

When looking at constituent loads, it can be difficult to determine whether improvements are being made due to the variations in flow. Because of this, it is useful to compare the loads from years that had similar amounts of flow. Table 20 lists the flow and TN, TP, and SS loads for 1996 and 2003. The fact that constituent loads tend to be higher during higher flow years suggests that the loads for TN, TP, and SS should be higher for all sites except Conestoga during 1996. This was the case for TN, TP, and SS at all sites except Newport, which showed higher percent loads as compared to the 1996 values for TN and TP.

Tables 21–24 show seasonal comparisons of years 1996 and 2003. Newport showed higher percentages than 1996 for TN and TP for all seasons, including doubling the 1996 spring value. SS at Conestoga was four times the 1996 value, while the TP value was only 43.27 percent of the 1996 value. This indicates less sediment bound phosphorous was being transported. Summer sampling results showed increased percentages as compared to 1996 in TP and SS at Towanda, Danville, Conestoga, and Marietta. TN was higher in the fall at Newport, Conestoga, and Marietta.

SEASONAL WATER DISCHARGES AND NUTRIENT AND SUSPENDED-SEDIMENT LOADS AND YIELDS

Seasonal loads for all parameters and all sites are listed in Table 25 for loads and Table 26 for percentages (high values in boldface type). For the purposes of this project, January through March is winter, April through June is spring, July through September is summer, and October through December is fall. As a general note, nutrient and SS levels increase with increases in flow. This was observed at all sites for TN except at Towanda. TP, DP and DOP were highest during the fall for all sites except for TP at Conestoga. This matched the highest flow season for Towanda, Danville, Lewisburg, and Marietta.

For Newport, fall was actually the lowest flow season while it was the highest for TP, DP, DOP, and the second highest for TN, DN, total nitrate plus nitrite (TNOx), dissolved nitrate plus nitrite (DNOx), total ammonia (TNH3), dissolved ammonia (DNH3), and TOC. Winter at Newport

constituted 36.5 percent of the annual flow and 26.54 percent of the SS annual load while fall represented 13.73 percent of the flow and 24.28 percent of the SS. SS was highest during the winter at Towanda, Danville, Lewisburg, and Marietta even though the season was the second highest for flow at each of the four sites. Conestoga had the highest SS loads during the spring, which was the third highest flow season for the site. Flow at Conestoga for spring was 25.41 percent of the annual flow and 38.26 percent of the annual SS load.

When compared to the seasonal LTMs, Towanda and Danville showed higher than the LTMs for spring flow and lower than the LTMs in TN and TP, with large reductions shown in SS. Spring flows at Lewisburg for 2003 were equal to the LTM while similar reductions in TN, TP, and SS were found at Lewisburg as at the northern sites. Newport showed above LTM values for all seasons for flow, TN, TP, and SS. Marietta had a higher spring flow than the LTM while also showing a lower SS value. Conestoga had all flow values higher than the LTM and a much larger SS value as compared to the LTM during the spring. Figures 7-12 show graphs of discharge, TN, TP and SS as compared to the LTM.

Newport showed an increase in TN yields during the winter and spring when compared to the LTM yields, while Marietta showed higher TN yields in the fall as compared to the LTM yield. Towanda, Danville, and Marietta showed increasing TP yields downstream for 2003, which matched the same trend in LTM yields. Marietta and Newport both showed significant increases in yield values during the summer and fall months as compared to the LTMs. Increases over the LTMs also were apparent during those seasons at all other sites. SS showed a generally decreasing trend in the long term when moving downstream on the Susquehanna. 2003 yields roughly followed the same pattern during winter and fall but showed increasing yields during the spring and summer. When comparing the seasonal percentages, spring had the highest percent of TP, SS, and flow at all sites. Figures 13-16 show the seasonal yields for each site.

Table 20. Comparison of 2003 Loads with 1996 Loads for Flow, TN, TP, and SS

Site	Discharge (cfs)			TN thousands (lbs)			TP thousand (lbs)			SS thousands (lbs)		
	1996	2003	% Change	1996	2003	% Change	1996	2003	% Change	1996	2003	% Change
Towanda	17,000	16,290	95.82	43,400	32,621	75.16	4,800	2,677	55.77	8,690,000	2,399,772	27.62
Danville	24,800	24,050	96.98	64,600	50,184	77.68	6,890	4,691	68.08	7,450,000	2,855,630	38.33
Lewisburg	17,100	16,095	94.12	40,800	31,644	77.56	2,810	1,712	60.93	4,560,000	555,487	12.18
Newport	8,660	8,029	92.71	30,500	31,282	102.56	1,270	1,949	153.46	1,270,000	1,059,614	83.43
Marietta	63,600	59,234	93.14	221,000	193,078	87.37	16,200	15,013	92.67	14,000,000	8,041,920	57.44
Conestoga	1,120	1,154	103.04	16,300	17,139	105.15	1,580	1,055	66.77	759,000	561,962	74.04

Table 21. Comparison of 2003 Loads with 1996 Loads for Flow, TN, TP, and SS During Winter

Site	Discharge (cfs)			TN thousands (lbs)			TP thousand (lbs)			SS thousands (lbs)		
	1996	2003	% Change	1996	2003	% Change	1996	2003	% Change	1996	2003	% Change
Towanda	20,600	18,888	91.69	14,300	10,475	73.25	1,590	830	52.20	2,930,000	966,671	32.99
Danville	30,600	26,795	87.57	21,700	15,774	72.69	2,200	1,281	58.23	2,650,000	966,803	36.48
Lewisburg	24,200	16,344	67.54	16,800	8,870	52.80	1,260	505	40.08	2,690,000	229,980	8.55
Newport	12,700	10,186	80.20	11,600	9,857	84.97	618	515	83.33	496,000	281,229	56.70
Marietta	96,600	62,987	65.20	86,300	51,639	59.84	6,460	3,784	58.58	5,750,000	2,442,463	42.48
Conestoga	1,410	1,337	94.82	5,390	5,179	96.09	520	225	43.27	25,900	126,788	489.53

Table 22. Comparison of 2003 Loads with 1996 Loads for Flow, TN, TP, and SS During Spring

Site	Discharge (cfs)			TN thousands (lbs)			TP thousand (lbs)			SS thousands (lbs)		
	1996	2003	% Change	1996	2003	% Change	1996	2003	% Change	1996	2003	% Change
Towanda	20,900	17,454	83.51	12,500	8,096	64.77	1,160	538	46.38	2,310,000	400,918	17.36
Danville	29,200	26,696	91.42	17,400	12,502	71.85	1,620	1,029	63.52	2,020,000	663,111	32.83
Lewisburg	14,800	15,462	104.47	7,540	6,638	88.04	419	281	67.06	413,000	69,222	16.76
Newport	6,260	8,935	142.73	5,030	7,680	152.68	190	525	276.32	172,000	351,206	204.19
Marietta	62,000	64,682	104.33	44,200	44,306	100.24	2,770	3,446	124.40	2,220,000	1,880,303	84.70
Conestoga	1,010	1,172	116.04	3,720	4,162	111.88	277	297	107.22	122,000	214,999	176.23

Table 23. Comparison of 2003 Loads with 1996 Loads for Flow, TN, TP, and SS During Summer

Site	Discharge (cfs)			TN thousands (lbs)			TP thousand (lbs)			SS thousands (lbs)		
	1996	2003	% Change	1996	2003	% Change	1996	2003	% Change	1996	2003	% Change
Towanda	4,740	9,454	199.45	2,320	3,916	168.79	183	380	207.65	83,500	274,906	329.23
Danville	7,380	14,255	193.16	3,640	5,954	163.57	307	657	214.01	106,000	309,983	292.44
Lewisburg	7,790	13,634	175.02	3,610	5,649	156.48	210	299	142.38	135,000	79,585	58.95
Newport	6,470	4,948	76.48	6,020	4,831	80.25	300	363	121.00	462,000	169,942	36.78
Marietta	27,000	40,352	149.45	18,900	30,556	161.67	1,210	2,663	220.08	745,000	1,332,297	178.83
Conestoga	563	810	143.87	1,950	2,835	145.38	151	264	174.83	50,100	123,607	246.72

Table 24. Comparison of 2003 Loads with 1996 Loads for Flow, TN, TP, and SS During Fall

