1-2001

Soil and Nutrient Loss from Selected Subwatersheds of Conesus Lake

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Prepared for the Livingston County Planning Department
With Funds Provided by New York State
Under the Finger Lakes-Lake Ontario Watershed
Protection Alliance Program

by

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January 2001

Executive Summary

1. The purpose of this study was to evaluate the loss of soil and nutrients from the upland area of ten selected small watersheds or subwatersheds surrounding Conesus Lake. Macrophyte beds of mixed composition exist around the entire edge of Conesus Lake – perimeter beds. In addition, macrophyte beds consisting mainly of Eurasian milfoil exist at or near many of the creek mouths within the littoral zone of Conesus Lake. These creek-mouth associated beds are of interest because their presence may be associated with creeks that lose a large amount of nutrients and soils from their subwatershed.

2. Two rivulets (rivulet #5989 and GraywoodAcres) that drain subwatersheds of Conesus Lake contributed excessive amount of total Kjeldahl nitrogen, nitrate and phosphorus into the lake relative to similar nearby watersheds. The high loss of phosphorus and nitrate undoubtedly stimulate algae and macrophyte growth "locally" at stream mouths and potentially play a role in deteriorating water quality of the entire lake. The existence of macrophyte beds consisting mainly of Eurasian milfoil and clouds of filamentous algae (metaphyton) at many of these stream mouths suggests a connection between land use practices in the watersheds and plant overgrowth.

3. High levels of coliform bacteria were observed in many of the streams during events. This result indicated the presence of bacteria in the water and that fecal material was either being swept off the watershed from warm-blooded organisms during events or from septic systems that were not operating properly. In addition, Giardia, an intestinal parasite, were detected in rivulet #5989.

4. The possibility exists that control of nutrient and soil loss through management practices within the watershed may reduce the size of macrophyte beds and abundance of macrophytes within the beds at the creek mouth. What affect management practices on these small watersheds will have on the perimeter beds of macrophytes surrounding the lake is at best speculative. In general, reduction of nutrients should reduce the abundance of all macrophyte beds simply because there are less nutrients. In either the perimeter or the stream-mouth associated beds, any reduction will not be instantaneous. Improvements in water quality of Irondequoit Bay in Monroe County and Lake Erie were not realized until almost 20 to 25 years after implementation of either the phosphate abatement program or other management practices. However, the creeks-mouth macrophyte beds should respond earlier than the whole lake. These stream The creek-mouth beds could be used as an indicator of effectiveness of management practices in the watershed.

Introduction

The purpose of this study was to evaluate the loss of soil and nutrients from the upland area of ten small watersheds or subwatersheds located in Conesus Lake watershed. Perimeter beds, macrophyte beds of mixed composition, exist around the entire edge of Conesus Lake. In addition, macrophyte beds consisting mainly of Eurasian milfoil exist at or near many of the creek mouths within the littoral zone of Conesus Lake (Fig. 1)(Bosch *et al*. 2001). These creek-associated beds are of interest because their presence appears to be associated with creeks that lose a large amount of nutrients and soils from their subwatersheds. Thus a mechanism is suggested for reducing the size of macrophyte beds in Conesus Lake. Application of best management plans should reduce nutrient and soil loss and with time reduce the size of the macrophyte beds associated with streams. To test the hypothesis that the proximity of the macrophyte beds in Conesus Lake are related to loss of nutrients from these subwatersheds, information on loading of nutrients and soil from the impacted areas is needed. Some data exist from the previous studies of Makarewicz et al. (1991, 1999). However, recent information does not exist for several subwatersheds, and in some cases, no information exists for several of the small rivulets. A data gap exists on the level of loss of nutrients and materials from these smaller creeks. These suspected subwatersheds are candidates for a USDA grant to evaluate management plans that may reduce nutrient and soil loss. To accomplish this task, ten streams draining subwatersheds were sampled on six sampling dates during the autumn of 2000 (Table 1). The sampling design included three precipitation events and three non-event periods.

Previous work in the late 1980s and early 1990s had estimated the loss of nutrients from Long Point Gully, North Gully, and "No Name" Creek (Makarewicz et al. 1991). In this study, these larger watersheds were used for comparative purposes or a point of reference in evaluating soil and nutrient loss from the smaller subwatersheds of concern. If land use is similar, larger watersheds will generally lose more soil and nutrients than a smaller watershed. If we observe larger losses of nutrients and soils from the smaller watersheds or if we observe more loss per unit area of watershed in the smaller than in the larger watershed, it would indicate a detrimental land practice in the watershed; that is, a land use is causing excessive loss of soils and nutrients compared to other nearby watersheds of similar soil, geological formation and slope.

Methods

Because much of the loss of soils and nutrients occurs during precipitation events in any watershed, water samples were taken and stream discharge measured during three precipitation events and during three non-events. Soil loss (as total suspended solids), nutrient loss (nitrate, dissolved phosphorus as soluble reactive phosphorus, total phosphorus), organic nitrogen plus ammonia as total Kjeldahl nitrogen and de-icing salt as sodium were measured as a function of stream discharge and concentration. Samples were taken manually and transported to SUNY Brockport for water chemistry analysis. All sampling bottles were pre-coded so as to ensure exact identification of the particular sample. All filtration units and other processing apparatus were cleaned routinely with phosphate-free RBS. Prior to sample collection, containers were rinsed with the water being collected. In general, all procedures followed EPA standard methods (EPA 1979) or Standard Methods for the Analysis of Water and Wastewater (APHA 1999). Sample water for dissolved nutrient analysis (nitrate + nitrite, TDP, and SRP) was filtered immediately with 0.45-µm MCI Magna Nylon 66 membrane filters and held at 4°C until analysis.

Water Chemistry:

Nitrate + Nitrite: Dissolved nitrate + nitrite nitrogen analyses were performed by the automated (Technicon Autoanalyser) cadmium reduction method (EPA 1979, APHA 1999).

Total Phosphorus: Raw water was digested using the persulfate digestion procedure prior to analysis by the automated (Technicon autoanalyser) colorimetric ascorbic acid method (APHA 1999).

Total Dissolved Phosphorus: Raw water was filtered (0.45-µm nylon MCI Magna 66 membrane filter) and digested using the persulfate digestion procedure prior to analysis by the automated (Technicon autoanalyser) colorimetric ascorbic acid method (APHA 1999).

Soluble Reactive Phosphorus: Filtered raw water was analyzed by the automated (Technicon autoanalyser) colorimetric ascorbic acid method (APHA 1999).

Total Kjeldahl Nitrogen: Analysis was performed using a modification of the Technicon Industrial Method 329-74W/B. The following modifications were performed:

1. In the sodium salicylate-sodium nitroprusside solution, sodium nitroferricyanide (0.4g) replaced the concentrated nitroprusside stock solution.
2. The reservoir of the autoanalyser was filled with 0.2M H_2SO_4 instead of distilled water.
2. Other reagents were made fresh prior to each analysis.

Total Suspended Solids: APHA (1999) Method 2540D was employed for this analysis.

Sodium: Sodium was determined by atomic absorption spectrophotometry (Perkin Elmer Analyst 100) (APHA 1999) on filtered samples.

Stream Velocity: Stream velocity was measured at equally spaced locations in either a culvert or cement channel of a bridge under a road with a Gurley flow meter (Chow 1964).

Stream Height and Cross-Sectional Area: Stream depth was measured as the difference between the vertical height of the culvert/bridge opening and the distance between the stream surface and upper portion of the culvert/bridge. Stream cross-sectional area for various stream heights was calculated by planimetry after measuring the cross-sectional dimensions of each stream monitored.

Coliform Bacteria and Giardia**:** Samples were taken by Dick Davin, while analyses for total coliforms and E. coli were performed by Wayland Laboratory Services (ELAP#11338).

Watershed Area: Subwatershed areas were obtained from Makarewicz and Lewis (1999) and Makarewicz et al. (1991). In the case of the subwatershed draining the rivulet at Sutton Point and the GraywoodArea Creek, subwatershed area was estimated from USGS topographic maps.

Nutrient Loading: Daily nutrient and sediment loadings from the watershed were calculated by multiplying the discharge on the day of the sample by the concentration of the nutrient or solids from the appropriate water sample.

Quality Assurance Internal Quality Control: Multiple sample control charts (APHA 1999) were constructed for each parameter analyzed, except total suspended solids. A prepared quality control solution was placed in the analysis stream for each sampling date. If the control solution was beyond the set limits of the control chart, corrective action was taken and the samples re-run.

