SUSQUEHANNA RIVER BASIN COMMISSION

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Sediment and Nutrients Assessment Program

2010 Summary Report

www.srbc.net/programs/CBP/nutrientprogram.htm

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About the Program

From 1984 to 1989, SRBC conducted an initial 5-year nutrient monitoring program involving 14 sampling sites to establish a database for estimating nutrient (nitrogen and phosphorus) and suspended sediment loads in the Susquehanna basin. This initial effort, funded by the Pennsylvania Department of Environmental Protection and conducted as part of the Chesapeake Bay Restoration Program, consisted of monthly base flow sampling and periodic sampling during high flows.

The sampling network — consisting of sites on the mainstem Susquehanna, major tributaries and smaller watersheds to represent different land uses — was established to: collect the data needed to enable accurate allocation of nutrient and suspended sediment loads to the mainstem Susquehanna River reaches and to the major subbasins; and to provide a long-term nutrient and suspended-sediment database and loading data in sufficient detail to track and better define nutrient loading dynamics.

After the initial effort, the monitoring sites were reduced to the following six sites to continue evaluating trends from the major subbasins: Susquehanna River at Towanda, Pa. (to estimate loads from New York State); Susquehanna River at Danville, Pa.; Susquehanna River at Marietta, Pa.; West Branch Susquehanna River at Lewisburg, Pa.; Juniata River at Newport, Pa.; and Conestoga River at Conestoga, Pa. (to provide data from a major tributary watershed with intensive agricultural activity and increasing development).

The long-term monitoring at these six sites has allowed SRBC to determine whether conditions were improving (decreasing trends), staying the same, or becoming worse (increasing trends) over the years for nitrogen, phosphorus and suspended sediment loads. SRBC releases its findings annually.

Between 2004 and 2005, the U.S. Environmental Protection Agency provided funding to significantly expand SRBC's overall monitoring network to 23 sites in the basin (see map on page 2). These additional sites were added as part of the Chesapeake Bay Program's Non-tidal Monitoring Network. Additionally, the U.S. Geological Survey (USGS) conducts sampling at three other sites in the Susquehanna basin (see Figure 1).

This report summarizes the findings of the technical report *2010 Nutrients and Suspended Sediment in the Susquehanna River Basin*. Detailed information on monitoring sites, data collection, and data analysis can be found in the full report and on the SRBC web site at *www.srbc.net/programs/CBP/nutrientprogram.htm*.

This summary report provides an overview of the following report findings:

Chesapeake Bay Watershed
Courtesy USGS

Nutrient and Suspended Sediment Loads and Yields

— basic information on annual and seasonal loads and yields of nutrients and suspended sediment (SS) measured during calendar year 2010 at SRBC's six long-term monitoring sites;

Data Comparisons

— data comparisons with Long-Term Means (averages) and historical baseline datasets. Significant deviations from baselines indicate a change in annual yields that warrant further evaluation; and