Site	Discharge (cfs)			TN thousands (lbs)			TP thousand (lbs)			SS thousands (lbs)		
	1996	2003	% Change	1996	2003	% Change	1996	2003	% Change	1996	2003	% Change
Towanda	21,700	19,363	89.23	14,200	10,134	71.37	1,860	928	49.89	3,250,000	747,276	22.99
Danville	31,900	28,456	89.20	21,800	15,955	73.19	2,730	1,723	63.11	2,670,000	915,735	34.30
Lewisburg	21,800	18,940	86.88	12,900	10,488	81.30	927	627	67.64	1,320,000	176,699	13.39
Newport	9,210	3,830	41.59	7,900	8,915	112.85	162	546	337.04	138,000	257,267	186.43
Marietta	79,100	68,913	87.12	71,800	66,577	92.73	5,740	5,120	89.20	5,310,000	2,386,857	44.95
Conestoga	1,490	1,294	86.85	5,270	4,963	94.17	635	268	42.20	327,000	96,568	29.53

Table 25. Seasonal Mean Water Discharges and Loads of Nutrients and Suspended Sediment, Calendar year 2003

Station	Season	Mean Water Discharge	Total Nitrogen as N	Dissolved Nitrogen as N	Total Ammonia as N	Dissolved Ammonia as N	Total Organic Nitrogen as N	Dissolved Organic Nitrogen as N	Total Nitrate Plus Nitrite as N	Dissolved Nitrate Plus Nitrite as N	Total Phosphorus as P	Dissolved Phosphorus as P	Dissolved Ortho-Phosphate as P	Total Organic Carbon	Suspended Sediment
		cfs	thousands of pounds												
Towanda	Winter	18,888	10,475	9,768	414	476	3,106	2,548	7,138	7,113	830	248	184	27,711	966,671
	Spring	17,454	8,096	7,477	247	280	2,580	2,194	5,418	5,434	538	178	136	27,771	400,918
	Summer	9,454	3,916	3,466	143	142	1,549	1,310	2,330	2,300	380	136	116	20,758	284,906
	Fall	19,363	10,134	9,513	514	563	2,784	2,489	7,170	7,031	928	344	267	35,906	747,276
Danville	Winter	26,795	15,774	14,430	687	770	4,656	3,464	11,029	11,022	1,281	353	269	38,853	966,803
	Spring	26,696	12,502	10,894	380	470	4,510	3,136	7,929	7,868	1,029	278	213	43,525	663,111
	Summer	14,255	5,954	5,008	187	200	2,498	1,747	3,384	3,304	657	190	148	30,363	309,983
	Fall	28,456	15,955	14,565	829	812	4,511	3,546	11,098	10,917	1,723	528	374	53,621	915,735
Lewisburg	Winter	16,344	8,870	7,753	339	382	2,770	1,617	6,027	6,028	505	146	95	15,889	229,980
	Spring	15,462	6,638	5,994	180	250	1,801	1,245	4,840	4,809	281	104	60	14,882	69,222
	Summer	13,634	5,649	5,118	134	181	1,615	1,085	4,248	4,172	299	114	74	18,700	79,585
	Fall	18,940	10,488	9,341	378	425	2,708	1,620	8,060	7,992	627	219	135	23,757	176,699
Newport	Winter	10,186	9,857	9,099	175	182	1,903	1,304	7,904	7,875	515	238	229	14,119	281,229
	Spring	8,935	7,680	6,919	146	157	1,761	1,118	5,927	5,891	525	217	200	13,378	351,206
	Summer	4,948	4,831	4,373	95	99	992	642	3,781	3,754	363	178	180	9,313	169,942
	Fall	3,830	8,915	8,248	171	173	1,436	954	7,479	7,436	546	272	264	13,592	257,267
Marietta	Winter	62,987	51,639	47,366	2,102	1,910	10,460	7,152	39,371	39,095	3,784	1,079	1,007	81,725	2,442,463
	Spring	64,682	44,306	39,263	1,072	1,148	9,049	5,751	32,581	32,151	3,446	1,100	972	90,966	1,880,303
	Summer	40,352	30,556	26,569	633	665	6,009	3,890	21,928	21,715	2,663	918	883	73,517	1,332,297
	Fall	68,913	66,577	60,573	2,584	2,232	9,830	6,320	53,034	52,740	5,120	1,570	1,497	110,504	2,386,857
Conestoga	Winter	1,337	5,179	4,937	77	77	952	750	4,313	4,275	225	98	80	2,883	126,788
	Spring	1,172	4,162	3,929	57	51	714	544	3,569	3,550	297	100	95	2,887	214,999
	Summer	810	2,835	2,694	44	38	420	308	2,541	2,543	264	107	111	2,246	123,607
	Fall	1,294	4,963	4,803	80	76	711	554	4,428	4,432	268	143	128	3,137	96,568

Table 26. Seasonal Mean Water Discharge and Load Percentages of Nutrients and Suspended Sediment, Calendar year 2003

Station	Season	Mean Water Discharge	Total Nitrogen as N	Dissolved Nitrogen as N	Total Ammonia as N	Dissolved Ammonia as N	Total Organic Nitrogen as N	Dissolved Organic Nitrogen as N	Total Nitrate Plus Nitrite as N	Dissolved Nitrate Plus Nitrite as N	Total Phosphorus as P	Dissolved Phosphorus as P	Dissolved Ortho-Phosphate as P	Total Organic Carbon	Suspended Sediment
		cfs	thousands of pounds												
Towanda	Winter	28.99%	32.11%	32.32%	31.41%	32.58%	31.00%	29.83%	32.36%	32.51%	31.02%	27.37%	26.17%	24.71%	40.28%
	Spring	26.79%	24.82%	24.74%	18.74%	19.16%	25.75%	25.69%	24.56%	24.84%	20.10%	19.65%	19.35%	24.76%	16.71%
	Summer	14.51%	12.00%	11.47%	10.85%	9.72%	15.46%	15.34%	10.56%	10.51%	14.20%	15.01%	16.50%	18.51%	11.87%
	Fall	29.72%	31.07%	31.47%	39.00%	38.54%	27.79%	29.14%	32.51%	32.14%	34.68%	37.97%	37.98%	32.02%	31.14%
Danville	Winter	27.85%	31.43%	32.14%	32.98%	34.19%	28.79%	29.13%	32.98%	33.29%	27.31%	26.17%	26.79%	23.35%	33.86%
	Spring	27.75%	24.91%	24.26%	18.24%	20.87%	27.88%	26.37%	23.71%	23.76%	21.94%	20.61%	21.22%	26.16%	23.22%
	Summer	14.82%	11.86%	11.15%	8.98%	8.88%	15.44%	14.69%	10.12%	9.98%	14.01%	14.08%	14.74%	18.25%	10.86%
	Fall	29.58%	31.79%	32.44%	39.80%	36.06%	27.89%	29.82%	33.19%	32.97%	36.74%	39.14%	37.25%	32.23%	32.07%
Lewisburg	Winter	25.39%	28.03%	27.19%	32.88%	30.86%	31.14%	29.05%	26.01%	26.21%	29.50%	25.04%	26.10%	21.70%	41.40%
	Spring	24.02%	20.98%	21.25%	17.46%	20.19%	20.25%	22.36%	20.88%	20.91%	16.41%	17.84%	16.48%	20.32%	12.46%
	Summer	21.18%	17.85%	18.15%	13.00%	14.62%	18.16%	19.49%	18.33%	18.14%	17.46%	19.55%	20.33%	25.54%	14.33%
	Fall	29.42%	33.14%	33.12%	36.66%	34.33%	30.45%	29.10%	34.78%	34.75%	36.62%	37.56%	37.09%	32.44%	31.81%
Newport	Winter	36.51%	31.51%	31.77%	29.81%	29.79%	31.24%	32.45%	31.50%	31.56%	26.42%	26.30%	26.23%	28.01%	26.54%
	Spring	32.03%	24.55%	24.16%	24.87%	25.70%	28.91%	27.82%	23.62%	23.61%	26.94%	23.98%	22.91%	26.54%	33.14%
	Summer	17.74%	15.44%	15.27%	16.18%	16.20%	16.28%	15.98%	15.07%	15.04%	18.62%	19.67%	20.62%	18.48%	16.04%
	Fall	13.73%	28.50%	28.80%	29.13%	28.31%	23.57%	23.74%	29.81%	29.80%	28.01%	30.06%	30.24%	26.97%	24.28%
Marietta	Winter	26.58%	26.75%	27.26%	32.89%	32.07%	29.59%	30.94%	26.80%	26.83%	25.20%	23.12%	23.10%	22.91%	30.37%
	Spring	27.30%	22.95%	22.59%	16.77%	19.28%	25.60%	24.88%	22.18%	22.07%	22.95%	23.57%	22.30%	25.50%	23.38%
	Summer	17.03%	15.83%	15.29%	9.90%	11.17%	17.00%	16.83%	14.93%	14.90%	17.74%	19.67%	20.26%	20.61%	16.57%
	Fall	29.09%	34.48%	34.86%	40.43%	37.48%	27.81%	27.34%	36.10%	36.20%	34.10%	33.64%	34.34%	30.98%	29.68%
Conestoga	Winter	28.98%	30.22%	30.17%	29.84%	31.82%	34.04%	34.79%	29.04%	28.89%	21.35%	21.88%	19.32%	25.85%	22.56%
	Spring	25.41%	24.28%	24.01%	22.09%	21.07%	25.53%	25.23%	24.03%	23.99%	28.18%	22.32%	22.95%	25.89%	38.26%
	Summer	17.56%	16.54%	16.46%	17.05%	15.70%	15.02%	14.29%	17.11%	17.18%	25.05%	23.88%	26.81%	20.14%	22.00%
	Fall	28.05%	28.96%	29.35%	31.01%	31.40%	25.42%	25.70%	29.82%	29.95%	25.43%	31.92%	30.92%	28.13%	17.18%

