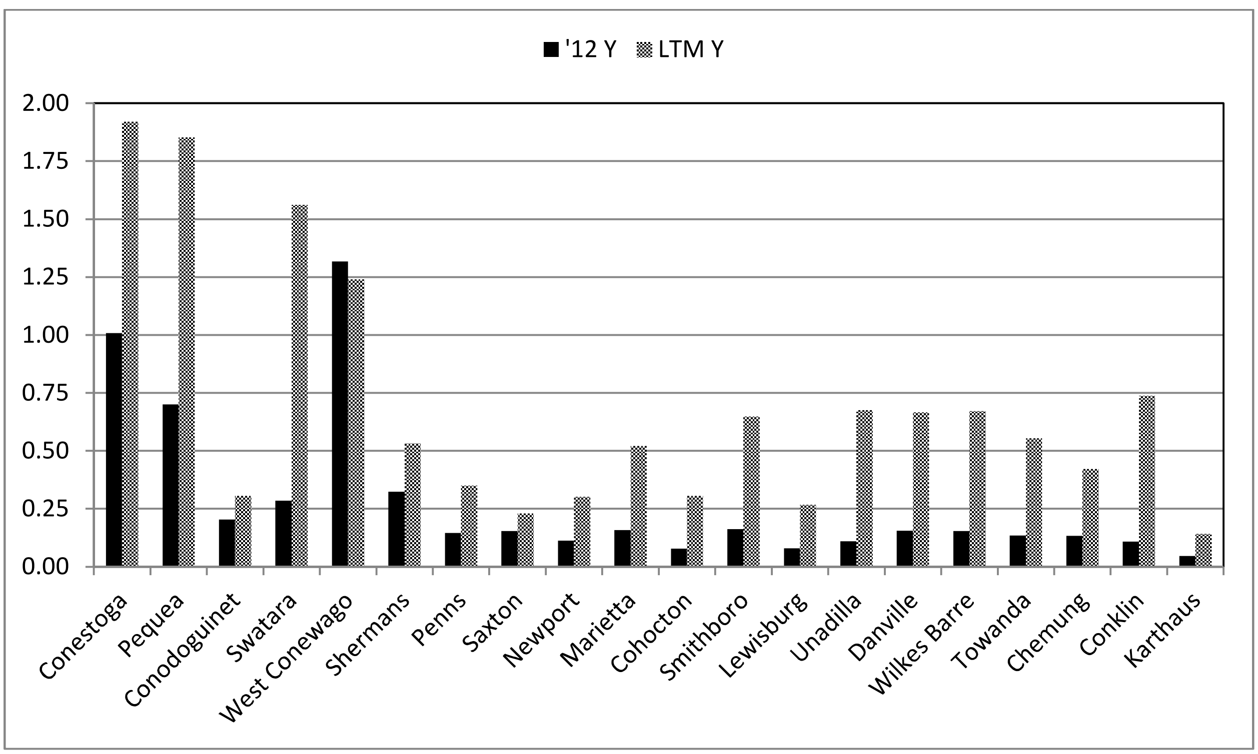

Figure D2. 2012 and Long-term Total Phosphorus Yields in lbs/ac at All Sites

APPENDIX E

Summary Statistics

Table E1. Temperature, Dissolved Oxygen, Conductivity, and pH Summary Statistics of Samples Collected During 2012

Station	Temperature (C°)					Dissolved Oxygen (mg/L)					Conductivity (umhos/cm)					pH (S.U.)				
