

Lake Wallenpaupack Watershed Assessment Project



March 2006

Submitted to:

Pennsylvania Growing Greener Grants Center

Submitted by:

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Executive Summary

Lake Wallenpaupack is a vital resource to the Pocono Mountains region of northeastern Pennsylvania. The lake is owned and used to generate hydroelectric power by PPL Corporation. Although the lake has been classified as borderline eutrophic in past years and experiences periodic blue-green algae blooms, it continues to be one of the major recreational resources in Pennsylvania.

The purpose of this project was to implement a water monitoring program for the Lake Wallenpaupack Watershed that includes both dry weather and wet weather stream monitoring. This project included the installation of automated sampling equipment, analysis of water samples, and the development of pollutant budgets. The result of this study is updated water and pollutant budget data for Lake Wallenpaupack. These data will be used for evaluating in-lake water quality treatment, setting priorities for Best Management Practices (BMPs), and evaluating the effectiveness of watershed management programs.

The wet weather averages were significantly higher than the dry weather averages for all three parameters (total phosphorus, total nitrogen, and total suspended solids) in all six streams. This indicates the need for better stormwater management within the Lake Wallenpaupack watershed.

As expected due to the sizes of the subwatersheds, the Main Stem and West Branch of Wallenpaupack Creek had the greatest nutrient and sediment loads during 2004 and 2005. The most striking result of this study was the extent to which nutrient and sediment loads increased at all six stations over the levels calculated during the 1982 study. This is probably due in large part to the fact that automated samplers were used during the 2004-2005 study allowing nearly continuous data collection. During the 1982 study, samplers had to be manually started during storm events, leading to many fewer storms being analyzed. One cannot, however, discount the possibility that significant development has occurred in the Lake Wallenpaupack watershed within the past 22 years, which has contributed to the increase in nutrient and sediment loading.

Regardless of the reason for the increases, it is clear that stormwater management measures are needed within the Lake Wallenpaupack watershed in order to reduce nutrient and sediment loads to the lake. Taking into account the unit areal loadings data, the biggest priority subwatersheds for implementing stormwater Best Management Practices (BMPs) are the Main Stem and West Branch of Wallenpaupack Creek, as well as Ariel Creek. In addition, Mill Brook should be targeted for BMPs that reduce total suspended solids concentrations.

Stormwater BMPs that are designed to reduce peak flow velocities and infiltrate stormwater into the ground rather than storing and releasing stormwater to surface waters should be implemented wherever possible in the targeted subwatersheds. These BMPs include but are not limited to: bioretention systems, infiltration trenches, green roofs, grassed swales, buffer strips, constructed wetlands, and extended detention basins.

1.0 Introduction

The Lake Wallenpaupack watershed covers 219 square miles and includes portions of four counties and 14 townships. In 1979, the Lake Wallenpaupack Watershed Management District (LWWMD) was formed to preserve and protect the water quality of Lake Wallenpaupack. The Lake Wallenpaupack Watershed Management Plan was prepared in 1982 to outline specific recommendations for furthering the LWWMDs mission. In preparing the 1982 Lake Wallenpaupack Watershed Management Plan, a comprehensive dry weather and wet weather stream sampling program was conducted, and one of the recommendations of the Management Plan was to continue to monitor Lake Wallenpaupack and its tributaries. Since 1982, the lake has been monitored each year by the Lake Wallenpaupack Watershed Management District using funds provided by PPL Utilities, but stream monitoring has been extremely limited.

Over the past 20 years a significant amount of development has occurred in the watershed, and nonpoint source pollutant loads have most likely increased. The Watershed Management Plan is currently being updated. Wet weather sampling to quantify nonpoint source pollution loads will help to address nonpoint source pollution management in the updated management plan.

Funding from the Pennsylvania Department of Environmental Protection (DEP) Growing Greener Grant Program and from an existing EPA grant helped to fund this detailed stream water quality monitoring program. The result of this study is updated water and pollutant budget data for Lake Wallenpaupack. These data will be used for evaluating in-lake water quality treatment, setting priorities for Best Management Practices (BMPs), and evaluating the effectiveness of watershed management programs.