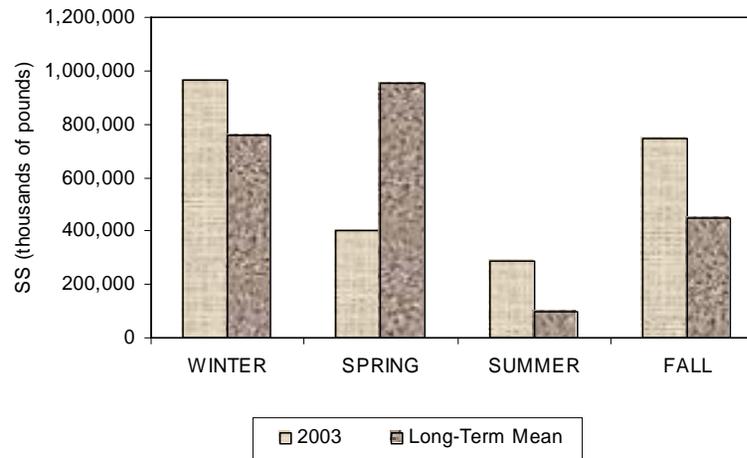
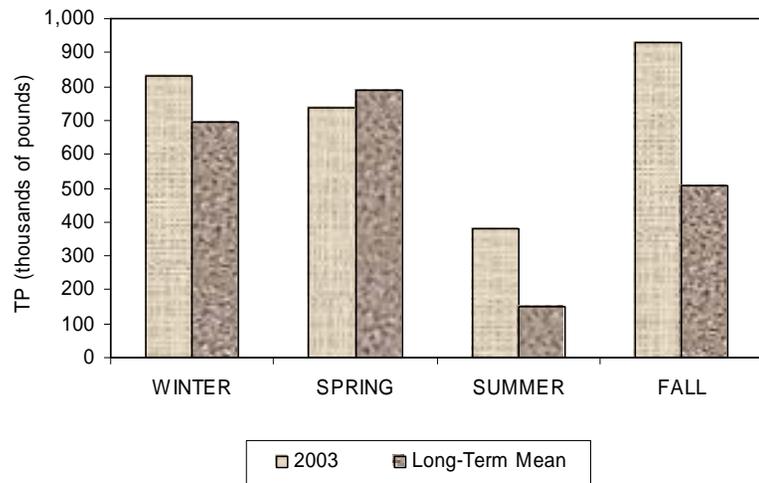
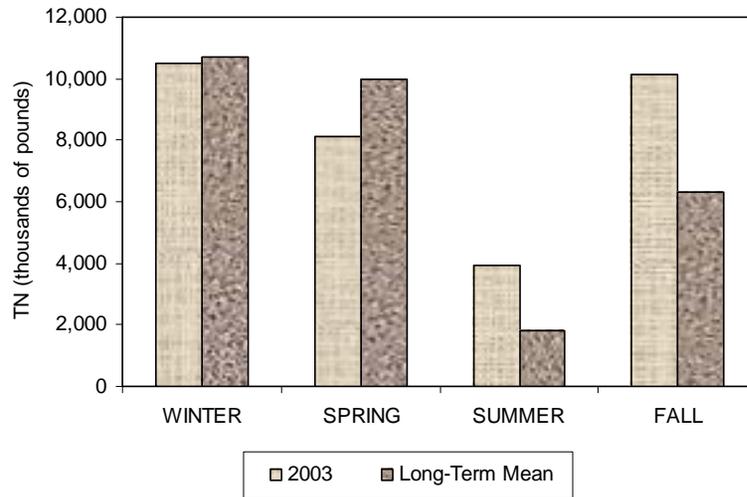
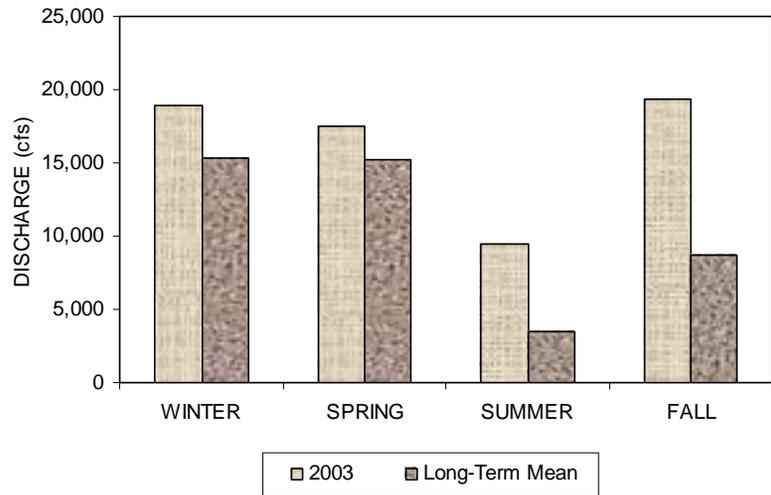


Figure 7. Seasonal Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Towanda, Pa., Calendar Year 2003