	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD
Chemung	0.40	26.41	19.39	14.85	9.23	5.04	14.28	9.30	9.83	3.05	171	704	333	347	133	7.22	8.65	7.59	7.71	0.46
Cohocton	1.29	24.17	16.79	12.50	7.78	7.98	14.41	11.25	11.05	2.42	186	666	464	414	159	7.49	8.81	7.96	8.02	0.36
Conklin	0.29	27.65	14.95	14.56	10.62	8.95	13.83	9.53	10.80	1.93	116	256	170	174	72	6.84	8.72	7.71	7.74	0.70
Smithboro	0.49	27.30	15.06	14.43	9.41	5.97	13.94	9.71	10.02	2.58	131	515	186	229	97	7.09	8.50	7.69	7.66	0.35
Itaska	0.15	27.70	16.10	13.13	9.13	8.59	14.07	10.82	11.28	1.92	167	409	290	283	78	7.22	8.40	7.92	7.85	0.40
Unadilla	0.17	25.04	15.20	12.30	8.32	8.95	13.76	9.73	10.70	1.78	138	385	218	240	85	5.85	8.81	7.68	7.64	0.68
Castanea	2.92	22.42	13.24	12.16	6.37	9.44	14.87	11.21	11.60	1.69	200	401	259	280	66	7.02	8.52	7.98	7.88	0.39
Conestoga	3.25	25.41	12.83	14.04	7.30	6.69	17.55	10.82	10.94	2.77	321	753	600	563	110	7.25	8.82	8.05	8.02	0.35
Dalmatia	1.28	25.54	13.46	12.60	7.49	7.36	15.47	11.11	11.13	2.67	122	268	146	162	41	7.11	9.64	7.66	7.94	0.73
Danville	0.24	27.91	11.54	12.84	8.70	7.50	15.62	9.51	10.73	2.49	144	461	231	250	76	7.28	8.67	7.71	7.79	0.32
Dromgold	1.88	25.20	13.65	12.67	6.74	8.80	15.82	10.78	11.04	1.78	100	225	140	152	40	7.25	8.89	8.08	8.06	0.42
Hershey	2.51	24.47	13.46	12.88	7.18	6.80	14.16	8.97	9.91	2.51	127	445	252	264	110	7.32	8.34	7.76	7.76	0.26
Hogestown	4.78	25.32	12.27	13.49	6.63	8.09	14.26	10.62	10.86	1.65	180	490	362	343	95	7.04	8.50	7.90	7.95	0.32
Jersey Shore	0.78	25.72	14.24	13.29	7.99	8.65	14.43	10.85	10.98	1.97	122	367	222	228	80	4.75	8.72	7.75	7.65	0.80
Karthaus	1.62	27.37	12.22	12.79	7.93	7.00	14.01	10.20	10.77	1.88	169	657	324	383	164	6.40	7.78	7.44	7.34	0.35
Lewisburg	0.76	26.10	11.06	12.22	7.96	6.65	14.45	10.56	10.61	2.29	105	376	194	199	62	7.16	8.53	7.64	7.70	0.31
Manchester	2.04	26.92	13.13	13.96	7.61	6.69	14.87	9.67	9.78	2.63	129	333	255	237	57	6.94	8.25	7.55	7.53	0.32
Marietta	0.89	29.62	11.39	12.88	8.08	7.39	14.65	10.90	10.86	2.17	139	351	215	224	57	7.12	9.04	8.02	8.03	0.44
Martic Forge	3.32	23.63	15.71	14.29	6.53	7.38	14.91	11.10	10.60	2.22	257	521	456	441	71	7.20	8.41	7.93	7.91	0.29
Newport	1.45	25.87	11.75	13.04	7.57	7.76	14.98	11.03	11.16	1.77	160	351	225	240	56	7.25	9.24	8.24	8.23	0.39
Paxton	3.44	26.06	14.28	13.72	6.75	7.12	15.59	10.34	10.75	2.49	254	879	405	451	135	7.50	8.69	8.11	8.09	0.32