External Quality Control: The Water Chemistry Laboratory at SUNY Brockport is certified through the New York State Department of Health's Environmental Laboratory Approval Program (ELAP - # 11439). This program includes biannual proficiency audits, annual inspections and good laboratory practices documentation of all samples, reagents and equipment.

Results and Discussion

Concentration is the amount of a nutrient or a material per unit volume of water. Table 2 indicates that event concentrations of total phosphorus, soluble reactive phosphorus, nitrate and total Kjeldahl nitrogen were generally high. Of the creeks sampled, the highest concentrations observed were for the small creek or rivulet located in the Graywood Acres area (Fig. 2). Even more surprising was the high concentrations observed during nonevent conditions at this watershed (Table 2). Other creeks with high precipitation event concentrations of total phosphorus and nitrate were Hanna’s Creek, Sand Point, Long Point Gully, “No Name” Creek and North Gully. Total dissolved phosphorus (TDP) concentrations were not significantly different from soluble concentrations (SRP) suggesting that all dissolved phosphorus was in the inorganic form. Similarly, high nitrate concentrations or substantial increases from nonevents to events were observed at Long Point Gully, “No Name” Creek, Cottonwood Gully, Rivulet #5989, Sutton Point and North Gully. High concentrations of nitrate were observed, not only during events, but also during non-events in the Cottonwood Gully, Rivulet #5989, Graywood Gully and North Gully watersheds. Except for the Graywood Gully and Sutton Point sites, which have not been previously monitored, the high concentrations currently observed were previously documented ten years ago by Makarewicz et al. (1991), or a year ago in the Rivulet Study commissioned by the Livingston County Health Department (Makarewicz and Lewis 1999). This suggests that the sources of these nutrients are not new.

Loading is the amount of nutrients and soil that is lost from the watershed and carried by the stream into Conesus Lake. Unlike concentration, loading considers the volume of water being lost from the watershed per day (discharge, Fig. 3) and the concentration (Table 2) and is expressed as kilograms of nutrient per day entering the lake. Thus loading provides a better representation of the actual amount of soil and nutrient being lost from the subwatersheds and deposited into the lake. Table 3, which provides a summation of loss of materials from the watersheds by sampling date and the averages and maxima for events and nonevents, demonstrates a commonly known fact for western New York watersheds. In general, in non-forested watersheds, precipitation events contributed well over 70 - 90 percent of the losses of nutrients and soil (Makarewicz and Lewis, 2000).

Although loading expressed as kilograms of nutrient lost per day provides an overall impact of a subwatershed on a lake – the greater the loading, the greater the potential impact on water quality - it is not a good measure to compare subwatersheds. The reason is that larger watersheds would be expected, in general, to deliver larger loads of nutrients simply because of their larger size. To allow comparison of subwatersheds, the loading data is normalized by the size of the watersheds: that is, the loss of nutrients or soil per unit area of watershed per day (e.g., g/ha/day), where g is grams (1000 grams = 2.2 lbs) and ha is a hectare (1 ha = 2.47 acres). This "normalization" procedure allows a fairer comparison between subwatersheds. A high "areal" loading value during a precipitation event compared to another subwatershed would suggest that the higher losses are due to material being swept off the watershed by rainwater or melt water. Those streams that have a high loss of materials from the watershed are likely due to land use practices within that watershed.

Figures 4 to 9 provide estimates of "areal" loading of total Kjeldhal nitrogen, total phosphorus, soluble reactive phosphorus, nitrate, sodium and total suspended solids. Although discharge, the amount of water coming off a subwatershed via a stream, was expected to be the highest for the larger subwatersheds (Hanna's, North Long Point and "No Name")(Fig. 3), these subwatersheds were not providing the largest amount of nutrients to the lake per unit area of watershed. Instead, two small watersheds (Rivulet #5859 and the Graywood Gully) were delivering an excessive amount of materials during events into Conesus Lake. Their impact was much greater than what was expected based on the area of these small watersheds. The subwatersheds associated with Rivulet #5859 and the Graywood Gully delivered excessive amounts of total phosphorus (Fig. 4), soluble reactive phosphorus (Fig. 5), nitrate (Fig. 7) and total Kjeldahl nitrogen (Fig. 8). This result suggests that a land-use practice allowed water to carry surficial materials during precipitation events out of the watershed and into Conesus Lake. The fact that these subwatersheds were delivering such high levels of nutrients is of concern since it has been previously established that Long Point Gully and "No Name" watersheds were major contributors of nitrate to Conesus Lake (Makarewicz and Lewis 1992). The high nitrate losses from the Long Point and "No Name" watersheds have been associated with agricultural practices in these watersheds, especially with fields planted in corn (Makarewicz and Lewis 1992). Also, the large contribution from Rivulet #5989 confirmed observations from 1999 (Makarewicz and Lewis 1999).

High loss of soil as TSS was observed from Cottonwood and North Gully (Fig. 6). Sodium loss was highest from Rivulet #5989 and Hanna's Gully and reflected the loss of deicing salt used on roads in these hilly areas. In the case of TKN, basically organic nitrogen and ammonia, the high loss during rain events from watersheds #5859 and Graywood Gully suggests that some type of organic materials, such as manure, was being washed off the landscape and into the lake. High concentrations of coliform bacteria were also observed during many of the precipitation events (Table 4). Coliform bacteria are indicators of the presence of bacteria commonly found in the intestinal tract of warm-blooded animals. Also, Giardia were observed on two occasions at Rivulet #5899. Giardia is an intestinal parasite passed in the feces of an infected animal or person. The presence of coliform bacteria and Giardia in stream water suggests contamination with sewage or fecal material. This contamination may be from humans, cows and possibly geese. The high levels of coliforms suggest that the source is unlikely a small number of "wild" animals. Both the biological and chemical data suggest a source within the watershed of organic materials containing fecal materials.

Similarly, the high loss of TSS (i.e., soils) and the associated particulate forms of phosphorus (TP) during events suggested that soil was being either eroded from the stream bank or that a land-use practice in the watershed (e.g., tillage) was the cause of this loss. Soil loss from the watershed is causing a new delta to form on Conesus Lake at a couple of locations (e.g., house #5413 West Lake Road). It was also evident from the video of the stream at 5413 Lake Road from spring of 1998 that losses of soils and associated nutrients could be considerably higher than what was observed in this study (Makarewicz and Lewis 2000). We believe the losses observed were conservative because of the low event flows experienced during the sampling period.

Summary

Two rivulets (rivulet #5989 and Graywood Gully) that drain subwatersheds of Conesus Lake contributed excessive amount of total Kjeldahl nitrogen, nitrate and phosphorus into Conesus Lake relative to similar nearby watersheds. The high loss of phosphorus undoubtedly stimulated algae and macrophyte growth "locally" at stream mouths and potentially played a role in deteriorating water quality of the entire lake. Bosch et al. (2001) have demonstrated that

macrophyte beds consisting mainly of Eurasian milfoil and clouds of filamentous algae (metaphyton) exist at the stream mouths of many of the creeks monitored. The large amount of material being lost from these small subwatersheds was surprising when compared to larger nearby watersheds. A land-use practice in the watershed could be the cause. From a management perspective, the possibility exists that control of nutrient and soil loss through best management practices with the watershed may reduce the size of macrophyte beds and abundance of macrophytes within the beds. What affect management practices on these small watersheds have on the perimeter beds of macrophytes surrounding the lake is at best speculative. In general, reduction of nutrients should reduce the abundance of macrophytes simply because there are less nutrients. However, any reduction in the perimeter beds and in the stream-mouth associated beds will not be instantaneous. Improvements in water quality of Irondequoit Bay in Monroe County and Lake Erie were not realized until almost 20 to 25 years after implementation of either the phosphate abatement program or other management practices.

Acknowledgements

Mr. Dick Davin collected samples during precipitation events. We recognize his dedication and thank him for a job well done!

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Table 1. Summary data on sampling locations, weed presence, subwatershed area.