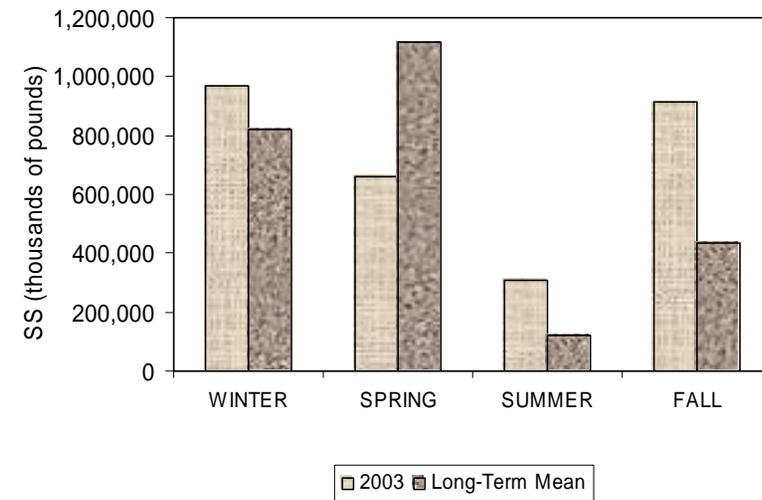
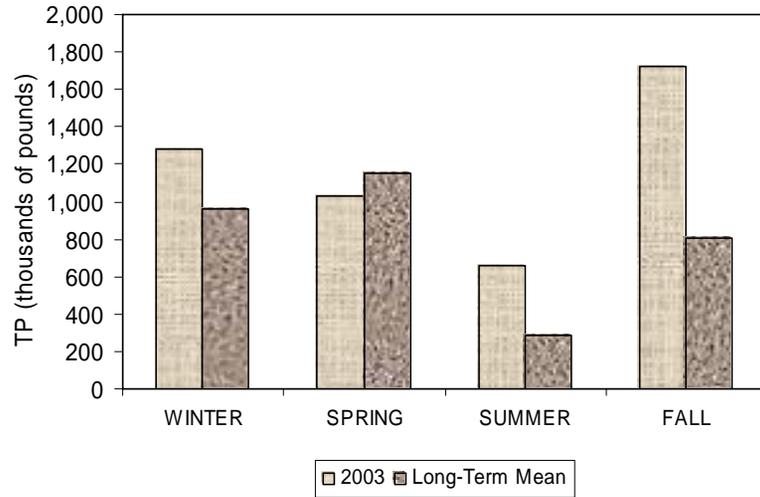
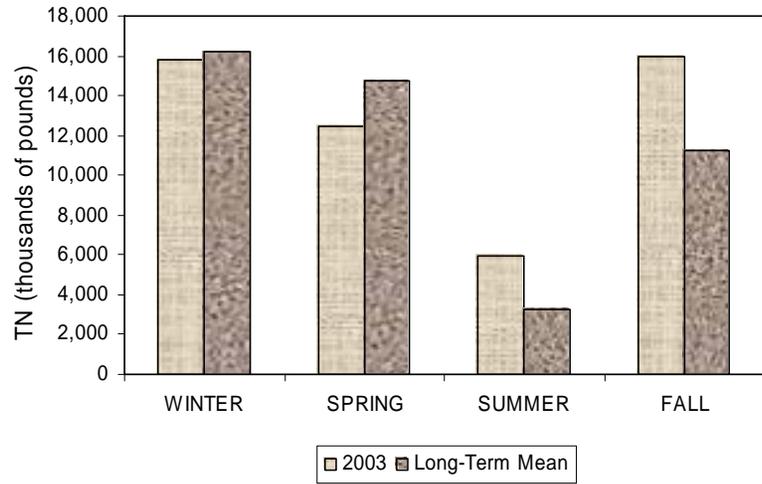
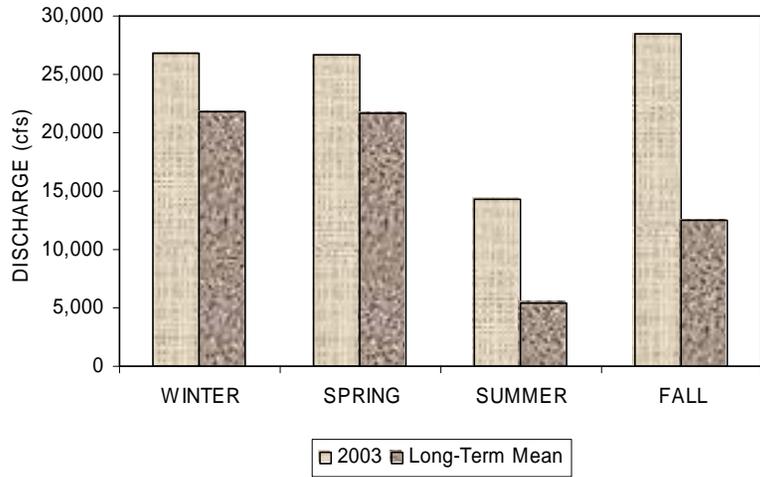


Figure 8. Seasonal Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Danville, Pa., Calendar Year 2003

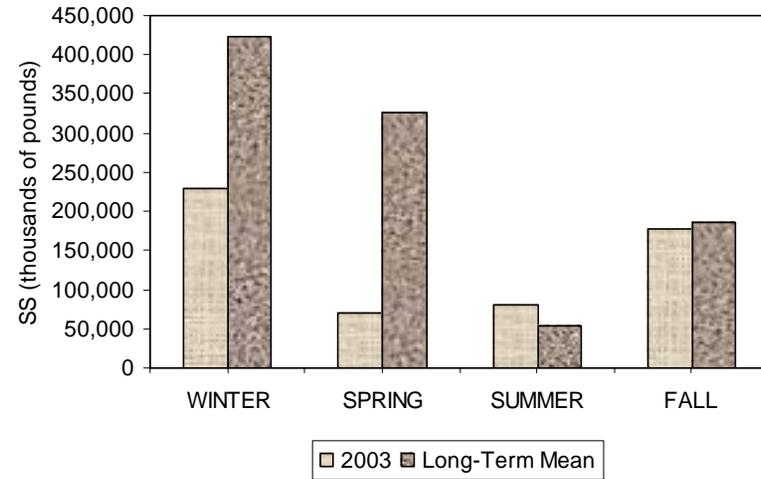
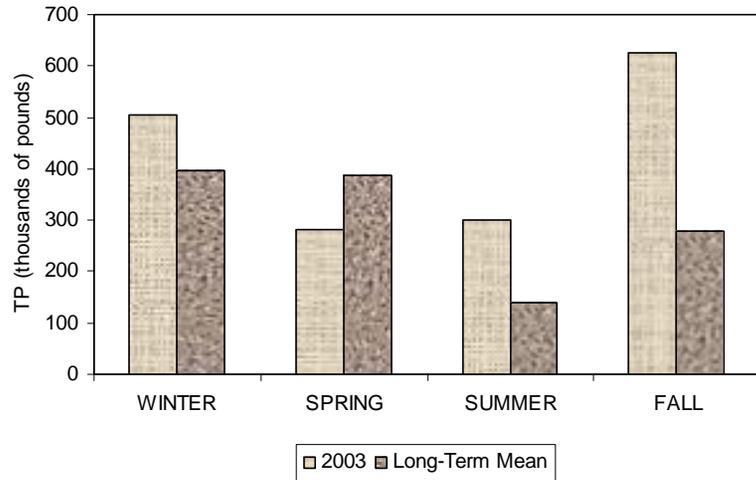
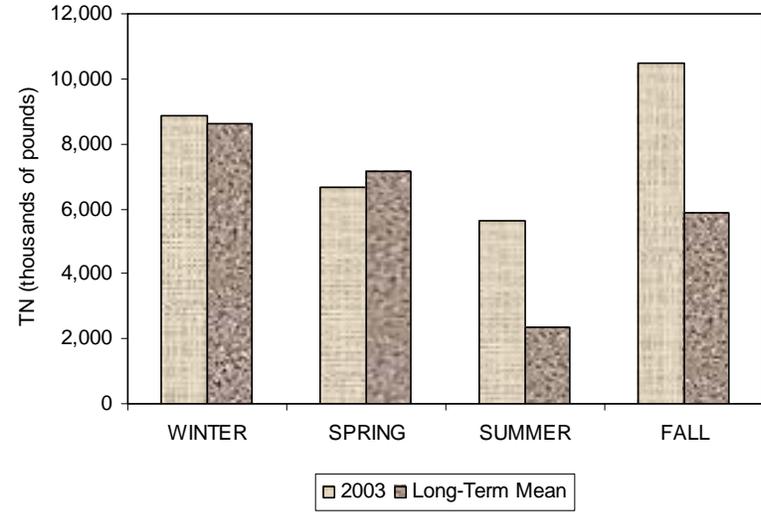
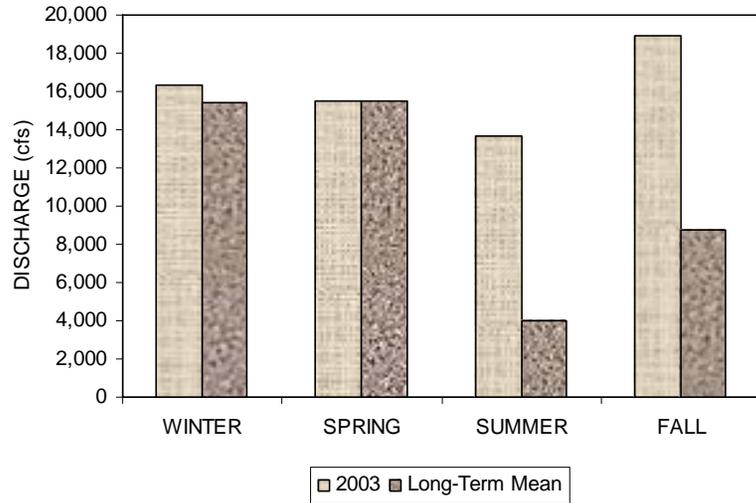


Figure 9. Seasonal Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Lewisburg, Pa., Calendar Year 2003