Nutrient and Suspended Sediment Trends

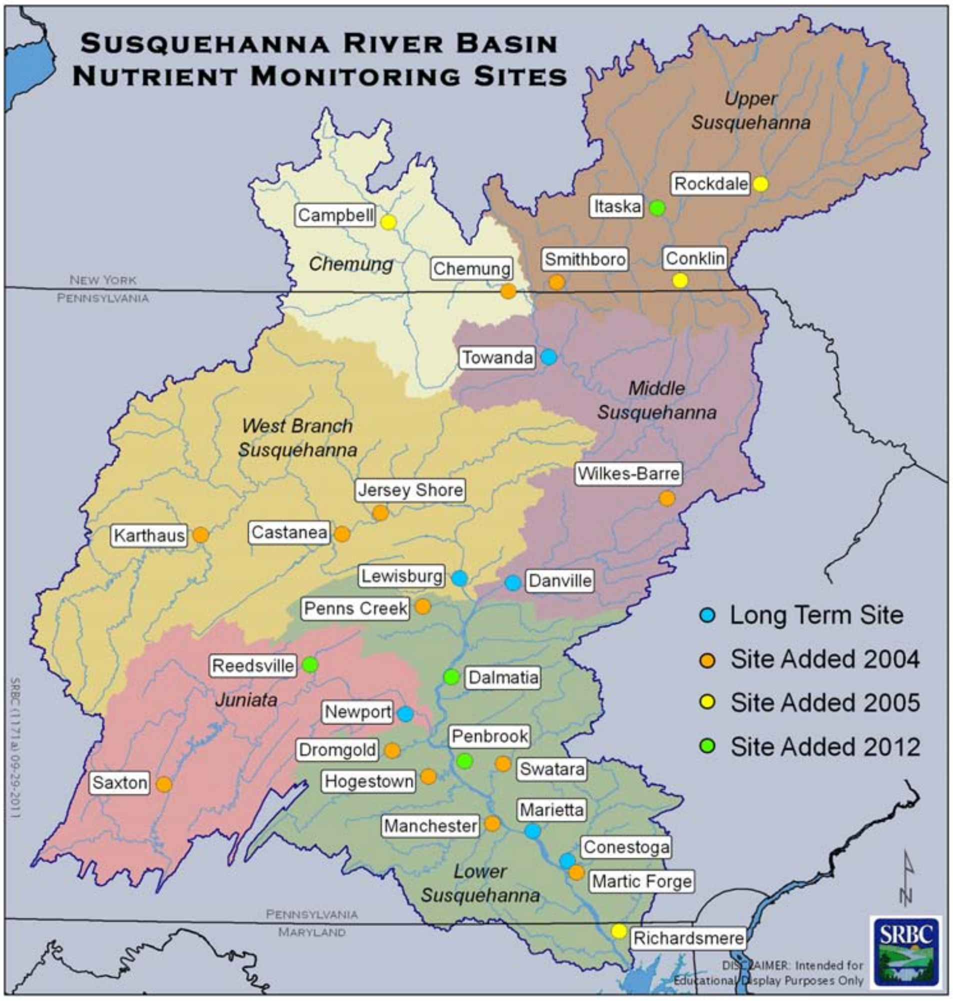
— changes over time in the concentrations of nutrients and sediment found in waterways, taking into account the effects of flow.

Marietta, Pa.

2010 Precipitation & Discharge Stats

- **2010 precipitation was dominated by four major rainfall events during the winter and fall months with offsetting lower flow seasons in the spring and summer. This led to the majority of loads being transported during these high flow seasons that contained the high flow storms.**
- **All four events resulted in substantial rainfall and subsequent rises in stream discharge at all mainstem Susquehanna sites. The fall storms had more isolated effects on the three tributary sites where the October event resulted in comparatively small rises in flow at Newport and Lewisburg while it resulted in very high rises at the Conestoga site. The other three major events had minimal impact at Conestoga.**
- **Total precipitation for January, March, October, and December was 39 percent of the total annual precipitation. Total discharge for the same months was 61 percent of the total annual flow and 136 percent of the Long-Term Means for the same months during previous years.**

Figure 1. Location of Sampling Sites within the Susquehanna River Basin



Monitoring Locations

Data were collected from six sites on the Susquehanna River, three sites on the West Branch Susquehanna River, and 14 sites on smaller tributaries in the basin. These 23 sites, selected for long-term monitoring of nutrient and SS transport in the basin, are shown in Figure 1. All sites have been co-located with USGS stream gaging stations to obtain discharge data.

Parameters Monitored

All water samples were analyzed for various species of Total Nitrogen (TN), Total Phosphorus (TP), Total Organic Carbon (TOC), and Suspended Sediment (SS).

For Group A sites, two samples were taken each month: a fixed-date sample and a base flow sample. Samples were also drawn during high flow events, targeting one per season. At Group B sites, fixed-date samples were taken monthly in addition to two storm samples collected each quarter.

Nutrient and Suspended Sediment Loads & 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.

Loads and yields are calculated using the USGS ESTIMATOR model. This tool relates a constituent's concentration to water discharge, seasonal effects, and long-term trends.

The full technical report includes tables that show the loads and yields for Group A monitoring sites, as well as the average annual concentrations for each constituent.

The full report also discusses monthly flows for each of the six long-term monitoring stations. Individual loads from historically similar flow months were compared with 2010 data, and seasonal variations at each of the stations are explored.

KEY FINDINGS: LOADS & YIELDS

Nutrient loads during January, March, October, and December accounted for 62-64 percent of the annual TN load, 69-77 percent of the annual TP load, and 83-91 percent of the annual SS load.

All samples were collected by hand with USGS depth integrating samplers.