Watershed	Location of stream depth measurement	Lat/Long	Weed Bed Area (ha)	Watershed Area (ha)
Hanna's Creek (#11) 3502 Pebble Beach Road	Triangle on East side of Bridge	42° 49.90 N 77° 42.37W	337.5	717.5
Graywood Gully 4003 West Lake Road Turn East at GraywoodCenter sign	Center of culvert near shore of lake	42° 48.64 N 77° 42.95 W	23.4	33.8
Sand Point Gully 4661 West Lake Rd. Left on Wadsworth Cove veer left	Triangle on Bridge	42° 47.22 N 77° 43.34 W	9.5	325
Long Point Gully (#3) West Lake Road @ Creekside Lane	Triangle on East face of bridge	42° 46.82 N 77° 43.36 W	37.1	622.5
Cottonwood Gully 5341 W. Lake Rd. near pump station	Top of culvert on west side of road	42° 45.48 N 77° 43.67 W	15.1	76
No Name Creek (#12) 5577 W. Lake Rd	Triangle on East side of bridge	42° 44.95 N 77° 43.66 W	None (Steep shoreline)	415
5989 Rivulet 5989 West Lake Road	Center of culvert	42° 44.10 N 77° 43.50 W	None (Steep shoreline)	110.1
Sutton Point (#6) 5690 West Lake Rd.	Top of culvert on West side of road	42° 44.52 N 77° 43.67W	2.8	62.2
North Gully	Triangle on West side bridge	42° 46.71 N 77° 42.65 W	23.2	735
Densmore Creek Old Orchard Point (#7) 4683 E. Lake Rd near storage place	Triangle on East side of Road	42° 47.56 N 77° 42.46 W	54.3	647.5

Table 2. Average concentrations of nutrients, sodium and soil (TSS) in water draining selected subwatersheds of Conesus Lake. TP = total phosphorus, SRP = soluble reactive phosphorus, TKN = total Kjeldahl nitrogen, TSS = total suspended solids (soils), TDP = total dissolved phosphorus.

		TP (µg P/L)	Nitrate (mg N/L)	TSS (mg/L)	TKN (µg N/L)	Sodium (mg/L)	SRP (µg P/L)	TDP (µg P/L)
Hanna's Creek	Baseline	82.8	0.33	1.5	557	86.94	68.4	75.9
	Event	202.2	0.75	11.5	557	75.44	116.5	121.8
Graywood Gully	Baseline	209.4	5.62	9.3	650	59.85	177.0	178.6
	Event	372.0	13.73	16.8	1113	45.15	336.0	338.4
Sand Point Gully	Baseline	80.7	0.10	2.5	613	15.90	62.9	67.0
	Event	117.7	1.66	19.2	383	18.19	82.5	84.1
Long Point Gully	Baseline	115.6	0.00	0.9	520	47.65	103.8	109.7
	Event	187.4	7.63	18.5	700	41.68	142.8	151.7
Cottonwood Gully	Baseline	58.2	6.06	0.9	210	21.65	51.3	52.7
	Event	82.1	1.50	21.1	473	23.40	46.5	47.3
No Name Creek	Baseline	50.5	2.80	0.1	490	21.02	48.0	49.0
	Event	122.8	5.03	34.8	547	23.21	62.2	62.7
Sutton Point	Baseline	48.2	0.47	7.5	283	20.18	33.5	34.7
	Event	53.6	2.61	2.8	428	16.51	45.9	46.7
5989 Rivulet	Baseline	78.5	3.58	1.3	437	30.40	72.3	76.7
	Event	96.1	8.70	4.3	487	33.00	80.2	83.9
North Gully	Baseline	17.6	2.75	0.9	213	18.92	13.8	14.4
	Event	86.2	0.82	39.6	278	23.81	30.2	61.7
Densmore Creek	Baseline	13.1	0.11	1.1	180	80.77	7.5	11.6
	Event	42.2	0.40	6.2	407	79.06	25.6	25.8

Table 3. Loss of soil and nutrients from selected subwatersheds of Conesus Lake during the fall of 2000. TP = total phosphorus, SRP = soluble reactive phosphorus, TKN = total Kjeldahl nitrogen, TSS = total suspended solids (soils), TDP=total dissolved phosphorus.

Hanna's Creek

Date		Discharge m^3/day	TP (kg/day)	Nitrate (kg/day)	TSS (kg/day)	TKN (kg/day)	Sodium (kg/day)	SRP (kg/day)	TDP (kg/day)
10/5/00	Baseline	2437	0.23	0.02	5.24	1.68	242.66	0.16	0.19
10/6/00	Event	6783	1.89	2.54	44.09	4.27	438.23	0.89	0.96
10/18/00	Baseline	6783	0.88	3.41	5.43	3.93	492.90	0.81	0.87
11/2/00	Baseline	1550	0.04	0.74	2.48	0.62	137.31	0.03	0.03
11/27/00	Event	3132	0.15	0.78	5.32	1.19	328.54	0.14	0.15
12/17/00	Event	139960	39.05	229.53	3666.94	92.37	7949.71	24.37	24.49
Mean	Baseline	3590	0.38	1.39	4.38	2.08	290.96	0.33	0.37
Maximum	Baseline	6783	0.88	3.41	5.43	3.93	492.90	0.81	0.87
Mean	Event	49958	13.70	77.62	1238.79	32.61	2905.49	8.46	8.54
Maximum	Event	139960	39.05	229.53	3666.94	92.37	7949.71	24.37	24.49

Graywood Gully

Date		Discharge m^3/day	TP (kg/day)	Nitrate (kg/day)	TSS (kg/day)	TKN (kg/day)	Sodium (kg/day)	SRP (kg/day)	TDP (kg/day)
10/5/00	Baseline	411	0.09	3.94	6.37	0.31	29.23	0.09	0.09
10/6/00	Event	3259	1.23	59.26	100.06	3.59	184.08	1.20	1.21
10/18/00	Baseline	2607	0.58	0.12	6.52	1.67	128.15	0.56	0.57
11/2/00	Baseline	1790	0.32	12.94	17.90	1.00	106.15	0.17	0.17
11/27/00	Event	176	0.03	1.40	0.56	0.07	10.51	0.03	0.03
12/17/00	Event	4072	2.25	61.28	66.77	7.49	78.50	1.88	1.89
Mean	Baseline	1603	0.33	5.67	10.26	0.99	87.85	0.27	0.28
Maximum	Baseline	2607	0.58	12.94	17.90	1.67	128.15	0.56	0.57
Mean	Event	2502	1.17	40.65	55.80	3.72	91.03	1.04	1.04
Maximum	Event	4072	2.25	61.28	100.06	7.49	184.08	1.88	1.89

Sand Point Gully

Date		Discharge m^3/day	TP (kg/day)	Nitrate (kg/day)	TSS (kg/day)	TKN (kg/day)	Sodium (kg/day)	SRP (kg/day)	TDP (kg/day)
10/5/00	Baseline	29	0.00	0.01	0.06	0.01	0.71	0.00	0.00
10/6/00	Event	327	0.03	0.93	2.35	0.19	3.17	0.03	0.03
10/18/00	Baseline	90	0.01	0.00	0.23	0.08	0.67	0.01	0.01
11/2/00	Baseline	699	0.06	0.01	2.10	0.36	11.24	0.04	0.05
11/27/00	Event	5409	0.29	0.49	0.00	0.59	69.39	0.28	0.29
12/17/00	Event	25291	4.92	52.10	1274.65	11.38	810.06	2.82	2.83
Mean	Baseline	273	0.02	0.01	0.79	0.15	4.21	0.02	0.02
Maximum	Baseline	699	0.06	0.01	2.10	0.36	11.24	0.04	0.05
Mean	Event	10342	1.75	17.84	425.67	4.06	294.21	1.04	1.05
Maximum	Event	25291	4.92	52.10	1274.65	11.38	810.06	2.82	2.83

Table 3 (continued). Loss of soil and nutrients from selected subwatersheds of Conesus Lake during the fall of 2000. TP = total phosphorus, SRP = soluble reactive phosphorus, TKN = total Kjeldahl nitrogen, TSS = total suspended solids (soils), TDP=total dissolved phosphorus.

