

## DISCUSSION

2008 flow at Towanda was 96 percent of the LTM, with significant rainfall during the winter months and December and shortfalls during all other months. Years with similar annual flow include 1992, 1998, and 2007. While there were no large variations between loads for years 2007 and 2008, there were variations between both years and loads for 1992 and 1998. Loads for TN, DN, TON, DON, TNOx, and DNOx were all lower for 2007 and 2008 as compared to 1992 and 1998, while TP, DP, and DOP were all higher. Seasonal loads for all parameters were highest during winter, including 80 percent of the annual SS load delivered during the period, while only 56 percent of the annual flow was delivered during the season. The majority of this load was during March, which had 27 percent of the annual flow and 47 percent of the annual SS load. TN and TP loads also were higher during March than any other month in 2008, with 29 percent and 35 percent of the annual yield, respectively. Seasonal baseline comparisons showed that TP and SS were higher than predicted for both winter and fall while only TP was higher for summer. Annual yields were above the baseline prediction for all comparisons for TP, while yields for all other parameters were below the baseline predictions. Trends for the time period showed 11 downward trends, one upward trend for DOP, and four nonsignificant trends for TP, DP, DNH<sub>3</sub>, and flow.

2008 flow at Danville was 106 percent of the LTM due to significant rainfall during the winter months and December. Years with similar annual flow include 1986 and 1998. Comparisons with these years show that 2008 had below expected load values for all parameters except TP, DP, and DOP. TP loads were as predicted, while DP and DOP were above predicted values as compared to the previous similar water years. Seasonal loads were similar to Towanda's, with all parameters being highest during winter, including 80 percent of the annual SS load delivered during the winter months, while only 56 percent of the annual flow was delivered during the same time

period. The majority of this load was during March, which had 26 percent of the annual flow and 50 percent of the annual SS load. TN and TP loads also were higher during March than any other month in 2008 with 28 percent and 36 percent of the annual yield, respectively. Both annual and seasonal baseline comparisons for all parameters showed 2008 yields below the predicted values, except for TP for the comparison with the second half of the dataset. Although the predicted value was lower than the actual 2008 value, the magnitude was not enough to imply degradations. Trends for the time period included 12 downward trends and four nonsignificant trends for DP, DNH<sub>3</sub>, DOP, and flow.

2008 flow at Lewisburg was 93 percent of the LTM, with above LTM flow during February, March, May, and December. Years with similar annual flow include 1985, 1992, 1998, 2002, and 2005. Comparisons with these years show that 2008 had below expected load values for all nitrogen parameters except TNOx and DNOx, which were near the previous year's values. TP, TOC, and SS loads also were similar to previous similar water years, while DP and DOP both were greater in 2008 than expected based on previous water years. Seasonal loads were similar to Towanda and Danville, with all parameters being highest during winter, including 78 percent of the annual SS load delivered during the winter months, while only 55 percent of the annual flow was delivered. The majority of this load was during March, which had 28 percent of the annual flow and 50 percent of the annual SS load. TN and TP loads also were higher during March than any other month in 2008 with 28 percent and 35 percent of the annual yield, respectively. 2008 annual yields were below the baseline predictions for all comparisons for TN, TP, and SS. Seasonal baseline comparisons showed that TP yields were higher than predicted values for winter and summer, while SS yields were higher than predicted for winter. Trends for the time period included 11 downward trends and five nonsignificant trends for DP, DNH<sub>3</sub>, DOP, TOC, and flow.

2008 flow at Newport was 110 percent of the LTM, with above LTM flows during February, March, December, and highest above LTM values during May. Years with similar annual flow include 1989, 1990, 1994, and 1997. Comparisons with these years show that 2008 had below expected load values for TN and DN and above expected values for DOP. All other parameters showed no variation from previous years. Seasonal flows and loads were more evenly distributed among the seasons at Newport for 2008. Winter still had the highest percentage of flow, with 45 percent of annual flow, which led to highest load values for all parameters during the season, with SS having the highest percentage at 56 percent. The majority of this load was during March, which had 23 percent of the annual flow and 45 percent of the annual SS load. TN and TP loads also were higher during March, with 23 percent and 29 percent of the annual yield, respectively. May was the second highest month for flow, with 18 percent of the annual flow and 18, 23, and 22 percent of annual loads for TN, TP, and SS, respectively. Both annual and seasonal baseline comparisons for all parameters showed 2008 yields below the predicted values at Newport. Trends for the time period included 10 downward trends, five nonsignificant trends for  $\text{TNH}_3$ ,  $\text{DNH}_3$ ,  $\text{TNO}_x$ ,  $\text{DNO}_x$ , and flow, and one upward trend for DOP.

2008 flow at Marietta was 105 percent of the LTM, with above LTM flows during February, March, May, and December. Years with similar annual flow include 1998 and 2005. Comparisons with these years show that 2008 had no variation for TON, DON, TKN, and DOP. All other parameters showed lower than expected loads when compared to the previous years with similar flows. Winter was the highest flow season for 2008, with flow being 53 percent of annual flow, which led to highest load values for all parameters during the season with SS having the highest percentage at 79 percent. The majority of this load was during March, which had 26 percent of the annual flow. TN, TP, and SS loads also were highest during March in 2008 with 26, 29, and 57 percent of the annual yield, respectively. 2008 yield values for 2008 were below the annual baseline predictions

for all parameters, while the high flow season, winter, had 2008 yields for TP and SS that were above what was predicted by baseline values. 2008 trends at Marietta were downward for all parameters except DOP and flow, which had no significant trends.

2008 flow at Conestoga was 94 percent of the LTM, with above LTM flows during February, March, and December. Years with similar annual flow include 1987, 1988, 1990, 1998, 2000, and 2007. Comparisons with these similar flow years showed no variation for  $\text{TNH}_3$  and  $\text{DNH}_3$ . 2008 values for all other parameters were lower than expected loads when compared to these years. Flow and seasonal loads for all parameters were highest during the winter months. Large variations between the percentage of flow for the season and the percentage of each parameter for the season were not found at Conestoga as it had been at all other sites due to lower flows during March. Comparisons for February specifically did show this variation with 18 percent of the annual flow occurring during February, while 30 percent of the annual SS load was transported during that month. December had similar loads with 14 percent of the annual flow and 13, 22, and 29 percent of the TN, TP, and SS loads, respectively. All baseline comparisons showed that 2008 yields were below the predicted values and thus suggest possible improvements in conditions. Trends for the time period showed 11 downward trends and five nonsignificant trends for DN, DON,  $\text{TNO}_x$ ,  $\text{DNO}_x$ , and flow.

2008 loads and trends indicated that reductions were attained for nearly all nitrogen species at all sites. Phosphorus species showed the opposite in the three northernmost sites at Towanda, Danville, and Lewisburg. Specifically, DOP loads were higher than predicted by analyses at all sites except at Conestoga. 2008 loads at Conestoga showed reductions in both nitrogen and phosphorus species and suspended sediment as compared to previous years, although it still maintains the highest yield values of all sites for all parameters. Marietta, the southernmost site on the Susquehanna River, had downward trends for all analyzed parameters during 2008 except

DOP, which had no trend due to greater than 20 percent of the measured values being below the laboratory method's detection limit. Considering the trapping effect of the

Conowingo Dam below Marietta, loads transported to the Bay were likely lower than shown at Marietta for both phosphorus and suspended sediment during 2008.