2.0 Methodology

2.1 Monitoring Equipment

For this study, the Lake Wallenpaupack Watershed Management District purchased six state-of-the-art automated water level recorders (ISCO Model 720 Submerged Probe Flow Logger) and automated samplers (ISCO Model 6712). The automated monitoring stations were installed on the six major streams entering Lake Wallenpaupack, including:

- Ariel Creek
- Diamond Run
- Mill Brook
- Purdy Creek
- Main Stem Wallenpaupack Creek
- West Branch Wallenpaupack Creek

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The locations of the monitoring stations are shown in Figure 1. The sites were selected based on a number of factors including ease of access, proximity to historic water quality monitoring sites, and watershed coverage.

The automated monitoring equipment was installed in permanent housing structures to protect against weather and vandalism. The equipment was directly connected to phone service and solar panels with backup batteries. This allowed instantaneous remote viewing of stream levels and flow and remote operation (starting and stopping) of the samplers. The LWWMD worked with PPL Utilities to establish power and phone service the stations.

2.2 Monitoring Methods

A Quality Assurance/Quality Control Plan was prepared and approved by the PA DEP prior to sampling. LWWMD administered and managed this project as well as assisting with the required field work. F. X. Browne, Inc. installed the automated water samplers, developed rating curves, coordinated the field work and operation and maintenance of the monitoring stations, provided laboratory services, and developed pollutant budgets from field data for the final report. F. X. Browne, Inc. and LWWMD personnel maintained the water samplers and flow meters. The stations were checked on a weekly basis to ensure that no physical damage occurred to the station, and to remove debris from around the staff gage and the metering probe.



Sampling Station at Mill Brook

The automated stream level recorders were calibrated to stream depth at installation and set to record stream water level continuously at 15 to 30 minute intervals. The stations were also programmed to collect flow-proportioned water samples during storm events. A total of 12 dry weather samples were collected at each sampling location, and wet samples were collected during 11 rain events. Wet weather samples were analyzed for total phosphorus, total Kjeldahl nitrogen, ammonia nitrogen, nitrate/nitrite nitrogen, and total suspended solids. Dry weather samples were analyzed for the above parameters, plus dissolved reactive phosphorus, pH, alkalinity, and conductivity.

During dry weather events, stream samples were collected manually. The automated samplers collected samples during wet weather events. Staff gauges were installed at each monitoring location. Stream flow was measured manually under varying flow regimes throughout the study period to develop rating curves. Once a rating curve was established, the samplers were programmed to collect a flow-weighted composite sample.