Long Point Gully

Date		Discharge m^3/day	TP (kg/day)	Nitrate (kg/day)	TSS (kg/day)	TKN (kg/day)	Sodium (kg/day)	SRP (kg/day)	TDP (kg/day)
10/5/00	Baseline	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
10/6/00	Event	3827	0.81	39.11	65.06	4.94	177.03	0.78	0.80
10/18/00	Baseline	7222	0.83	0.00	6.50	3.76	344.13	0.75	0.79
11/2/00	Baseline	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
11/27/00	Event	5556	0.70	2.00	0.00	0.72	184.91	0.56	0.61
12/17/00	Event	86168	19.24	1060.73	3308.86	58.59	3919.79	10.59	11.87
Mean	Baseline	7222	0.83	0.00	6.50	3.76	344.13	0.75	0.79
Maximum	Baseline	7222	0.83	0.00	6.50	3.76	344.13	0.75	0.79
Mean	Event	31850	6.92	367.28	1124.64	21.42	1427.24	3.98	4.43
Maximum	Event	86168	19.24	1060.73	3308.86	58.59	3919.79	10.59	11.87

Cottonwood Gully

Date		Discharge m^3/day	TP (kg/day)	Nitrate (kg/day)	TSS (kg/day)	TKN (kg/day)	Sodium (kg/day)	SRP (kg/day)	TDP (kg/day)
10/5/00	Baseline	86	0.00	0.11	0.09	0.02	2.11	0.00	0.00
10/6/00	Event	1591	0.15	2.34	14.79	1.10	35.77	0.10	0.10
10/18/00	Baseline	736	0.03	11.92	0.81	0.23	14.70	0.03	0.03
11/2/00	Baseline	264	0.02	0.19	0.13	0.04	5.39	0.02	0.02
11/27/00	Event	405	0.01	0.23	0.12	0.07	8.48	0.01	0.01
12/17/00	Event	15640	1.91	38.48	839.88	8.76	419.16	0.76	0.77
Mean	Baseline	362	0.02	4.07	0.34	0.09	7.40	0.02	0.02
Maximum	Baseline	736	0.03	11.92	0.81	0.23	14.70	0.03	0.03
Mean	Event	5879	0.69	13.68	284.93	3.31	154.47	0.29	0.29
Maximum	Event	15640	1.91	38.48	839.88	8.76	419.16	0.76	0.77

No Name Creek

Date		Discharge m^3/day	TP (kg/day)	Nitrate (kg/day)	TSS (kg/day)	TKN (kg/day)	Sodium (kg/day)	SRP (kg/day)	TDP (kg/day)
10/5/00	Baseline	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
10/6/00	Event	22682	2.50	114.33	136.09	21.55	516.48	1.47	1.47
10/18/00	Baseline	2202	0.11	6.18	0.22	1.08	46.29	0.11	0.11
11/2/00	Baseline	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
11/27/00	Event	1762	0.08	3.88	0.88	0.21	20.68	0.08	0.08
12/17/00	Event	50385	10.65	395.53	4927.70	28.72	1770.04	3.86	3.88
Mean	Baseline	2202	0.11	6.18	0.22	1.08	46.29	0.11	0.11
Maximum	Baseline	2202	0.11	6.18	0.22	1.08	46.29	0.11	0.11
Mean	Event	24943	4.41	171.24	1688.23	16.83	769.07	1.80	1.81
Maximum	Event	50385	10.65	395.53	4927.70	28.72	1770.04	3.86	3.88

Table 3 (continued). Loss of soil and nutrients from selected subwatersheds of Conesus Lake during the fall of 2000. TP = total phosphorus, SRP = soluble reactive phosphorus, TKN = total Kjeldahl nitrogen, TSS = total suspended solids (soils), TDP=total dissolved phosphorus.

Sutton Point

Date		Discharge m^3/day	TP (kg/day)	Nitrate (kg/day)	TSS (kg/day)	TKN (kg/day)	Sodium (kg/day)	SRP (kg/day)	TDP (kg/day)
10/5/00	Baseline	44	0.00	0.05	0.61	0.02	1.06	0.00	0.00
10/6/00	Event	73	0.00	0.34	0.23	0.08	1.66	0.00	0.00
10/18/00	Baseline	461	0.01	0.09	0.28	0.06	7.59	0.01	0.01
11/2/00	Baseline	34	0.00	0.01	0.27	0.01	0.67	0.00	0.00
11/27/00	Event	123	0.01	0.06	0.02	0.00	0.80	0.01	0.01
12/17/00	Event	2887	0.17	7.71	14.15	0.49	59.02	0.13	0.13
Baseline	Mean	180	0.01	0.05	0.39	0.03	3.11	0.00	0.00
Baseline	Maximum	461	0.01	0.09	0.61	0.06	7.59	0.01	0.01
Event	Mean	1028	0.06	2.70	4.80	0.19	20.49	0.05	0.05
Event	Maximum	2887	0.17	7.71	14.15	0.49	59.02	0.13	0.13

5989 Rivulet

Date		Discharge m^3/day	TP (kg/day)	Nitrate (kg/day)	TSS (kg/day)	TKN (kg/day)	Sodium (kg/day)	SRP (kg/day)	TDP (kg/day)
10/5/00	Baseline	1285	0.09	4.56	0.64	0.32	39.09	0.09	0.09
10/6/00	Event	14131	1.90	184.99	35.33	10.03	421.09	1.84	1.87
10/18/00	Baseline	13741	1.45	24.21	6.87	7.28	428.19	1.27	1.40
11/2/00	Baseline	4129	0.24	22.38	12.39	2.19	122.30	0.23	0.24
11/27/00	Event	587	0.01	2.43	0.12	0.10	18.13	0.01	0.01
12/17/00	Event	46392	6.33	412.43	468.56	26.91	1777.29	4.40	4.77
Baseline	Mean	6385	0.59	17.05	6.63	3.26	196.52	0.53	0.58
Baseline	Maximum	13741	1.45	24.21	12.39	7.28	428.19	1.27	1.40
Event	Mean	20370	2.74	199.95	168.00	12.35	738.84	2.08	2.22
Event	Maximum	46392	6.33	412.43	468.56	26.91	1777.29	4.40	4.77

North Gully

Date		Discharge m^3/day	TP (kg/day)	Nitrate (kg/day)	TSS (kg/day)	TKN (kg/day)	Sodium (kg/day)	SRP (kg/day)	TDP (kg/day)
10/5/00	Baseline	1174	0.02	0.01	2.00	0.45	21.21	0.01	0.01
10/6/00	Event	5073	0.19	0.46	53.26	2.79	143.31	0.12	0.12
10/18/00	Baseline	5579	0.10	45.90	4.46	0.73	116.65	0.09	0.10
11/2/00	Baseline	1879	0.03	0.00	0.19	0.24	33.45	0.03	0.03
11/27/00	Event	7634	0.08	1.83	3.82	0.19	177.19	0.07	0.07
12/17/00	Event	148230	31.13	314.25	15979.20	38.54	2960.15	8.72	22.56
Baseline	Mean	2877	0.05	15.30	2.22	0.47	57.10	0.04	0.05
Baseline	Maximum	5579	0.10	45.90	4.46	0.73	116.65	0.09	0.10
Event	Mean	53646	10.47	105.51	5345.43	13.84	1093.55	2.97	7.58
Event	Maximum	148230	31.13	314.25	15979.20	38.54	2960.15	8.72	22.56

Table 3 (continued). Loss of soil and nutrients from selected subwatersheds of Conesus Lake during the fall of 2000. TP = total phosphorus, SRP = soluble reactive phosphorus, TKN = total Kjeldahl nitrogen, TSS = total suspended solids (soils), TDP=total dissolved phosphorus.

Densmore Creek									
Date		Discharge m^3/day	TP (kg/day)	Nitrate (kg/day)	TSS (kg/day)	TKN (kg/day)	Sodium (kg/day)	SRP (kg/day)	TDP (kg/day)
10/5/00	Baseline	1820	0.03	0.14	5.10	0.29	160.16	0.01	0.02
10/6/00	Event	15530	0.53	2.89	35.72	11.18	1400.15	0.49	0.49
10/18/00	Baseline	6025	0.09	0.06	2.41	1.63	468.63	0.06	0.07
11/2/00	Baseline	1263	0.01	0.31	0.13	0.14	96.64	0.01	0.01
11/27/00	Event	8544	0.10	0.26	0.00	1.20	680.30	0.09	0.09
12/17/00	Event	41224	3.34	40.81	676.08	14.84	2778.12	1.44	1.45
Baseline	Mean	3036	0.04	0.17	2.54	0.69	241.81	0.03	0.04
Baseline	Maximum	6025	0.09	0.31	5.10	1.63	468.63	0.06	0.07
Event	Mean	21766	1.32	14.65	237.27	9.07	1619.53	0.67	0.68
Event	Maximum	41224	3.34	40.81	676.08	14.84	2778.12	1.44	1.45

Table 4. Total coliform (TC) and Escherichia coli (EC) abundance from selected streams of Conesus Lake during the autumn of 2000. All values are in CFU/100ml. CFU=Colony Forming Units. #5989=Rivulet at house #5989. Cotton=Cottonwood Gully, Den=Densmore Creek, Hanna=Hanna's Creek, Gray=Graywood Gully, Long=Long Point Gully, No=No Name Creek, North=North Gully, Sand=Sand Point Gully, Sutton=Sutton Point rivulet.