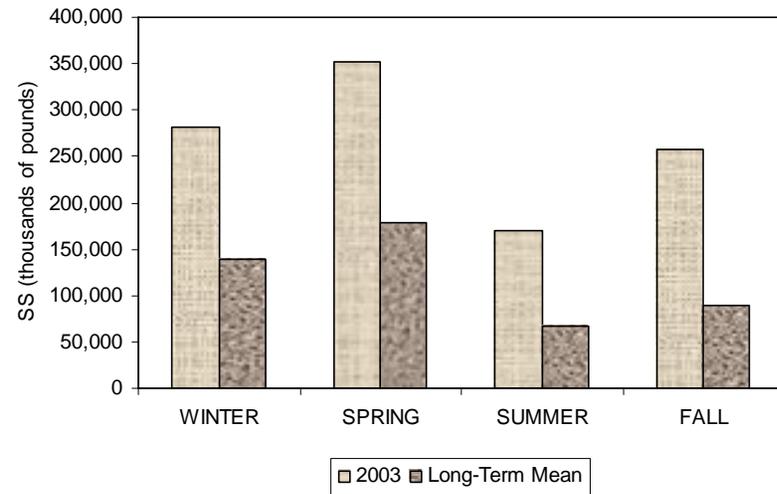
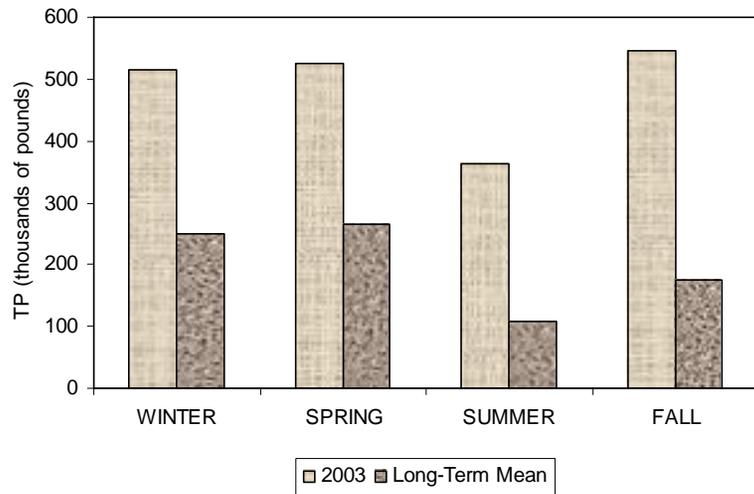
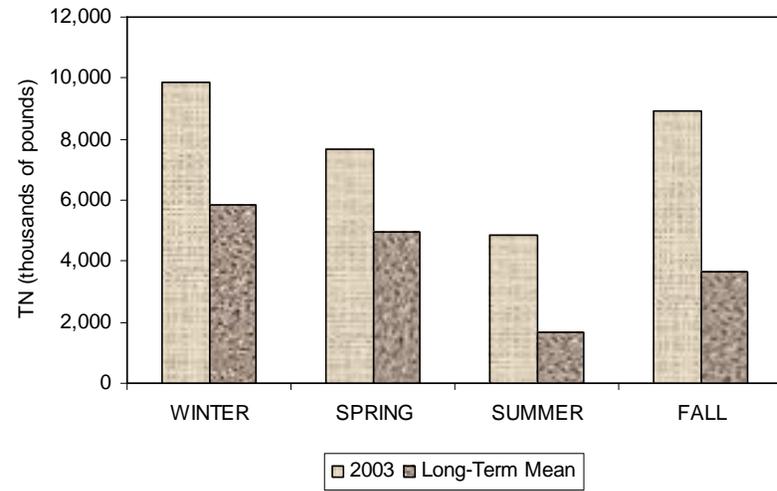
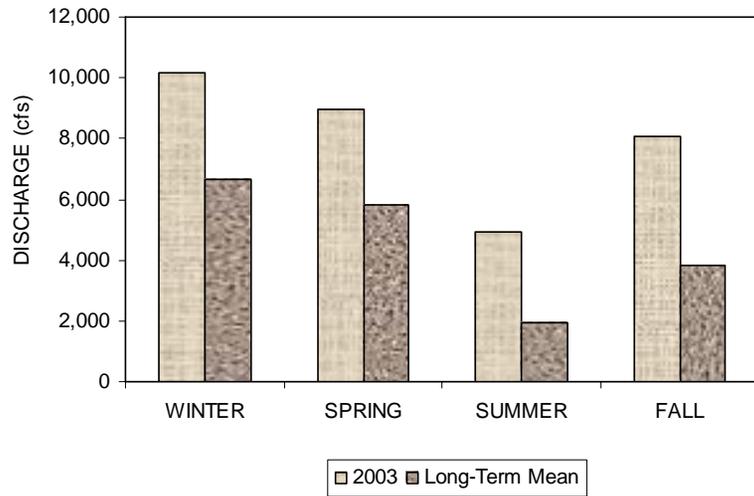


Figure 10. Seasonal Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Newport, Pa., Calendar Year 2003

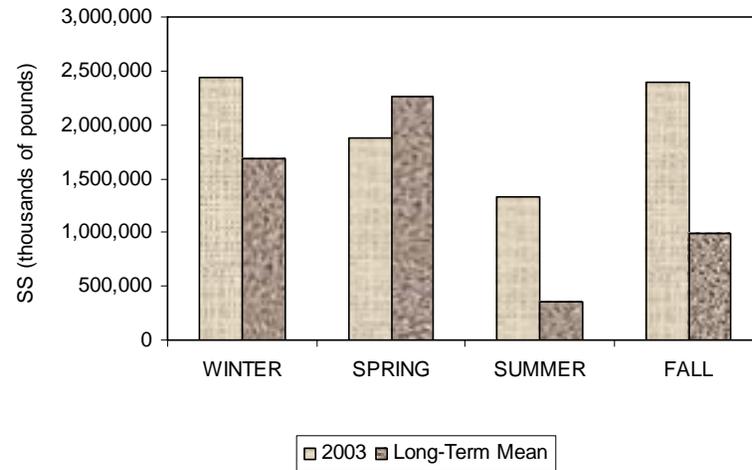
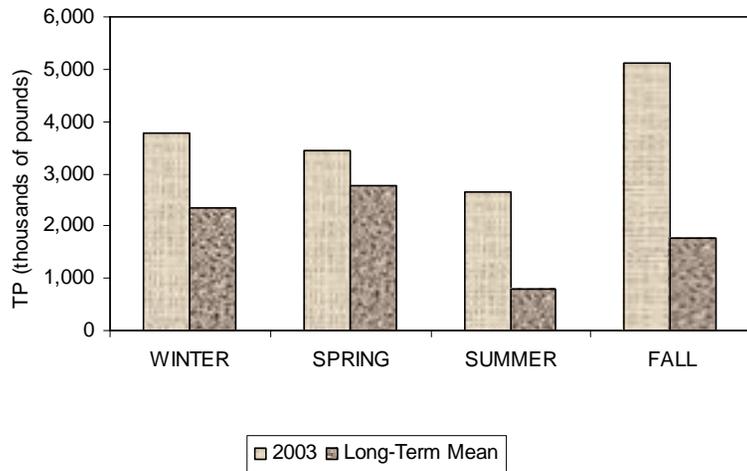
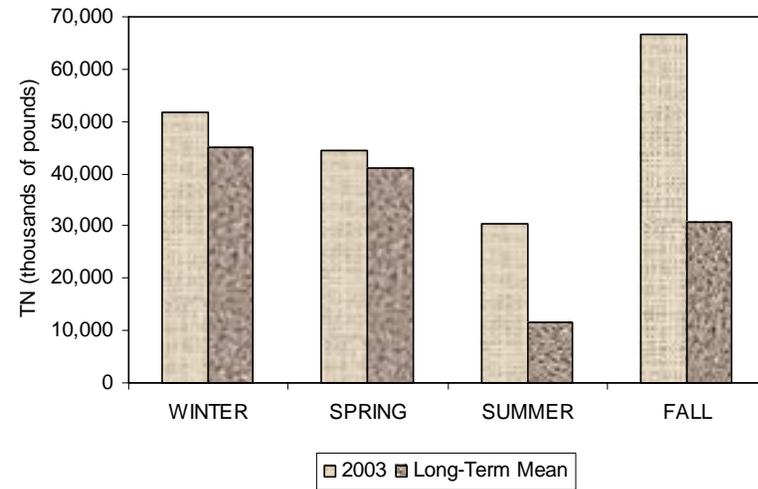
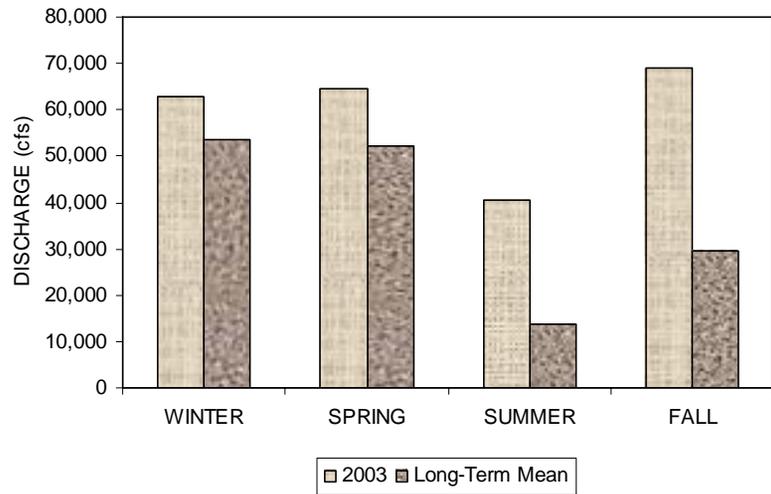