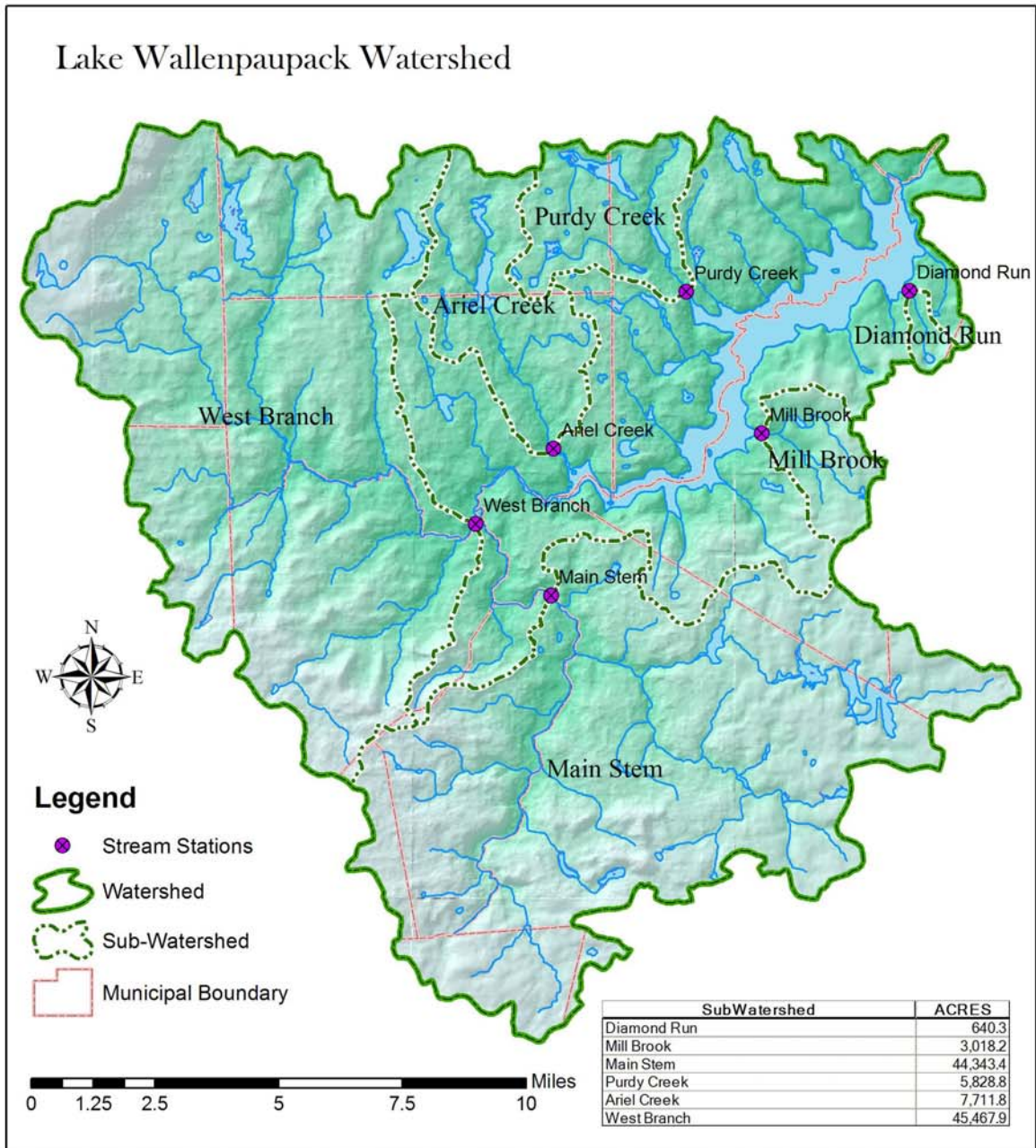


Figure 1 Lake Wallenpaupack Watershed Monitoring Stations and Subwatersheds

Data source: USGS Digital Elevation Models; US Census Bureau Tiger Files

2.3 Data Analysis

Data were downloaded continuously from the flow meters and managed in spreadsheet form to develop an accurate and long-term record of stream depths. Continuous flow measurements were calculated based on the rating curves that were developed for each station. These rating curves were used to convert continuous level recorder values to continuous flow values. The rating curves are provided in Appendix A.

The data gathered from the stream stations, together with available USGS hydrologic and NCDC climatological data, were used to prepare pollutant budgets for the major subwatersheds in the Lake Wallenpaupack watershed. Calculated pollutant loadings were compared to historical levels from the 1982 Diagnostic-Feasibility Study. Land use impacts and Unit Area Loadings developed in 1982 were reviewed in light of the new pollutant budgets.



Diamond Run

3.0 Water Quality Results

Dry weather stream samples were collected monthly from April 2004 through March 2005. Average dry weather pollutant concentrations are provided in Table 1. Monthly water quality data collected at each of the six sampling stations are provided in Appendix B. Average dry weather pollutant concentrations were used to calculate baseflow pollutant loads from each of the 6 subwatersheds.

**Table 1
Average Dry Weather Pollutant Concentrations**

Station	April 2004 - March 2005		
	Average Concentrations in mg/L		
	Total Phosphorus	Total Nitrogen	Total Suspended Solids
Purdy Creek	0.032	0.50	2.7
Ariel Creek	0.055	0.82	3.1
Mill Brook	0.019	0.21	2.5
Diamond Run	0.028	0.34	2.1
West Branch	0.037	0.53	7.6
Main Stem	0.016	0.45	2.5

As shown in Table 1, the highest baseflow total phosphorus and total nitrogen concentrations occurred in Ariel Creek. However, the highest total suspended solids concentrations occurred in the West Branch of Wallenpaupack Creek.