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Long-Term Trends

Trends for monthly mean flow and Flow-Adjusted Concentrations (FAC) were computed for the period January 1985 through December 2010 for flow, SS, TOC, and several forms of nitrogen and phosphorus (Figure 2).

FAC trends represent the trends after the effects of flow have been removed and represent the concentration that relates to the effects of nutrient-reduction activities and other actions taking place in the watershed.

Load and trend analyses were unable to be completed at Group B sites because samples have not been collected at the stations for a sufficient number of years. Summary statistics for all sites are included in the full report.

Baseline Comparisons

Annual fluctuations in nutrient and suspended sediment loads make it difficult to determine whether the changes were related to land use, nutrient availability, or annual water discharge. To make that determination, historical data sets are used to create baseline relationships between annual yields and water discharge.

This report used several different baselines: (1) 1985-1989 data; (2) the 5-year periods following the start of monitoring at stations initiated after 1987; (3) first half of the data set [1985-1996 data]; (4) second half of the data set [usually 1997-2010]; and (5) entire data set [1985-2010].

KEY FINDINGS: BASELINE COMPARISONS

All comparisons of 2010 yields to the initial baseline have shown dramatic improvements. Additionally, comparisons of first and second half baselines have consistently shown that water quality has improved between these two periods. Comparing both periods to the initial five-year dataset at each site shows that there were larger improvements early on in the data period and that the rate of improvements seems to have reduced somewhere in the middle of the period.

KEY FINDINGS: TRENDS

Consistent, basinwide trend results at all sites included downward trends for TN, DN, TON, DON, and SS. Other common trends were TP being downward at all sites except Towanda, and TOC being downward at all sites except Lewisburg. Unique findings included DP having no trend at both Towanda and Danville, while DOP had upward trends at Towanda and Newport. The two sites with the most downward trends were Marietta with all downward except DNH_3 and DOP, which had no trends, and Conestoga, which had downward trends for all except TNOx and DNOx. Conestoga also was the only site to have downward trends for all phosphorus species.