	10/06	**Event**	**10/18**	**Base**	**11/02**	**Base**	**11/27**	**Event**	**12/17**	**Event**
	TC	E C	TC	EC	TC	EC	TC	EC	TC	EC
#5989	>8,482	3,579	1,700	23	>16,000	23	2,200	50	>16,000	500
Cotton	>8,482	1,032	9,000	500	2,800	4	9,000	300	>16,000	700
Den	>8,482	2,196	16,000	500	1,100	110	3,500	900	>16,000	1,100
Gray	>8,482	>8,482	5,000	300	3,500	170	>16,000	2,200	>16,000	>16,000
Hanna	>8,482	>8,482	>16,000	300	5,000	30	>16,000	1,600	>16,000	2,200
Long	>8,482	>8,482	>16,000	130	dry	dry	>16,000	600	>16,000	9,000
No	>8,482	2,555	>16,000	500	dry	dry	>16,000	230	>16,000	9,000
North	>8,482	868	16,000	800	5,000	8	5,000	300	>16,000	1,300
Sand	>8,482	2,196	16,000	130	9,000	2	>16,000	900	>16,000	3,000
Sutton	8,482	325	2,400	30	1,300	6	3,000	4	>16,000	300

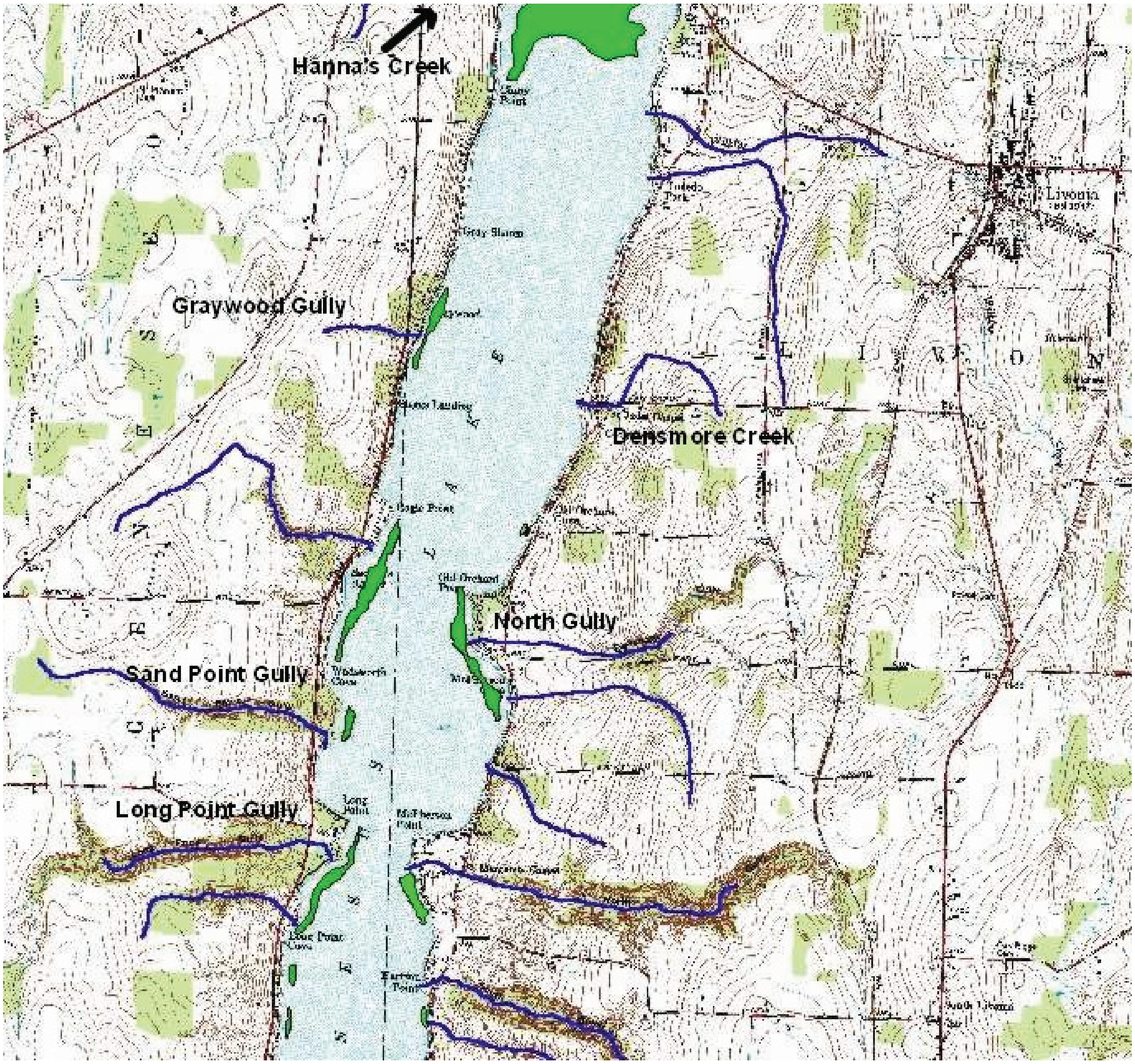

Figure 1. The location of macrophyte beds and streams on Conesus Lake, 2000.

Figure 2. Location of stream sampling sites during the autumn of 2000, Conesus Lake.

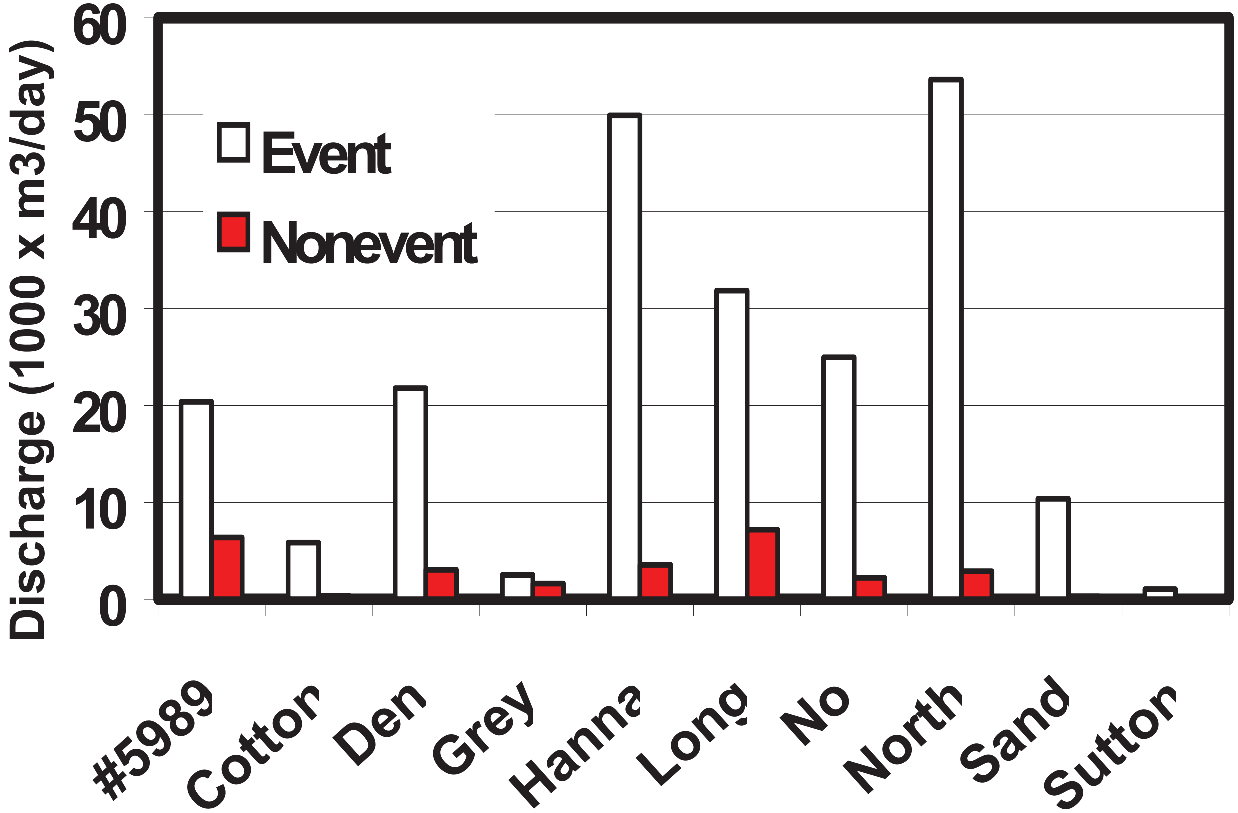

Figure 3. Event and non-event discharge from subwatersheds of Conesus Lake during the autumn of 2000. #5989=Rivulet at house #5989. Cotton=Cottonwood Gully, Den=Densmore Creek, Gray=Graywood Gully, Hanna=Hanna's Creek, Long=Long Point Gully, No=No Name Creek, Sand=Sand Point Gully, North=North Gully, Sutton=Rivulet at Sutton Point.

