Table 5. Summary of Criteria Used to Classify the Biological Conditions of Sample Sites

SAMPLING AND ANALYSIS				
↓				
↓				
TOTAL BIOLOGICAL SCORE DETERMINATION				
Metric	**Biological Condition Scoring Criteria**			
	6	**4**	**2**	**0**
1. Taxonomic Richness (a)	> 80%	79-60%	59-40%	<40%
2. Shannon Diversity Index (a)	> 75%	74-50%	49-25%	<25%
3. Hilsenhoff Biotic Index (b)	> 85%	84-70%	69-50%	<50%
4. EPT Index (a)	> 90%	89-80%	79-70%	< 70%
5. Percent Ephemeroptera (c)	> 25%	10-25%	1-9%	< 1%
6. Percent Chironomidae (c)	< 5%	5-20%	21-35%	>35%
7. Percent Dominant Taxa (c)	< 20%	20-30%	31-40%	>40%
Total Biological Score (d)				
↓				
↓				

BIOASSESSMENT	
Percent Comparability of Study and Reference Site Total Biological Scores (e)	**Biological Condition Category**
>83%	Nonimpaired
79-54	Slightly Impaired
50-21	Moderately Impaired
<17%	Severely Impaired

(a) Score is study site value/reference site value X 100
(b) Score is reference site value/study site value X 100.
(c) Scoring Criteria evaluate actual percentage contribution, not percent comparability to the reference station.
(d) Total Biological Score = the sum of Biological Condition Scores assigned to each metric
(e) Values obtained that are intermediate to the indicated ranges will require subjective judgment as to the correct placement into a biological condition category.

RESULTS

Water Quality

During late summer 2005, water quality at most of the river sites met water quality standards (Appendices A and B). Limit values were exceeded for 79 out of 950 total water chemistry values (8.3 percent). Most of these exceedances were for total aluminum, sodium, nitrogen, temperature, and conductivity. The exceedances are listed in Table 6 and depicted in Figure 3.

Table 6. Summary of Exceedances of Water Quality Standards

Parameter	Limit Concentration	# of Exceedances	# of Data Points
Temperature	25 degrees Celsius	21	125
Conductivity	800 µmhos/cm	8	125
Total Aluminum	200 µg/l	25	25
Total Sodium	20 mg/l	17	25
Total Nitrogen	1.0 mg/l	6	25
Total Phosphorus	0.1 mg/l	1	25
Total Orthophosphate	0.05 mg/l	1	25