Penns Creek	-0.07	22.74	12.72	11.18	6.25	7.82	14.33	10.18	10.82	1.95	150	418	224	239	68	7.43	9.74	8.30	8.36	0.57
Reedsville	3.19	19.20	9.99	10.86	4.58	9.75	13.55	11.55	11.65	1.05	161	448	283	311	86	6.81	8.76	8.15	8.09	0.42
Saxton	1.48	24.61	9.17	11.51	6.95	7.50	14.31	10.93	10.67	1.84	163	469	265	289	88	7.06	9.32	8.24	8.26	0.67
Towanda	0.10	25.81	9.76	11.79	8.81	6.70	15.03	9.17	10.24	2.62	109	377	216	238	86	6.68	8.58	7.86	7.89	0.43
Wilkes-Barre	0.90	26.30	13.30	12.64	8.36	6.63	13.94	9.23	9.75	2.57	149	565	229	267	110	7.31	8.17	7.60	7.65	0.22
Richardsmere	3.94	24.92	15.3	14.69	7.20	7.41	15.37	11.04	10.97	2.12	155	268	243	232	37	7.24	9.17	8.20	8.14	0.50

Table E2. Total Nitrogen Species Summary Statistics of Samples Collected During 2012, in mg/L

Station	Total Nitrogen					Total Ammonium					Total Nitrate plus Nitrite					Total Organic Nitrogen				
	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD
Chemung	0.59	1.67	1.02	1.04	0.25	0.01	0.13	0.02	0.03	0.03	0.34	0.92	0.60	0.63	0.16	0.08	0.80	0.40	0.39	0.19
Cohocton	0.75	2.46	1.45	1.60	0.54	0.01	0.09	0.03	0.03	0.02	0.32	1.70	1.18	1.16	0.47	0.11	0.93	0.32	0.41	0.23
Conklin	0.31	0.89	0.59	0.59	0.17	0.01	0.06	0.02	0.03	0.01	0.02	0.65	0.33	0.34	0.19	0.06	0.42	0.20	0.22	0.12
Smithboro	0.55	1.06	0.83	0.84	0.15	0.01	0.09	0.04	0.05	0.02	0.27	0.83	0.42	0.47	0.16	0.19	0.54	0.33	0.34	0.10
Itaska	0.6	1.79	0.96	1.01	0.30	0.01	0.06	0.03	0.03	0.01	0.34	1.47	0.69	0.74	0.31	0.08	0.41	0.25	0.24	0.09
Unadilla	0.49	1.27	0.81	0.79	0.21	0.01	0.12	0.03	0.04	0.03	0.21	0.94	0.45	0.50	0.21	0.06	0.71	0.21	0.24	0.15
Castanea	0.99	1.79	1.34	1.36	0.20	0.02	0.09	0.03	0.04	0.02	0.77	1.58	1.06	1.12	0.21	0.01	0.36	0.20	0.20	0.10
Conestoga	3.70	9.17	6.88	6.64	1.19	0.02	0.32	0.04	0.07	0.07	2.84	8.22	6.59	6.17	1.47	0.06	1.54	0.40	0.51	0.34
Dalmatia	0.93	6.71	3.38	3.32	1.61	0.02	0.08	0.02	0.03	0.02	0.72	6.41	2.97	3.03	1.63	0.07	1.04	0.27	0.31	0.22
Danville	0.51	1.47	0.84	0.86	0.22	0.02	0.07	0.03	0.03	0.01	0.17	0.94	0.56	0.52	0.19	0.09	0.66	0.29	0.31	0.14
Dromgold	1.03	2.27	1.69	1.65	0.39	0.02	0.06	0.03	0.03	0.01	0.86	2.05	1.36	1.39	0.39	0.09	0.65	0.22	0.25	0.14
Hershey	2.71	5.15	3.88	3.79	0.71	0.02	0.16	0.05	0.06	0.04	1.89	5.02	3.63	3.46	0.86	0.03	1.25	0.23	0.30	0.30
Hogestown	2.84	4.50	3.80	3.71	0.45	0.02	0.10	0.04	0.04	0.02	1.77	4.31	3.48	3.35	0.65	0.05	1.03	0.28	0.33	0.22