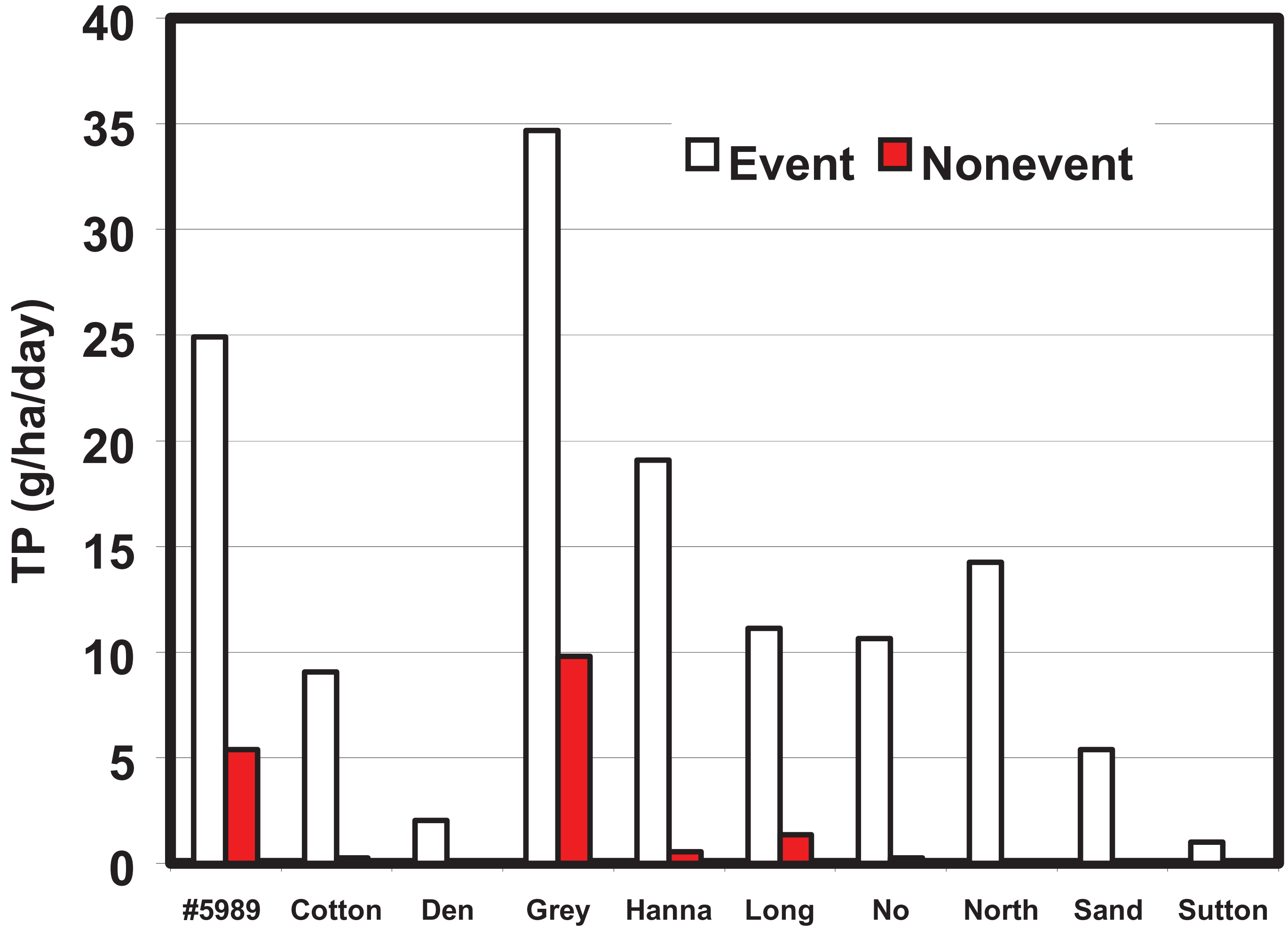

Figure 4. Event and non-event total phosphorus loss from subwatersheds of Conesus Lake during the autumn of 2000. #5989=Rivulet at house #5989. Cotton=Cottonwood Gully, Den=Densmore Creek, Gray=Graywood Gully, Hanna=Hanna's Creek, Long=Long Point Gully, No=No Name Creek, Sand=Sand Point Gully, North=North Gully, Sutton=Rivulet at Sutton Point.

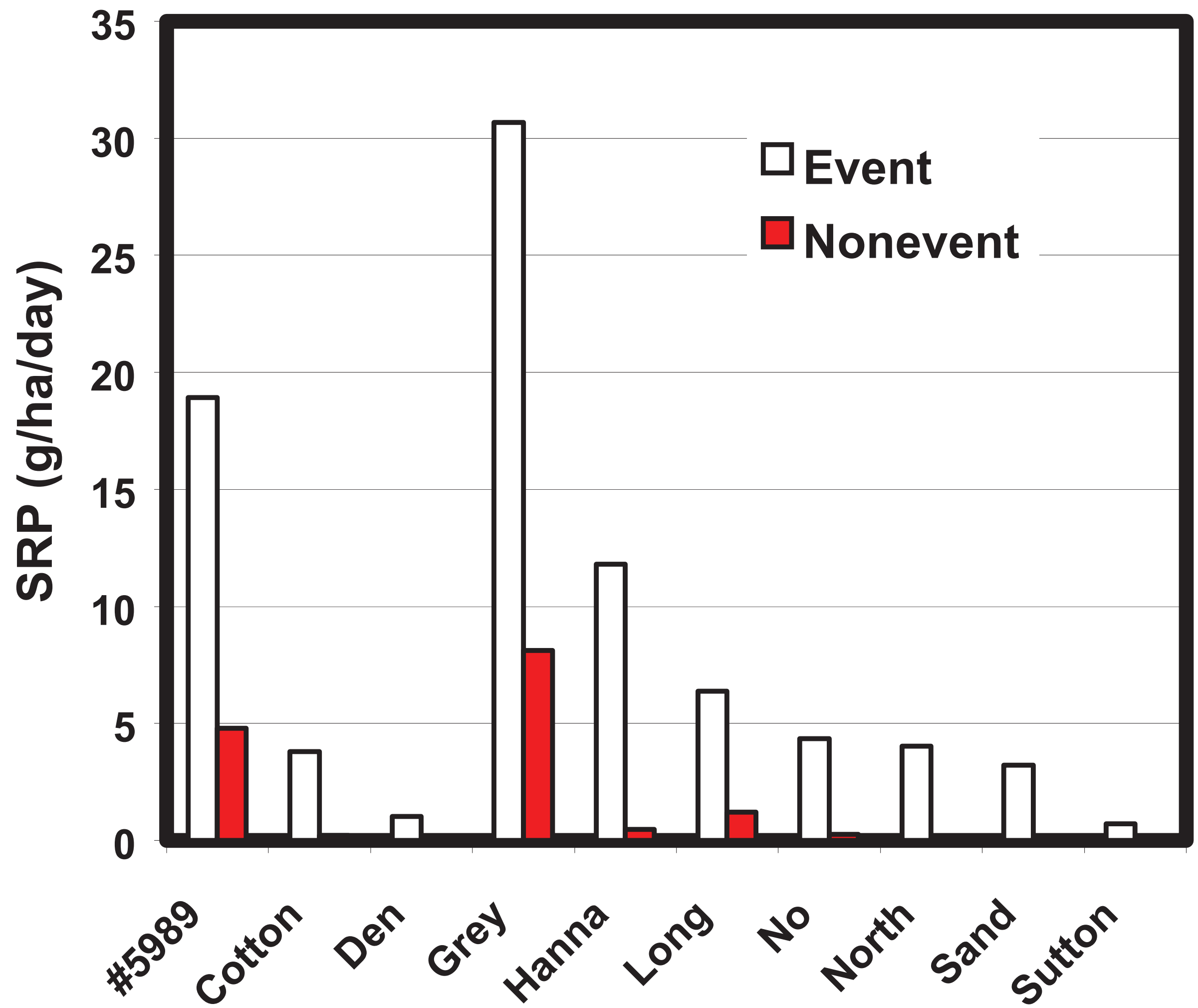

Figure 5. Event and non-event soluble reactive phosphorus loss from subwatersheds of Conesus Lake during the autumn of 2000. #5989=Rivulet at house #5989. Cotton=Cottonwood Gully, Den=Densmore Creek, Gray=Graywood Gully, Hanna=Hanna's Creek, Long=Long Point Gully, No=No Name Creek, Sand=Sand Point Gully, North=North Gully, Sutton=Rivulet at Sutton Point