Wet weather stream samples were collected during 11 separate rain events. Average wet weather pollutant concentrations were used to calculate wet weather pollutants loads from each subwatershed and are provided in Table 2. Water quality data for each rain event are provided in Appendix B for each sampling stations.

**Table 2
Average Wet Weather Pollutant Concentrations**

Station	August 2004 - November 2005		
	Average Concentrations in mg/L		
	Total Phosphorus	Total Nitrogen	Total Suspended Solids
Purdy Creek	0.246	1.51	44
Ariel Creek	0.166	1.47	64.5
Mill Brook	0.158	0.73	89.7
Diamond Run	0.117	0.92	36.7
West Branch	0.139	0.91	67.5
Main Stem	0.397	1.80	186.5

As shown in Table 2, the highest stormflow total phosphorus, total nitrogen, and total suspended solids concentrations occurred in the Main Stem of Wallenpaupack Creek. The wet weather averages were significantly higher than the dry weather averages for all three parameters in all six streams. This indicates the need for better stormwater management within the Lake Wallenpaupack watershed.

4.0 Pollutant Budgets

Pollutant loads to Lake Wallenpaupack via the six major tributaries were determined by calculating the total loadings from the automatic sampler data for each subwatershed, as described in Section 2.3. Tables 3-5 show the annual total phosphorus, total nitrogen, and total suspended solids loads for each subwatershed, respectively. Each table compares the pollutant loads listed in the 1982 Lake Wallenpaupack Watershed Management Plan with the pollutant loads for 2004 and 2005 determined during this study.

**Table 3
Annual Total Phosphorus Loads**

Station	1982	2004		2005	
	(lbs/yr)	(lbs/yr)	(percent)	(lbs/yr)	(percent)
Ariel Creek	1,825	5,613	5	8,078	6
Diamond Run	N/A	752	1	386	0
Mill Brook	445	1,449	1	3,059	2
Purdy Creek	1,090	4,045	3	3,828	3
Main Stem WC	7,685	69,802	58	57,495	45
West Branch WC	11,385	39,393	33	55,152	43
Total	22,430	121,054	100	127,998	100

**Table 4
Annual Total Nitrogen Loads**

Station	1982	2004		2005	
	(lbs/yr)	(lbs/yr)	(percent)	(lbs/yr)	(percent)
Ariel Creek	38,970	58,578	6	88,130	8
Diamond Run	N/A	3,351	0	3,408	0
Mill Brook	11,380	8,699	1	15,239	1
Purdy Creek	22,510	31,550	3	28,840	3
Main Stem WC	196,770	522,363	54	425,192	39
West Branch WC	202,760	343,768	36	529,551	49
Total	472,390	968,309	100	1,090,360	100

**Table 5
Annual Total Suspended Solids Loads**

Station	1982	2004		2005	
	(lbs/yr)	(lbs/yr)	(percent)	(lbs/yr)	(percent)
Ariel Creek	344,000	1,694,109	5	2,228,088	6
Diamond Run	N/A	100,034	0	100,400	0
Mill Brook	169,000	686,488	2	1,661,975	5
Purdy Creek	213,000	656,678	2	631,559	2
Main Stem WC	1,781,000	13,233,398	41	9,563,880	27
West Branch WC	4,372,000	16,035,690	49	20,712,286	59
Total	6,879,000	32,406,397	100	34,898,188	100

Unit areal loadings (in pounds per acre per year) were calculated for each of the major subwatersheds in the Lake Wallenpaupack watershed. The unit areal loadings were based on subwatershed acreages measured using GIS analysis. Tables 6-8 show the unit areal loadings

for each subwatershed for total phosphorus, total nitrogen, and total suspended solids, respectively. Each table compares the unit areal loadings listed in the 1982 Lake Wallenpaupack Watershed Management Plan with the loadings calculated for 2004 and 2005 during this study.