Figure 2. Flow-Adjusted Concentration Trends through 2010

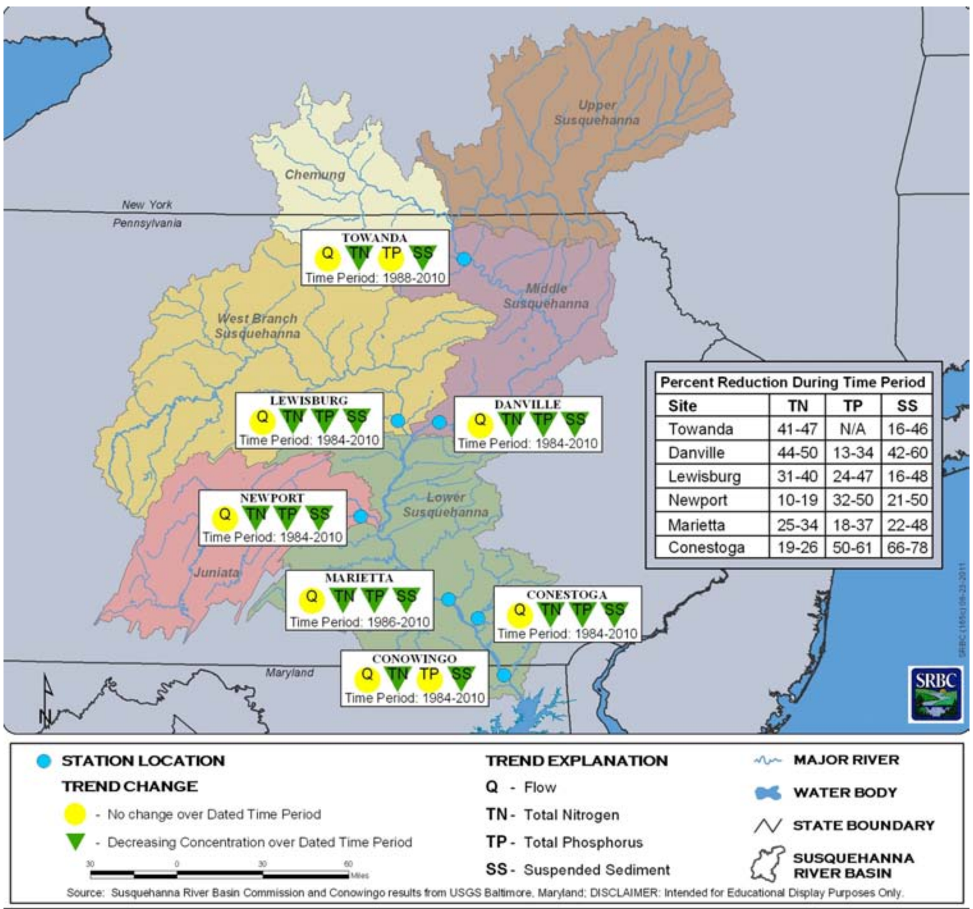

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Table 1. 2010 Annual, Seasonal and Annual Long-Term Mean Precipitation (inches), Flow (cfs), Loads (in 1000's of pounds), Yields (lbs/ac/yr), Concentration (mg/L) and Trends for Total Nitrogen (TN), Total Phosphorus (TP), and Suspended Sediment (SS) at Long-Term Monitoring Sites

Parameter		Period	Towanda	Danville	Lewisburg	Newport	Marietta	Conestoga
Precipitation		Winter	8.58	8.71	9.08	9.50	9.07	8.63
		Spring	10.06	9.71	8.90	8.79	9.14	9.26
		Summer	10.15	10.17	11.32	10.28	10.97	9.69
		Fall	12.87	12.59	12.79	11.97	11.83	12.11
		2010	41.66	41.18	42.09	40.54	41.01	39.69
		LTM	38.64	39.22	41.48	36.80	40.00	42.81
Flow		Winter	17,170	23,467	16,443	8,519	60,854	964
		Spring	8,975	13,372	8,219	4,127	31,922	627
		Summer	2,469	3,379	1,738	1,085	7,908	335
		Fall	15,719	22,223	13,180	4,137	49,641	667
		2010	10,987	15,531	9,837	4,434	37,359	645
		LTM	11,732	16,457	10,749	4,375	38,872	675
Total Nitrogen	Load	Winter	7,857	12,986	7,021	6,989	42,500	3,141
		Spring	3,519	6,232	3,003	2,964	18,720	1,887
		Summer	780	1,227	686	629	3,934	923
		Fall	5,859	10,821	5,183	3,565	36,545	2,013
		2010	18,016	31,266	15,893	14,148	101,699	7,965
		LTM	27,075	42,859	22,938	16,070	127,581	10,260
	Yield	2010	3.61	4.35	3.63	6.59	6.11	26.48
		LTM	5.43	5.97	5.23	7.49	7.67	34.11
	Conc.+	2010	0.83	1.02	0.82	1.63	1.39	6.27
		LTM	1.17	1.32	1.08	1.87	1.67	7.72
	Trend	*	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
Total Phosphorus	Load	Winter	759	1,230	386	299	2,566	83
		Spring	272	518	138	101	791	58
		Summer	83	109	24	31	180	77
		Fall	596	1,133	311	204	2,537	197
		2010	1,710	2,990	858	634	6,073	415
		LTM	2,290	3,623	1,230	765	7,446	642
	Yield	2010	0.34	0.42	0.20	0.30	0.37	1.38
		LTM	0.46	0.50	0.28	0.36	0.45	2.13
	Conc.+	2010	0.079	0.098	0.044	0.073	0.083	0.327
		LTM	0.099	0.112	0.058	0.089	0.097	0.483
	Trend	*	No Trend	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
Suspended Sediment	Load	Winter	724,031	1,057,647	411,374	296,950	3,402,434	43,360
		Spring	102,169	248,733	56,397	45,420	553,242	21,974
		Summer	16,255	23,861	3,643	6,457	51,615	50,830
		Fall	463,937	938,399	507,790	185,003	3,064,169	189,104
		2010	1,306,392	2,268,640	979,204	533,831	7,071,459	305,268
		LTM	2,849,417	3,332,098	1,142,868	506,510	6,511,108	346,545
	Yield	2010	262	316	223	249	425	1,015
		LTM	571	464	261	236	391	1,152
	Conc.+	2010	60	74	51	61	96	240
		LTM	123	102	54	59	85	261
	Trend	*	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing

** Trend time periods: Towanda 1989-2010; Marietta 1987-2010; Lewisburg, Danville, Newport, and Conestoga 1985-2010.*
+ Concentrations are calculated using total annual discharge and annual load.