Jersey Shore	0.39	1.38	0.61	0.67	0.22	0.02	0.05	0.03	0.03	0.01	0.29	0.68	0.44	0.44	0.09	0.02	0.90	0.17	0.20	0.20
Karthaus	0.30	1.16	0.55	0.62	0.23	0.02	0.08	0.04	0.04	0.02	0.18	0.72	0.39	0.42	0.13	0.02	0.71	0.13	0.16	0.15
Lewisburg	0.50	1.78	0.76	0.80	0.23	0.02	0.10	0.03	0.04	0.02	0.32	0.86	0.56	0.55	0.13	0.04	1.08	0.17	0.22	0.19
Manchester	1.20	3.09	2.48	2.34	0.49	0.02	0.25	0.06	0.08	0.06	0.75	2.56	1.86	1.79	0.50	0.01	1.22	0.45	0.49	0.30
Marietta	0.77	2.99	1.17	1.39	0.57	0.02	0.10	0.03	0.04	0.02	0.23	2.16	1.01	0.97	0.41	0.02	1.17	0.29	0.37	0.28
Martic Forge	4.72	8.75	7.55	7.23	1.24	0.02	0.33	0.08	0.10	0.08	3.10	8.85	7.22	6.70	1.64	0.01	1.46	0.48	0.52	0.39
Newport	0.93	2.80	1.47	1.50	0.35	0.02	0.09	0.03	0.03	0.01	0.71	1.70	1.20	1.19	0.27	0.05	1.28	0.25	0.29	0.23
Paxton	0.80	2.55	1.55	1.60	0.49	0.02	0.04	0.02	0.03	0.01	0.60	2.38	1.26	1.36	0.51	0.02	0.58	0.21	0.23	0.16
Penns Creek	1.05	2.22	1.52	1.53	0.33	0.02	0.09	0.03	0.03	0.02	0.79	1.90	1.20	1.25	0.31	0.01	0.65	0.22	0.25	0.16
Reedsville	1.47	5.49	3.52	3.43	0.97	0.02	0.08	0.03	0.03	0.01	1.16	5.01	3.43	3.23	0.97	0.02	0.53	0.12	0.18	0.15
Saxton	1.40	2.28	1.86	1.85	0.28	0.02	0.06	0.03	0.03	0.01	1.17	2.00	1.57	1.56	0.27	0.01	0.60	0.21	0.26	0.15
Towanda	0.48	1.50	0.83	0.84	0.20	0.02	0.11	0.04	0.04	0.02	0.06	0.89	0.48	0.45	0.19	0.08	0.92	0.34	0.36	0.18
Wilkes-Barre	0.60	1.25	0.89	0.86	0.18	0.02	0.08	0.05	0.05	0.01	0.21	0.80	0.44	0.44	0.16	0.06	0.72	0.36	0.37	0.17
Richardsmere	3.78	8.64	5.66	5.91	1.72	0.02	0.39	0.04	0.09	0.10	2.68	8.51	4.94	5.34	2.03	0.01	1.89	0.38	0.51	0.47

Table E3. Dissolved Nitrogen Species Summary Statistics of Samples Collected During 2012, in mg/L

Station	Dissolved Nitrogen					Dissolved Ammonium					Dissolved Nitrate plus Nitrite					Dissolved Organic Nitrogen				
	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD
Chemung	0.60	1.17	1.09	0.97	0.21	0.01	0.13	0.02	0.03	0.04	0.35	0.93	0.63	0.66	0.19	0.08	0.51	0.26	0.28	0.15
Cohocton	0.58	2.32	1.48	1.53	0.48	0.01	0.08	0.03	0.03	0.02	0.34	1.78	1.20	1.19	0.46	0.07	0.58	0.27	0.31	0.15
Conklin	0.30	0.80	0.64	0.58	0.16	0.01	0.06	0.02	0.02	0.01	0.02	0.66	0.36	0.35	0.19	0.06	0.36	0.21	0.22	0.09
Smithboro	0.55	1.00	0.80	0.78	0.14	0.04	0.08	0.05	0.05	0.01	0.28	0.84	0.47	0.50	0.17	0.04	0.45	0.24	0.23	0.14