Figure 11. Seasonal Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Marietta, Pa., Calendar Year 2003

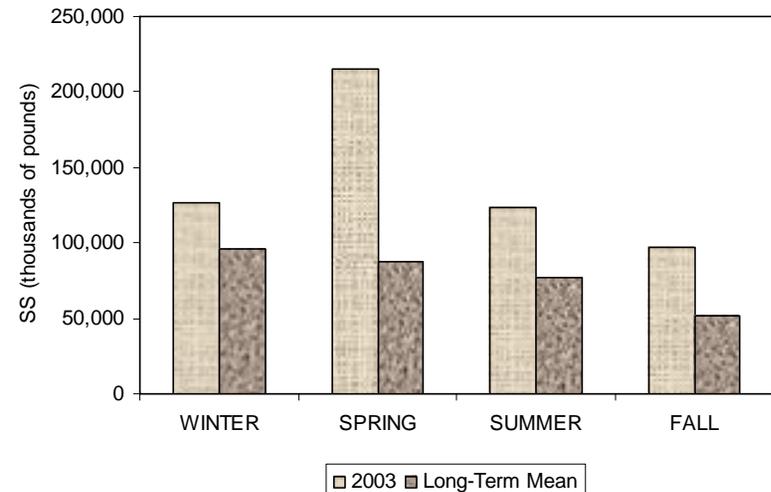
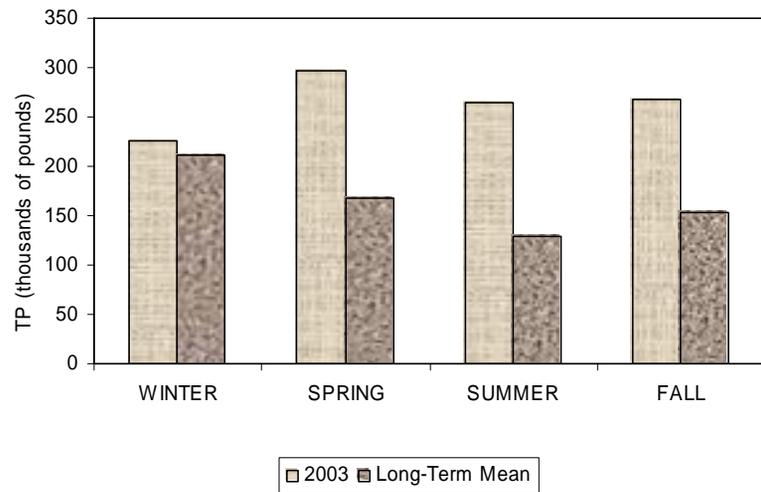
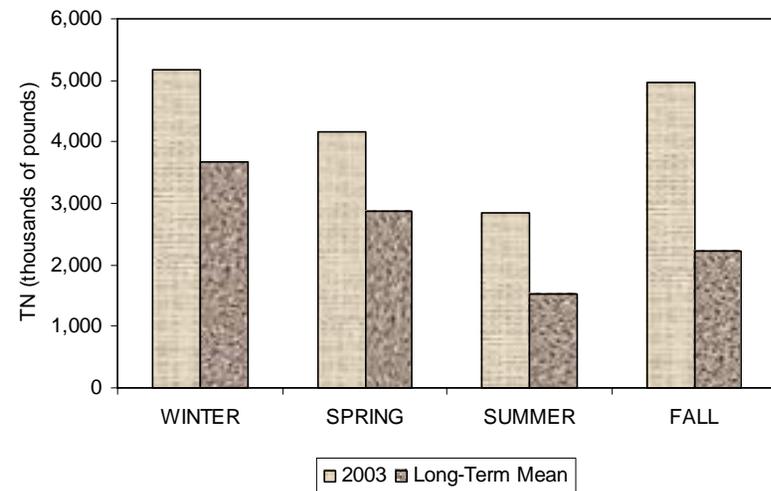
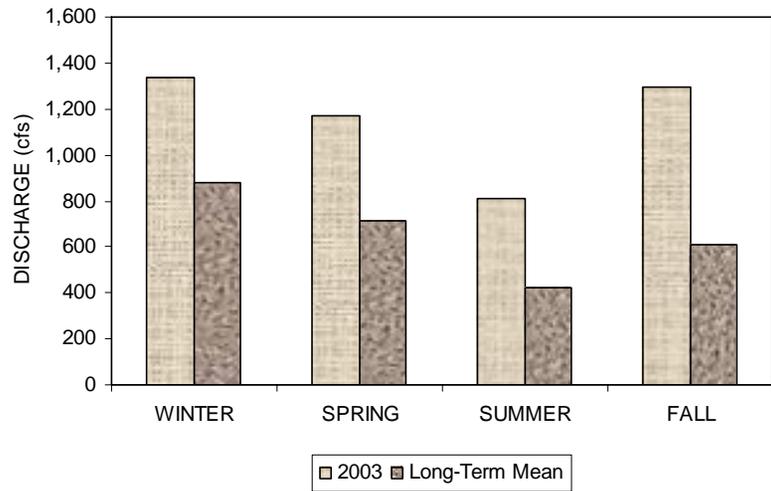


Figure 12. Seasonal Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Conestoga, Pa., Calendar Year 2003

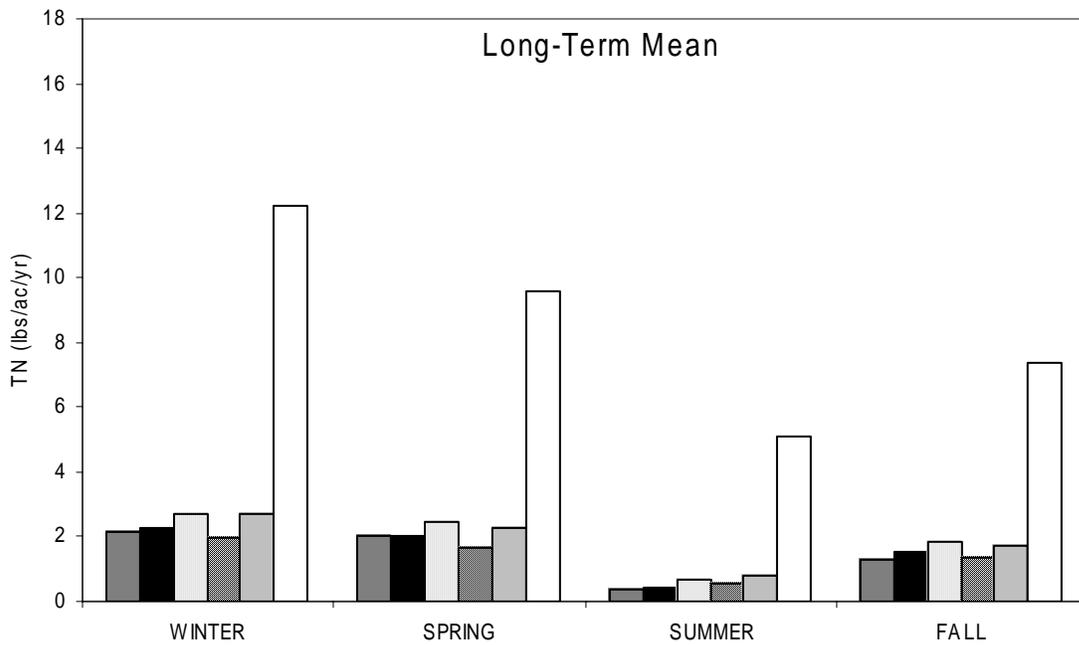
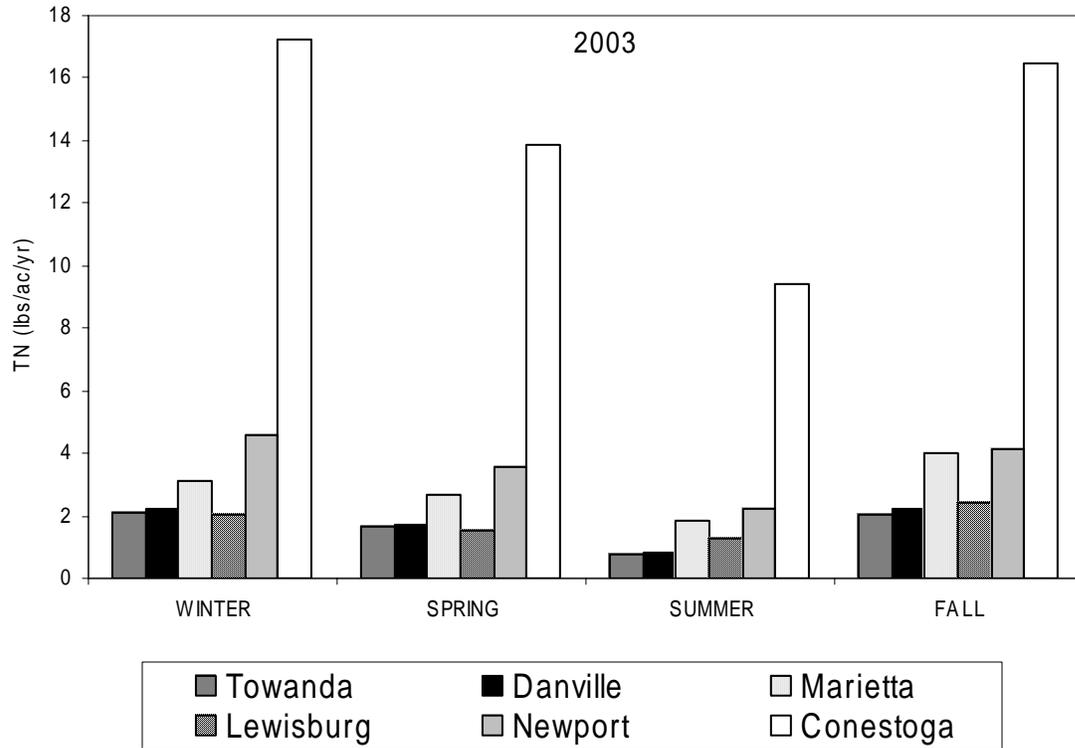