**Table 6
Unit Areal Subbasin Loadings for Total Phosphorus**

Station	1982	2004	2005
	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)
Ariel Creek	0.18	0.73	1.05
Diamond Run	N/A	1.17	0.60
Mill Brook	0.15	0.48	1.01
Purdy Creek	0.19	0.69	0.66
Main Stem WC	0.16	1.57	1.30
West Branch WC	0.26	0.87	1.21

**Table 7
Unit Areal Subbasin Loadings for Total Nitrogen**

Station	1982	2004	2005
	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)
Ariel Creek	3.9	7.6	11.4
Diamond Run	N/A	5.2	5.3
Mill Brook	3.8	2.9	5.0
Purdy Creek	3.9	5.4	4.9
Main Stem WC	4.1	11.8	9.6
West Branch WC	4.7	7.6	11.6

**Table 8
Unit Areal Subbasin Loadings for Total Suspended Solids**

Station	1982	2004	2005
	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)
Ariel Creek	35	220	289
Diamond Run	N/A	156	157
Mill Brook	56	227	551
Purdy Creek	37	113	108
Main Stem WC	37	298	216
West Branch WC	101	353	456

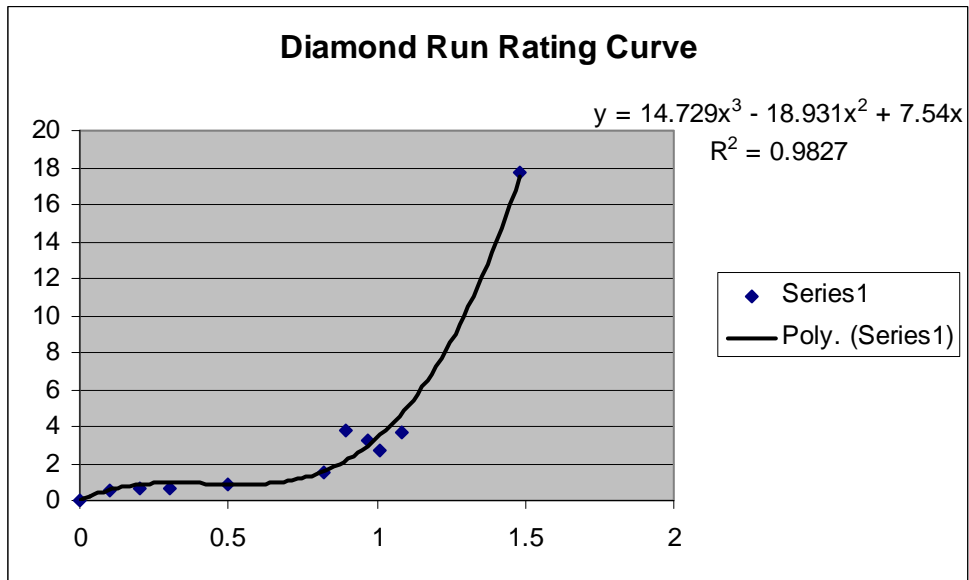
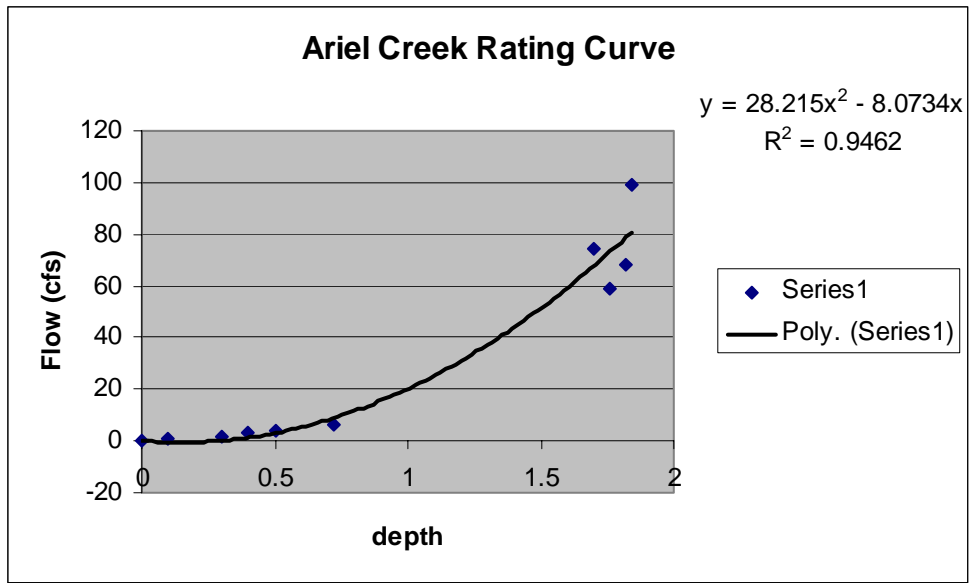
5.0 Recommendations and Conclusions