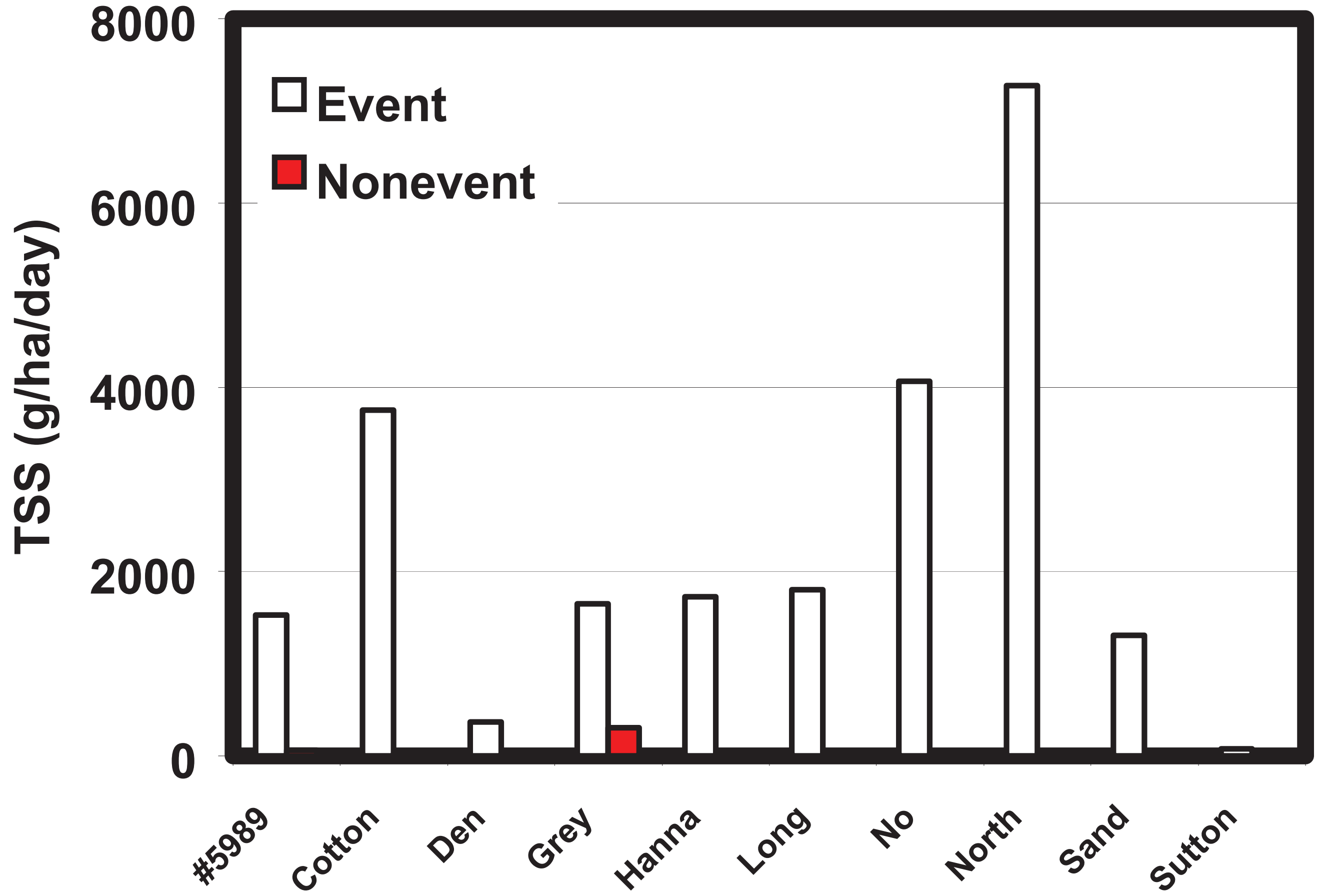

Figure 6. Event and non-event total suspended solids loss from subwatersheds of Conesus Lake during the autumn of 2000. #5989=Rivulet at house #5989. Cotton=Cottonwood Gully, Den=Densmore Creek, Gray=Graywood Gully, Hanna=Hanna's Creek, Long=Long Point Gully, No=No Name Creek, Sand=Sand Point Gully, North=North Gully, Sutton=Rivulet at Sutton Point.

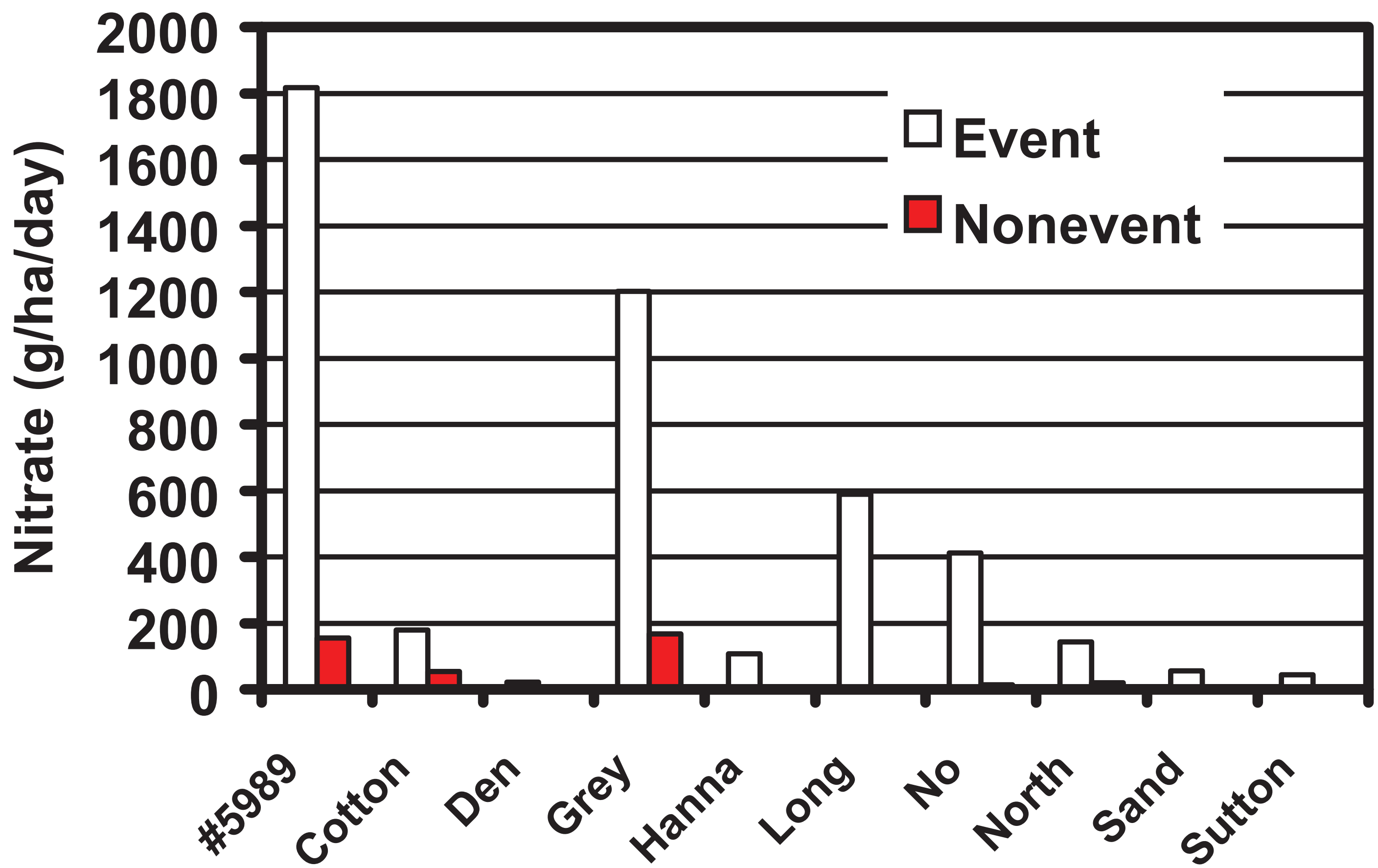

Figure 7. Event and non-event nitrate loss from subwatersheds of Conesus Lake during the autumn of 2000. #5989=Rivulet at house #5989. Cotton=Cottonwood Gully, Den=Densmore Creek, Gray=Graywood Gully, Hanna=Hanna's Creek, Long=Long Point Gully, No=No Name Creek, Sand=Sand Point Gully, North=North Gully, Sutton=Rivulet at Sutton Point.