Itaska	0.59	1.74	1.00	1.03	0.27	0.01	0.04	0.02	0.02	0.01	0.34	1.51	0.69	0.75	0.32	0.08	0.44	0.26	0.26	0.12
Unadilla	0.41	1.12	0.78	0.77	0.19	0.01	0.04	0.02	0.02	0.01	0.20	0.96	0.45	0.51	0.21	0.08	0.41	0.20	0.23	0.11
Castanea	0.99	1.78	1.26	1.31	0.20	0.02	0.09	0.03	0.04	0.02	0.77	1.59	1.07	1.13	0.22	0.01	0.33	0.15	0.14	0.09
Conestoga	3.68	9.43	7.01	6.55	1.34	0.02	0.30	0.05	0.07	0.06	2.82	8.25	6.59	6.17	1.47	0.01	1.16	0.36	0.40	0.28
Dalmatia	0.95	6.52	3.29	3.21	1.60	0.02	0.08	0.02	0.03	0.02	0.72	6.21	2.96	3.00	1.60	0.07	0.44	0.22	0.23	0.09
Danville	0.47	1.62	0.75	0.77	0.23	0.02	0.06	0.03	0.03	0.01	0.18	0.96	0.56	0.52	0.19	0.08	1.00	0.18	0.22	0.16
Dromgold	1.07	2.23	1.67	1.59	0.36	0.02	0.06	0.03	0.03	0.01	0.86	2.02	1.39	1.38	0.39	0.05	0.33	0.18	0.18	0.08
Hershey	2.43	5.15	3.82	3.69	0.77	0.02	0.15	0.05	0.06	0.04	1.88	5.02	3.52	3.44	0.85	0.01	0.49	0.16	0.21	0.14
Hogestown	2.31	4.49	3.71	3.59	0.52	0.02	0.16	0.04	0.05	0.03	1.76	4.35	3.50	3.35	0.65	0.01	0.41	0.18	0.21	0.11
Jersey Shore	0.41	0.90	0.57	0.60	0.11	0.02	0.05	0.03	0.03	0.01	0.29	0.68	0.44	0.44	0.09	0.01	0.27	0.14	0.13	0.07
Karthaus	0.26	1.01	0.53	0.56	0.17	0.02	0.08	0.04	0.04	0.01	0.18	0.72	0.39	0.42	0.13	0.02	0.25	0.10	0.11	0.07
Lewisburg	0.43	1.72	0.70	0.74	0.22	0.02	0.10	0.03	0.04	0.02	0.31	0.86	0.56	0.55	0.13	0.03	1.02	0.13	0.16	0.16
Manchester	1.13	3.01	2.21	2.21	0.48	0.02	0.24	0.06	0.07	0.06	0.76	2.54	1.82	1.79	0.50	0.02	0.65	0.36	0.35	0.20
Marietta	0.54	2.44	1.11	1.22	0.48	0.02	0.10	0.03	0.04	0.02	0.24	2.13	1.01	0.97	0.41	0.01	1.22	0.20	0.22	0.21
Martic Forge	3.96	8.79	7.47	7.05	1.35	0.02	0.33	0.08	0.10	0.08	3.10	8.94	7.23	6.72	1.67	0.01	0.76	0.35	0.39	0.26
Newport	0.91	2.76	1.40	1.43	0.34	0.02	0.06	0.03	0.03	0.01	0.71	1.67	1.19	1.18	0.26	0.04	1.29	0.18	0.22	0.21
Paxton	0.78	2.48	1.45	1.57	0.48	0.02	0.04	0.02	0.03	0.01	0.56	2.39	1.27	1.36	0.51	0.03	0.43	0.19	0.20	0.11
Penns Creek	1.03	2.06	1.40	1.45	0.28	0.02	0.05	0.03	0.03	0.01	0.80	1.91	1.20	1.25	0.31	0.06	0.37	0.19	0.19	0.09
Reedsville	1.49	5.36	3.47	3.36	0.97	0.02	0.10	0.03	0.03	0.02	1.16	4.98	3.44	3.23	0.99	0.06	0.35	0.14	0.16	0.09
Saxton	1.36	2.23	1.75	1.77	0.26	0.02	0.06	0.03	0.03	0.01	1.17	2.00	1.58	1.56	0.27	0.03	0.31	0.16	0.17	0.07
Towanda	0.32	1.35	0.72	0.76	0.23	0.02	0.06	0.04	0.03	0.01	0.06	0.90	0.49	0.46	0.20	0.08	0.77	0.24	0.28	0.15
Wilkes-Barre	0.48	1.02	0.70	0.71	0.14	0.02	0.08	0.04	0.04	0.02	0.21	0.79	0.44	0.44	0.16	0.04	0.35	0.24	0.23	0.08