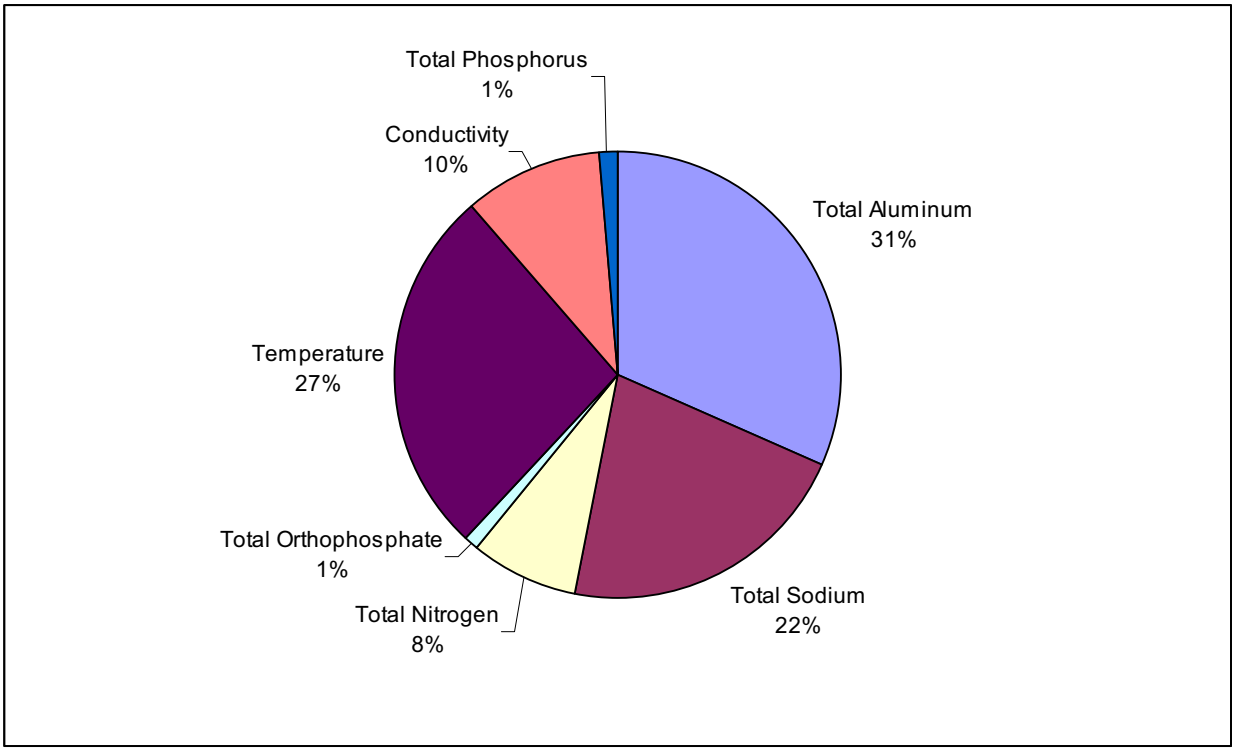

Figure 4. Parameters Exceeding Water Quality Standards

Biological Communities

Raw data for the benthic macroinvertebrate analysis can be found in Appendix C. The results of the metrics for the reference condition approach are found in Appendix D. A high RBP score indicates a low degree of impairment and a comparatively healthy macroinvertebrate community. Results of the data are summarized below for each site (Table 7). Table 7 shows the number of samples within each station that received a nonimpaired, slightly impaired, moderately impaired, or severely impaired designation for the reference condition analysis. The biological scores also were averaged to give an overall designation for each site (Table 7). All stations in this survey received either a slightly impaired or a moderately impaired designation.

Descriptive statistics (mean, median, mode, minimum, and maximum) were calculated for each sample type (from a rock basket or a kick net) and metric. Tables 8 and 9 detail the descriptive statistics for each metric for the rock basket and kick net samples, respectively. Additionally, two-tailed *t* tests were performed for each metric to determine if the results obtained from the samples for each sampler type were significantly different. As a part of these *t* tests, F tests also were performed to determine if the variances between the two samples were different. If the variances were different, a *t* test assuming unequal variances was performed; otherwise, a *t* test assuming equal variances was calculated. Statistical significance for these tests is assumed to be at the 95^{th} percentile level (p=0.05). Of the metrics used in this study, percent dominant taxa, number of EPT Taxa, and Shannon Wiener Diversity Index did not have equal variances. Based on the results of the *t* tests, it was determined that two of the metrics, number of EPT taxa and percent Chironomidae, were significantly different. Tables 10 and 11, respectively, depict the results from the F tests and *t* tests for each metric.

Table 7. Summary of Impairment Designations for Each Site

Station	Reference Condition				Overall Site Condition
	Nonimpaired	Slightly Impaired	Moderately Impaired	Severely Impaired	
SUSQ 394	3	6	1	0	Slightly Impaired
SUSQ 365	3	7	0	0	Slightly Impaired
SUSQ 356	2	5	3	0	Slightly Impaired
SUSQ 344	1	7	2	0	Slightly Impaired
SUSQ 327	0	0	6	1	Moderately Impaired
SUSQ 312	0	6	4	0	Slightly Impaired
SUSQ 300	0	7	2	0	Slightly Impaired
SUSQ 271	0	6	1	0	Slightly Impaired
SUSQ 256	0	3	4	0	Moderately Impaired
SUSQ 234	0	3	6	0	Moderately Impaired
SUSQ 219	0	8	1	0	Slightly Impaired
SUSQ 207	0	8	1	0	Slightly Impaired
SUSQ 192	0	6	1	0	Slightly Impaired
SUSQ 174	0	1	9	0	Moderately Impaired
SUSQ 157	0	4	6	0	Moderately Impaired
SUSQ 149	0	6	4	0	Slightly Impaired
SUSQ 138	1	4	5	0	Slightly Impaired
SUSQ 122	0	1	5	0	Moderately Impaired
SUSQ 106	0	7	2	0	Slightly Impaired
SUSQ 94	1	8	1	0	Slightly Impaired
SUSQ 77	0	7	3	0	Slightly Impaired
SUSQ 45	0	8	1	0	Slightly Impaired
CHEM 3	1	6	3	0	Slightly Impaired
WBSR 8	3	5	2	0	Slightly Impaired
JUNR 2	3	5	1	0	Slightly Impaired