Figure 13. Comparison of Seasonal Yields of Total Nitrogen (TN) at Towanda, Danville, Marietta, Lewisburg, Newport, and Conestoga, Pa.

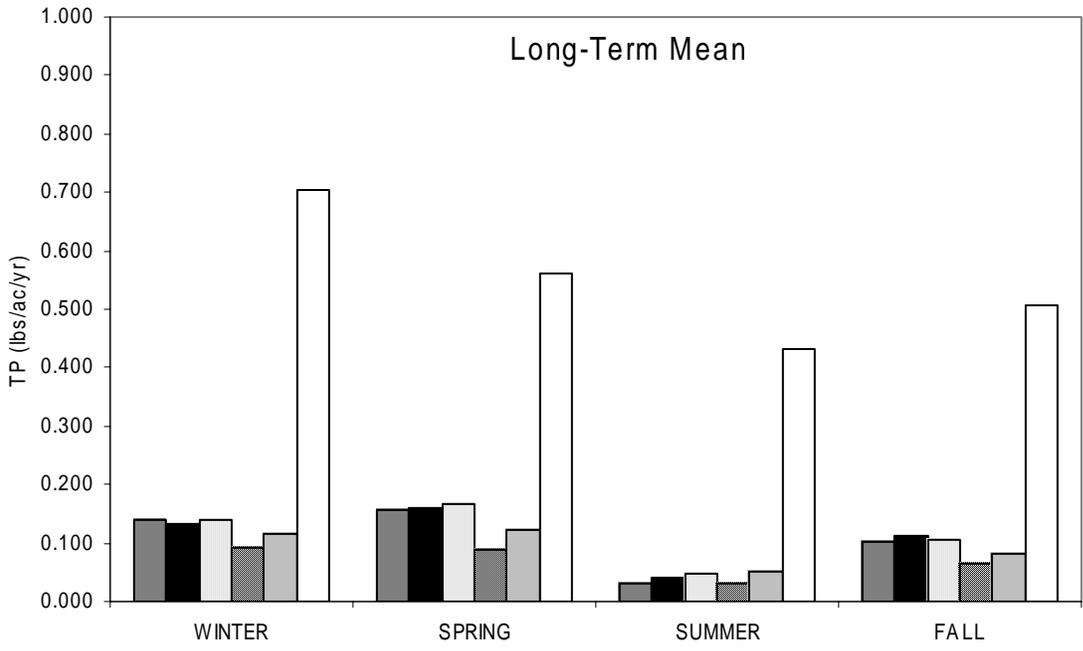
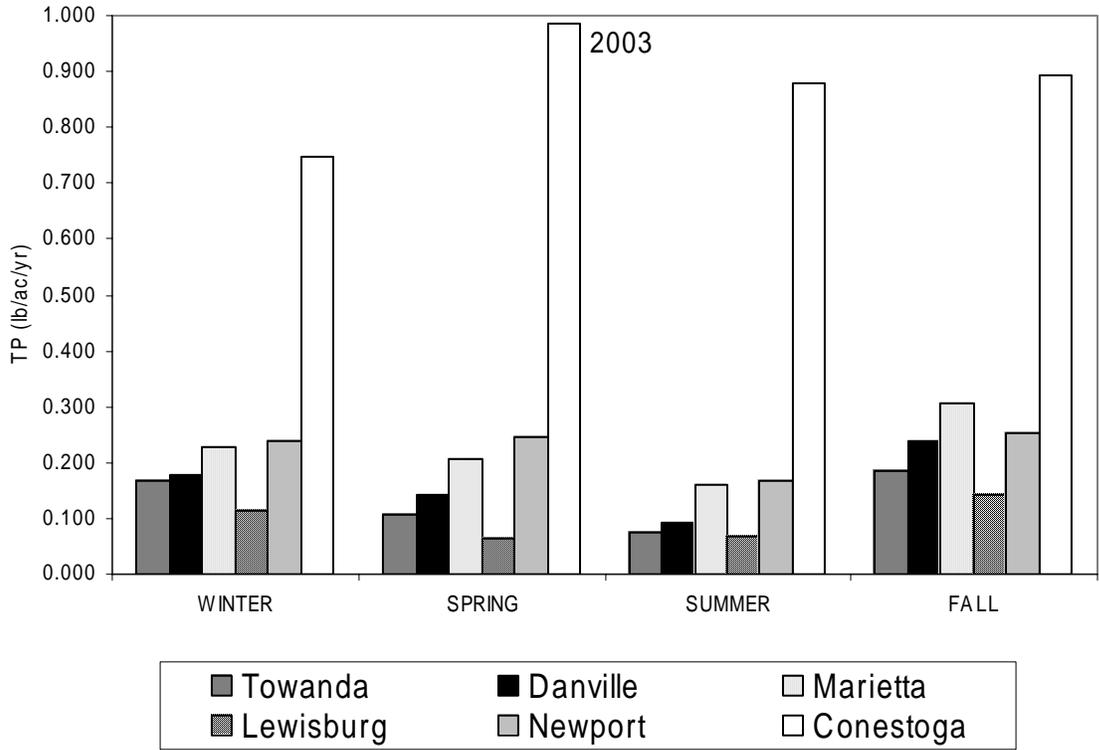


Figure 14. Comparison of Seasonal Yields of Total Phosphorus (TP) at Towanda, Danville, Marietta, Lewisburg, Newport, and Conestoga, Pa.