Richardsmere	3.39	8.44	5.13	5.68	1.80	0.02	0.38	0.04	0.09	0.10	2.64	8.58	4.97	5.35	2.04	0.01	0.75	0.28	0.32	0.22

Table E4. Phosphorus Species and Total Suspended Solids Summary Statistics of Samples Collected During 2012, in mg/L

Station	Total Phosphorus					Dissolved Phosphorus					Orthophosphorus					Total Suspended Solids				
	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD
Chemung	0.022	0.173	0.095	0.081	0.044	0.010	0.098	0.024	0.034	0.028	0.006	0.134	0.020	0.041	0.040	2.1	48	6.9	15.3	16.7
Cohocton	0.013	0.231	0.030	0.049	0.052	0.005	0.085	0.020	0.026	0.021	0.005	0.070	0.014	0.018	0.018	1.4	114	8.7	18.6	29.3
Conklin	0.012	0.145	0.027	0.039	0.035	0.005	0.036	0.011	0.015	0.009	0.005	0.014	0.006	0.008	0.003	2.2	135	10.8	21.8	36.1
Smithboro	0.022	0.102	0.040	0.048	0.021	0.012	0.052	0.023	0.024	0.012	0.005	0.037	0.012	0.014	0.008	3.0	86	8.6	17.8	22.6
Itaska	0.013	0.057	0.034	0.031	0.012	0.006	0.028	0.014	0.015	0.006	0.005	0.021	0.010	0.010	0.005	1.6	45	6.0	10.3	10.4
Unadilla	0.009	0.204	0.028	0.039	0.046	0.005	0.030	0.013	0.012	0.006	0.005	0.020	0.005	0.007	0.004	2.8	156	8.7	20.5	37.5
Castanea	0.010	0.064	0.023	0.025	0.012	0.010	0.021	0.010	0.012	0.004	0.010	0.020	0.011	0.012	0.003	5.0	26	6.0	8.6	5.5
Conestoga	0.036	0.846	0.155	0.199	0.162	0.024	0.354	0.128	0.146	0.099	0.020	0.326	0.121	0.136	0.093	5.0	330	9.0	27.0	58.1
Dalmatia	0.010	0.271	0.067	0.074	0.063	0.010	0.099	0.041	0.042	0.025	0.010	0.089	0.029	0.035	0.023	5.0	210	6.0	27.7	48.7
Danville	0.014	0.199	0.034	0.053	0.045	0.010	0.037	0.014	0.016	0.006	0.010	0.023	0.010	0.013	0.004	5.0	188	10.0	28.6	40.9
Dromgold	0.010	0.155	0.033	0.045	0.035	0.010	0.080	0.023	0.027	0.019	0.010	0.067	0.019	0.024	0.015	5.0	46	8.0	12.9	11.1
Hershey	0.021	0.386	0.055	0.084	0.084	0.014	0.111	0.039	0.046	0.026	0.013	0.091	0.035	0.039	0.021	5.0	246	12.0	29.8	55.2
Hogestown	0.010	0.172	0.038	0.057	0.050	0.010	0.084	0.028	0.028	0.019	0.010	0.068	0.021	0.024	0.015	5.0	108	10.0	22.8	29.3
Jersey Shore	0.010	0.090	0.013	0.023	0.022	0.010	0.011	0.010	0.010	0.000	0.010	0.012	0.010	0.010	0.001	5.0	82	6.0	14.7	19.2
Karthaus	0.010	0.114	0.010	0.021	0.025	0.010	0.010	0.010	0.010	0.000	0.010	0.010	0.010	0.010	0.000	5.0	96	8.0	15.9	20.4
Lewisburg	0.010	0.102	0.016	0.023	0.019	0.010	0.019	0.010	0.011	0.002	0.010	0.014	0.010	0.010	0.001	5.0	72	6.0	13.8	16.4