Table 8. Summary of Descriptive Statistics for Rock Basket Samples for Each Metric

Statistic	Mean	Median	Mode	Minimum	Maximum
Number of Individuals	231.7	241.5	251	4	234
Taxa Richness	15.8	15	13	3	28
Hilsenhoff Biotic Index	4.21	4.23	5	1.91	6.03
Percent Ephemeroptera	45.1	44.3	NA	0	94.6
Percent Dominant Taxa	41.4	37.0	33.3	16.8	91.1
EPT Index	10.2	10	10	1	17
Percent Chironomidae	12.3	9.5	0	0	50
Shannon-Wiener Diversity Index	1.82	1.87	NA	0.48	2.55

Table 9. Summary of Descriptive Statistics for Kick Net Samples for Each Metric

Metric	Mean	Median	Mode	Minimum	Maximum
Number of Individuals	249.0	244	219	94	422
Taxa Richness	18.2	18	17	9	28
Hilsenhoff Biotic Index	4.62	4.60	NA	3.64	5.66
Percent Ephemeroptera	22.6	19.5	17.0	0.5	60.3
Percent Dominant Taxa	36.1	31.3	26.6	12.7	74.3
EPT Index	10.7	11	11	1	17
Percent Chironomidae	10.8	6.0	0	0	59.4
Shannon-Wiener Diversity Index	2.05	2.10	NA	1.15	2.70

Table 10. Summary of F test Results for Each Metric

Metric	F value	P (one-tail)	F critical value
Number of Individuals	1.811	8.370E-04	1.364
Taxa Richness	1.551	0.0100	1.364
Hilsenhoff Biotic Index	2.801	3.235E-08	1.364
Percent Ephemeroptera	2.951	7.104E-09	1.364
Percent Dominant Taxa	1.246	0.122	1.364
EPT Taxa	1.253	0.116	1.364
Percent Chironomidae	0.615	0.006	0.7294
Shannon-Wiener Diversity Index	1.175	0.195	1.364

Table 11. Summary of Two-tailed t test Results for Each Metric

Metric	*t* stat	P (two-tail)	*t* critical value
Number of Individuals	-2.729	0.007	1.971
Taxa Richness	-4.978	1.277E-06	1.971
Hilsenhoff Biotic Index	-5.309	2.634E-07	1.971
Percent Ephemeroptera	9.168	3.137E-17	1.971
Percent Dominant Taxa	2.581	0.0105	1.972
EPT Taxa	-1.467	0.144	1.972
Percent Chironomidae	0.972	0.332	1.971
Shannon-Wiener Diversity Index	-4.633	6.355E-06	1.971

DISCUSSION

Water Quality

A comparison of water quality from the present large river assessment project (August – October 2005) to water quality samples collected for the most recent interstate streams (Steffy and Sitlinger, 2006), Upper Susquehanna Subbasin Survey (Stoe, 1999), Middle Susquehanna Subbasin Survey (LeFevre, 2002), West Branch Subbasin Survey (LeFevre, 2003), Juniata River Subbasin Survey (LeFevre, 2005), and Lower Susquehanna Subbasin Survey (LeFevre, 2006) indicates that water quality conditions on the Susquehanna River between Sidney, N.Y., and Marietta, Pa., and at the mouths of its major tributaries, are stable and generally below limits, although temperatures were greater than 25 degrees Celsius in most of the August samples and aluminum exceeded levels of concern in all samples. From the data analysis, it appears that the Susquehanna River, in the stretch encompassed by this study, contains fairly good water quality, with some slightly elevated parameters.

Macroinvertebrate Communities

Upper Susquehanna River and the Chemung River

The section of the Susquehanna River from the headwaters at Cooperstown, N.Y., to the confluence with the Chemung River at Sayre, Pa., is in the Upper Susquehanna Subbasin. This survey included seven stations on the mainstem Susquehanna River from Sidney, N.Y., to Sayre, Pa. The river in this part of the Susquehanna basin flows through mostly agricultural and forested land with some small communities and one larger population center, Binghamton, N.Y. Overall, the sites at Sidney (SUSQ 394) and Windsor (SUSQ 365), N.Y., exhibited high taxa richness, EPT Index, and diversity. At Sidney,