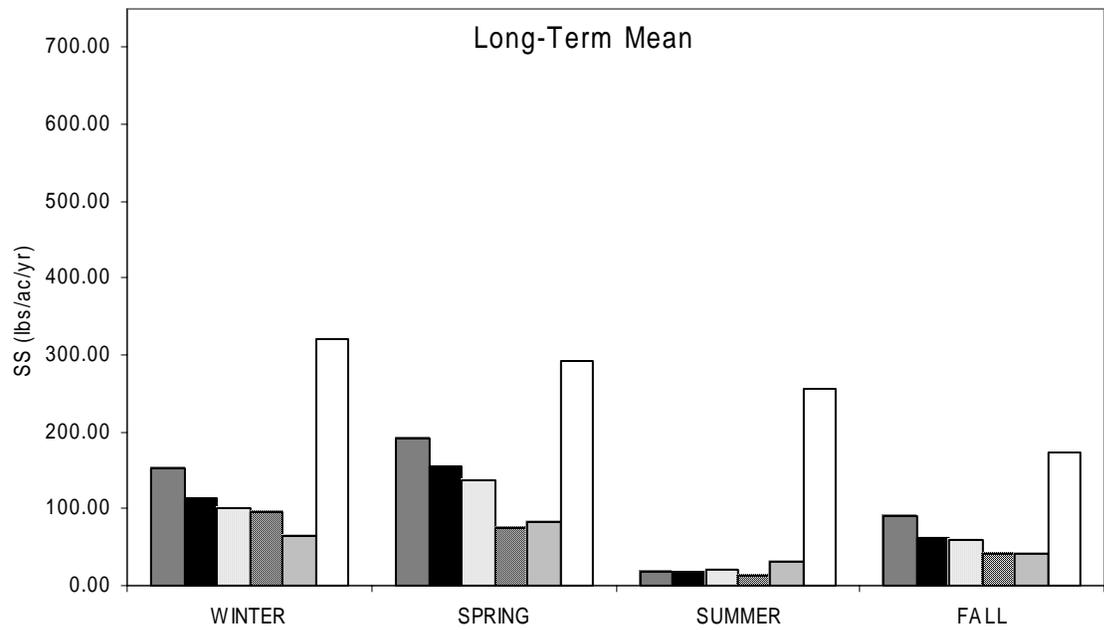
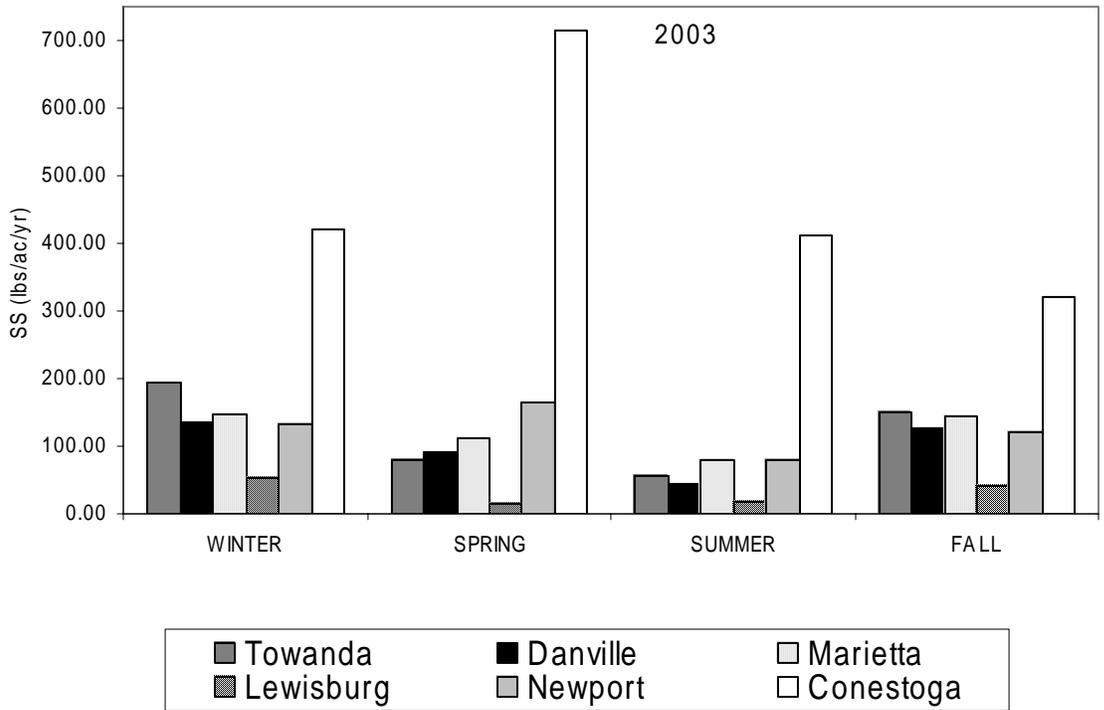


Figure 15. Comparison of Seasonal Yields of Suspended Sediment (SS) at Towanda, Danville, Marietta, Lewisburg, Newport, and Conestoga, Pa.

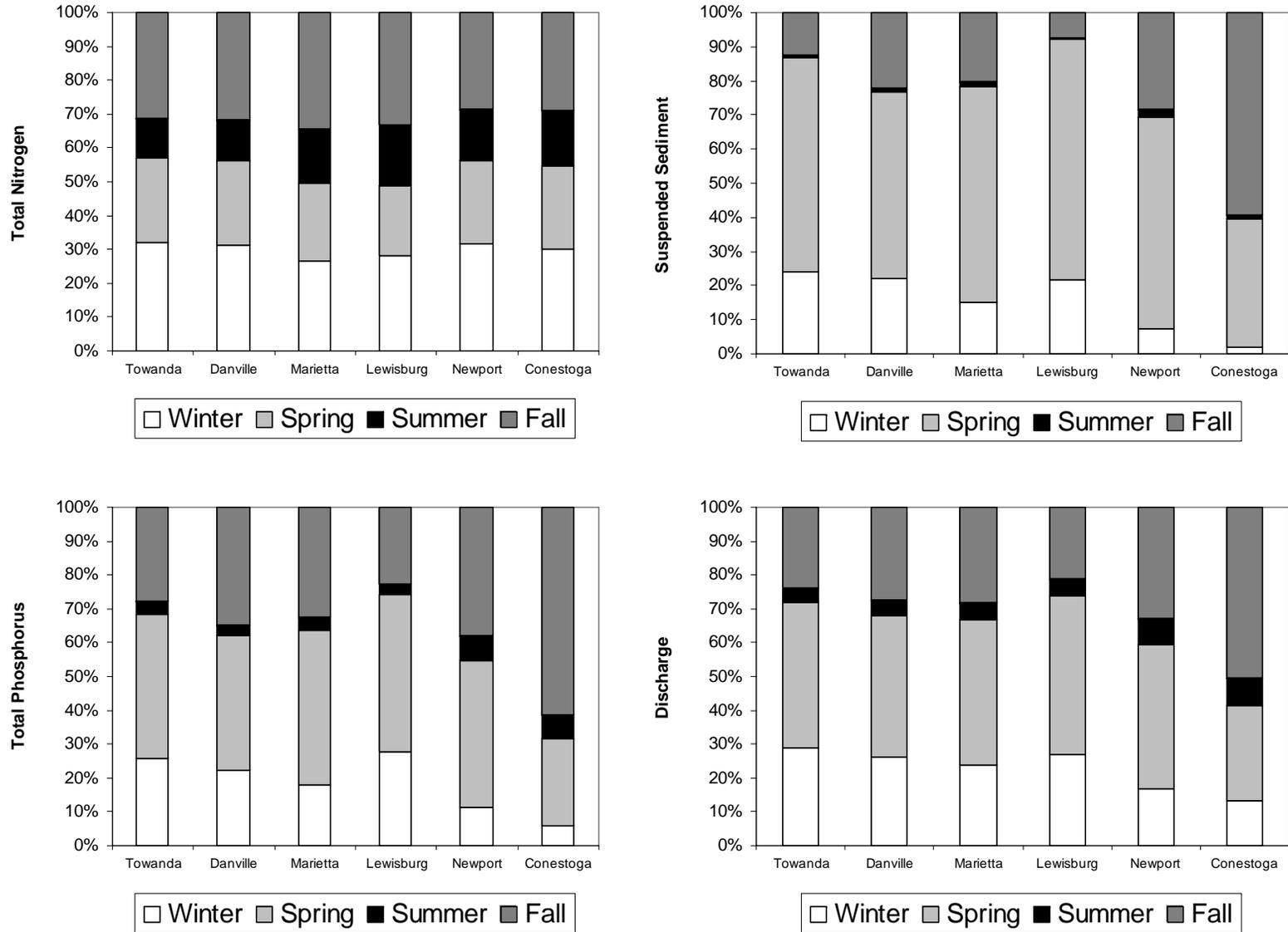


Figure 16. *Seasonal Percent of Annual Load of Total Nitrogen, Total Phosphorus, and Suspended Sediment at Towanda, Danville, Marietta, Lewisburg, Newport, and Conestoga, Pa.*