Manchester	0.021	0.584	0.143	0.163	0.138	0.016	0.343	0.098	0.116	0.090	0.012	0.320	0.091	0.105	0.083	5.0	172	10.0	27.1	40.7
Marietta	0.011	0.356	0.034	0.071	0.083	0.010	0.192	0.015	0.028	0.037	0.010	0.179	0.013	0.025	0.034	5.0	146	12.0	30.0	38.5
Martic Forge	0.020	1.162	0.182	0.269	0.274	0.015	0.698	0.123	0.189	0.173	0.014	0.649	0.120	0.175	0.159	5.0	332	20.0	46.1	77.1
Newport	0.010	0.186	0.032	0.043	0.037	0.010	0.071	0.017	0.023	0.015	0.010	0.060	0.016	0.021	0.013	5.0	92	5.5	15.6	20.2
Paxton	0.010	0.087	0.023	0.031	0.021	0.010	0.058	0.018	0.022	0.013	0.010	0.046	0.019	0.020	0.011	5.0	20	5.0	7.3	4.5
Penns Creek	0.010	0.151	0.025	0.039	0.038	0.010	0.100	0.013	0.025	0.024	0.010	0.061	0.011	0.017	0.012	5.0	66	10.0	14.5	14.3
Reedsville	0.011	0.177	0.046	0.060	0.038	0.015	0.093	0.034	0.043	0.025	0.011	0.093	0.035	0.041	0.023	5.0	78	6.0	11.1	16.6
Saxton	0.010	0.180	0.032	0.041	0.040	0.010	0.060	0.013	0.017	0.011	0.010	0.042	0.012	0.014	0.007	5.0	84	16.0	19.5	18.7
Towanda	0.017	0.159	0.051	0.057	0.034	0.010	0.068	0.029	0.028	0.016	0.010	0.053	0.023	0.023	0.012	5.0	148	10.0	21.7	32.1
Wilkes-Barre	0.014	0.249	0.047	0.069	0.060	0.010	0.039	0.016	0.018	0.007	0.010	0.024	0.011	0.013	0.005	5.0	166	12.0	40.7	51.3
Richardsmere	0.026	0.735	0.075	0.199	0.244	0.013	0.391	0.050	0.123	0.140	0.010	0.359	0.042	0.110	0.127	5.0	236	8.0	26.5	53.0

Table E5. ***Flow, Total Organic Carbon, Total Kjeldahl, and Dissolved Kjeldahl Summary Statistics of Samples Collected During 2012, in mg/L***

Station	Flow (cfs)					Total Organic Carbon					Total Kjeldahl Nitrogen					Dissolved Kjeldahl Nitrogen				
	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD	Min	Max	Med	Mn	SD
Chemung	245	11,600	1,620	2,769	3,141	2.30	5.50	3.20	3.45	1.04	0.10	0.81	0.42	0.42	0.19	0.10	0.52	0.27	0.31	0.15
Cohocton	51	1,170	410	442	337	2.20	8.20	3.50	4.32	1.97	0.14	1.02	0.34	0.44	0.24	0.10	0.63	0.29	0.34	0.16
Conklin	393	14,400	3,130	4,920	4,424	1.60	4.30	2.75	2.89	0.88	0.10	0.46	0.23	0.25	0.12	0.10	0.37	0.24	0.24	0.09
Smithboro	929	27,400	6,610	7,305	6,857	1.70	5.50	2.90	3.26	1.13	0.18	0.62	0.35	0.37	0.13	0.09	0.52	0.29	0.28	0.15
Itaska						1.50	4.70	3.30	3.09	0.99	0.10	0.43	0.28	0.27	0.09	0.10	0.47	0.29	0.28	0.13
Unadilla	118	3,890	801	1,024	939	1.70	4.60	3.20	3.12	0.96	0.10	0.75	0.26	0.28	0.16	0.10	0.44	0.24	0.25	0.11