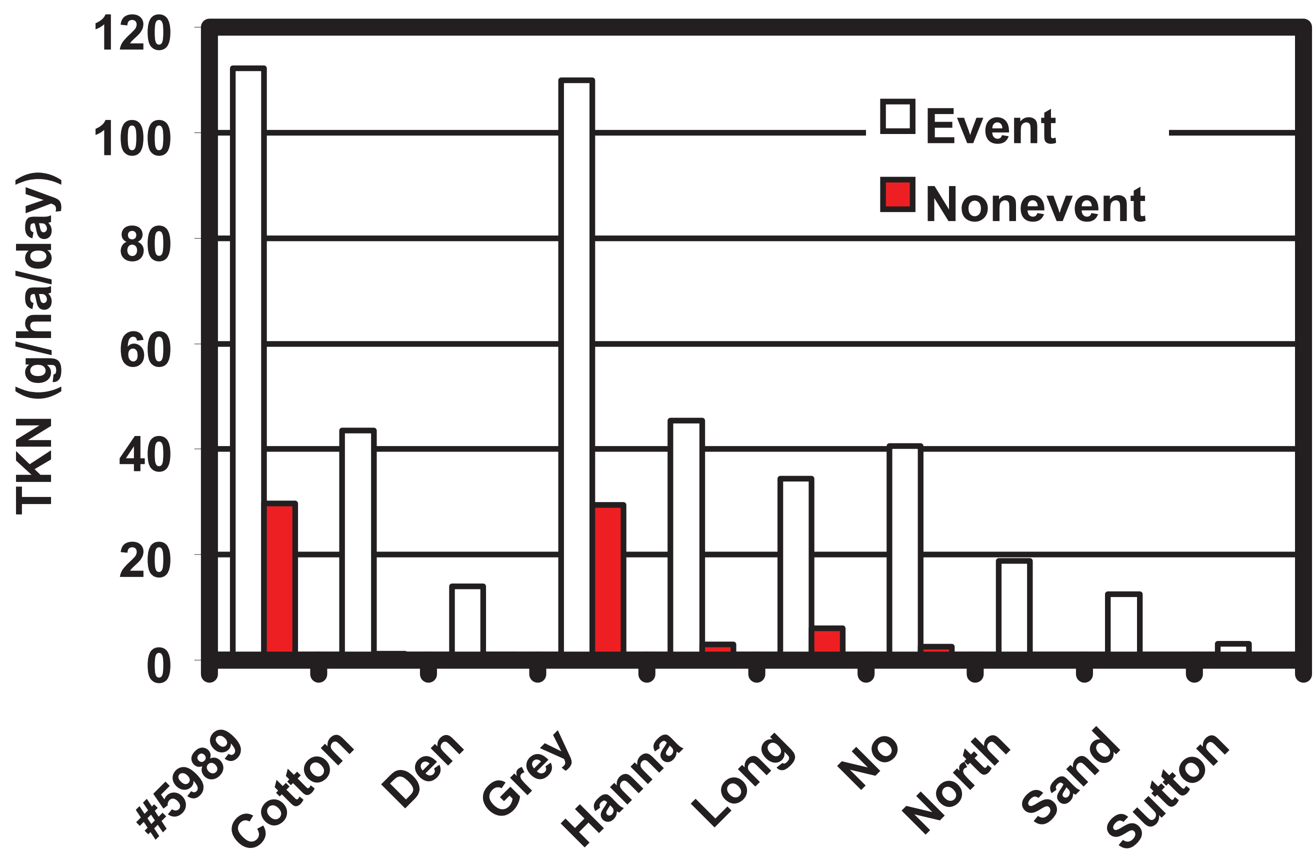

Figure 8. Event and non-event total Kjeldahl nitrogen loss from subwatersheds of Conesus Lake during the autumn of 2000. #5989=Rivulet at house #5989. Cotton=Cottonwood Gully, Den=Densmore Creek, Gray=Graywood Gully, Hanna=Hanna's Creek, Long=Long Point Gully, No=No Name Creek, Sand=Sand Point Gully, North=North Gully, Sutton=Rivulet at Sutton Point.

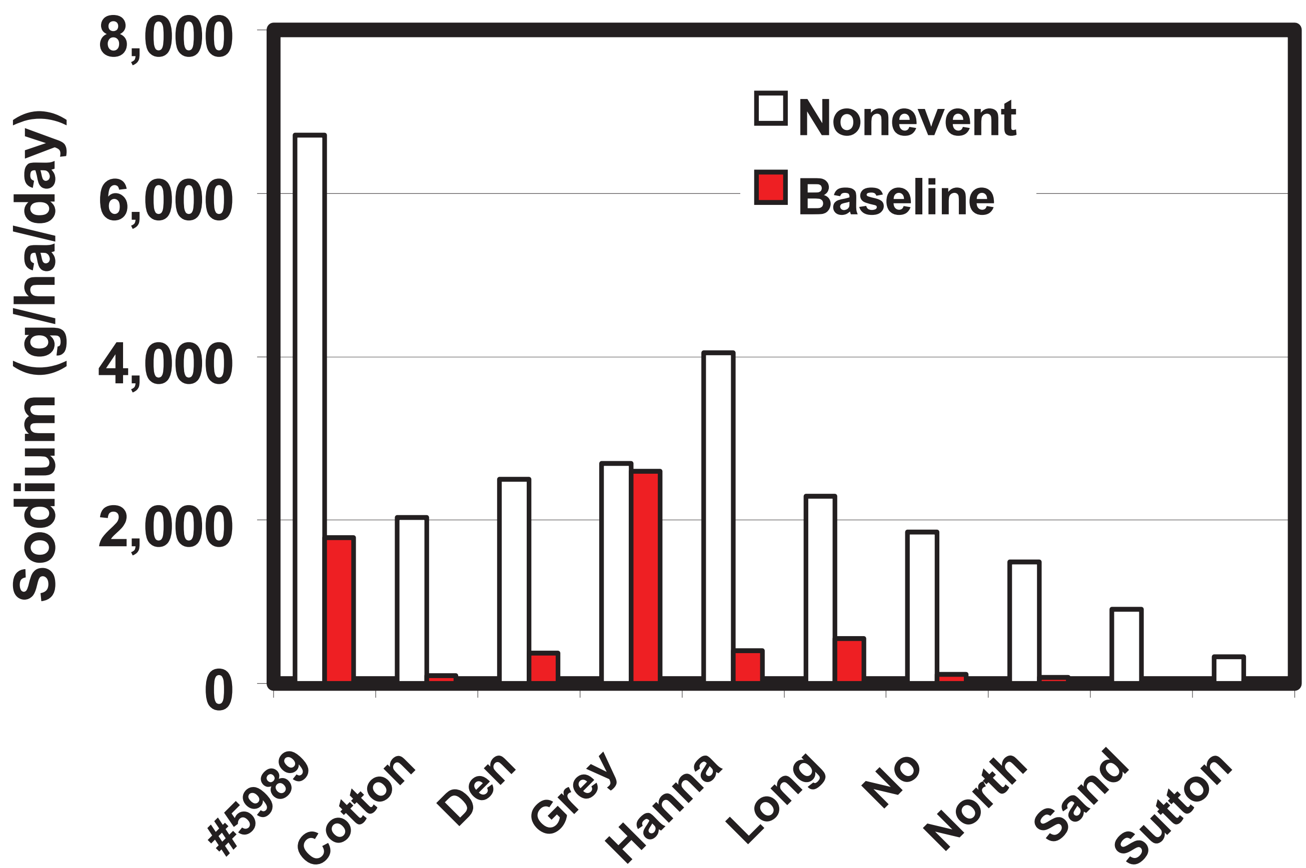

Figure 9. Event and non-event sodium from subwatersheds of Conesus Lake during the autumn of 2000. #5989=Rivulet at house #5989. Cotton=Cottonwood Gully, Den=Densmore Creek, Grey=Graywood Gully, Hanna=Hanna's Creek, Long=Long Point Gully, No=No Name Creek, Sand=Sand Point Gully, North=North Gully, Sutton=Rivulet at Sutton Point.