Castanea	340	4,248	1,057	1,714	1,438	0.90	4.50	1.77	1.91	0.79	0.04	0.41	0.24	0.23	0.11	0.04	0.37	0.19	0.18	0.09
Conestoga	172	3,280	513	786	670	1.60	7.62	2.63	3.26	1.67	0.02	1.66	0.50	0.55	0.38	0.02	1.18	0.44	0.45	0.30
Dalmatia	28	1,880	298	506	536	0.85	8.92	2.43	2.90	1.90	0.09	1.08	0.30	0.35	0.23	0.09	0.48	0.25	0.26	0.10
Danville	1,990	52,800	11,900	16,931	14,390	1.52	6.44	2.71	2.97	1.15	0.11	0.70	0.33	0.34	0.15	0.10	1.04	0.22	0.26	0.16
Dromgold	44	1,880	240	478	479	0.80	6.58	2.14	2.62	1.54	0.11	0.70	0.25	0.28	0.15	0.02	0.39	0.22	0.20	0.10
Hershey	135	6,750	1,016	1,727	1,868	0.98	7.07	2.53	3.15	1.67	0.06	1.41	0.25	0.36	0.33	0.05	0.63	0.22	0.27	0.17
Hogestown	196	6,770	767	1,320	1,499	1.08	6.93	2.42	3.07	1.80	0.07	1.13	0.32	0.38	0.24	0.04	0.55	0.22	0.25	0.14
Jersey Shore	986	25,500	3,175	6,248	8,195	0.74	6.78	1.60	2.09	1.41	0.04	0.94	0.20	0.23	0.20	0.03	0.30	0.17	0.16	0.07
Karthaus	264	11,400	2,125	3,082	3,280	0.74	7.08	1.52	2.09	1.54	0.07	0.76	0.16	0.19	0.15	0.05	0.29	0.12	0.14	0.07
Lewisburg	1,530	44,700	8,780	13,213	11,529	0.76	5.11	1.73	1.98	0.97	0.07	1.11	0.21	0.25	0.19	0.05	1.05	0.16	0.19	0.16
Manchester	126	9,920	818	1,690	2,444	2.14	10.69	4.38	5.01	2.36	0.05	1.34	0.49	0.56	0.34	0.06	0.80	0.38	0.43	0.22
Marietta	6,740	124,000	32,400	47,257	37,436	1.45	9.44	2.55	3.31	1.86	0.06	1.23	0.33	0.41	0.30	0.05	1.28	0.24	0.26	0.22
Martic Forge	76	339	181	183	83	1.30	11.80	2.50	3.80	2.71	0.03	1.62	0.56	0.63	0.44	0.03	0.93	0.42	0.48	0.32
Newport	571	33,000	3,885	6,700	7,431	1.47	8.02	2.47	2.72	1.19	0.01	1.30	0.27	0.31	0.23	0.07	1.31	0.20	0.25	0.21
Paxton						1.27	6.10	2.90	3.00	1.39	0.01	0.62	0.23	0.24	0.16	0.05	0.46	0.21	0.22	0.12
Penns Creek	110	2,780	419	725	719	1.24	7.41	2.12	2.77	1.49	0.03	0.71	0.26	0.28	0.17	0.08	0.42	0.21	0.22	0.09
Reedsville	46	837	211	286	242	1.10	4.40	1.51	1.94	0.95	0.04	0.61	0.15	0.21	0.16	0.01	0.38	0.15	0.17	0.11
Saxton	125	12,600	663	1,798	2,836	1.16	7.81	2.11	2.64	1.48	0.04	0.64	0.24	0.29	0.15	0.06	0.36	0.19	0.21	0.07
Towanda	1,190	35,400	7,610	9,543	8,238	1.53	8.15	3.06	3.27	1.37	0.12	0.96	0.38	0.40	0.18	0.10	0.80	0.27	0.31	0.15
Wilkes-Barre	1,580	47,300	13,000	17,038	14,549	1.59	6.74	2.98	3.30	1.28	0.11	0.77	0.42	0.41	0.17	0.09	0.40	0.29	0.27	0.09
Richardsmere	51	747	141	223	184	1.58	12.84	3.24	4.19	2.89	0.03	2.14	0.40	0.57	0.55	0.03	1.11	0.31	0.41	0.31