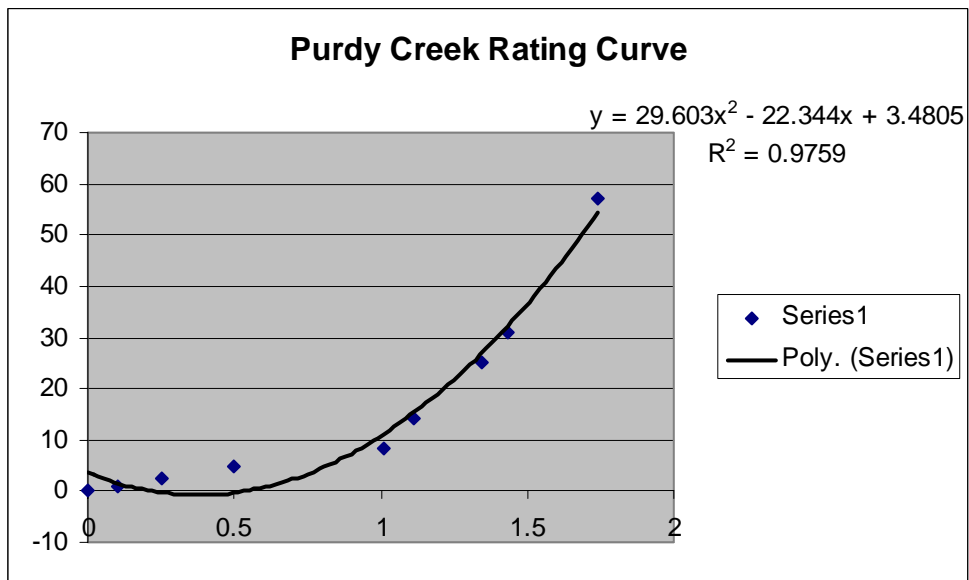
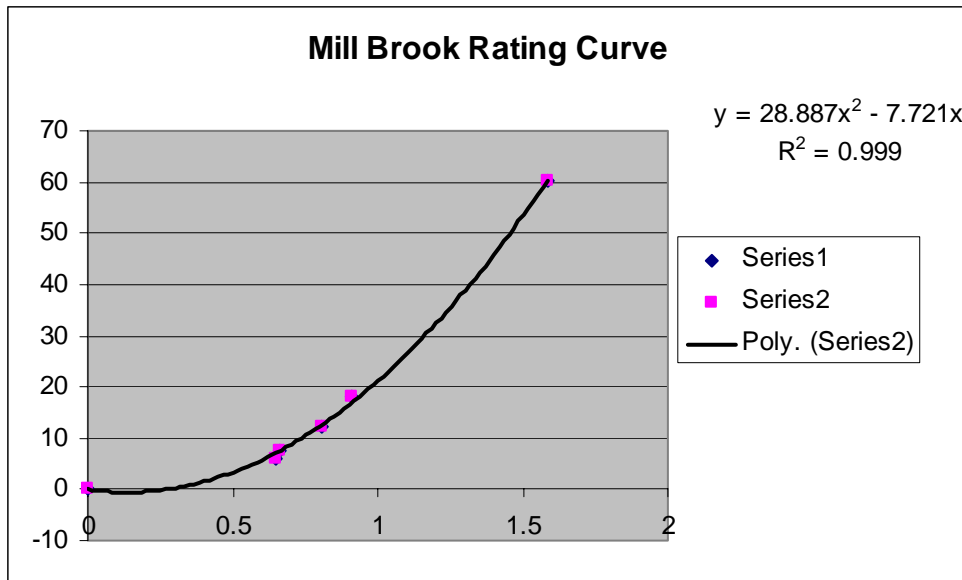
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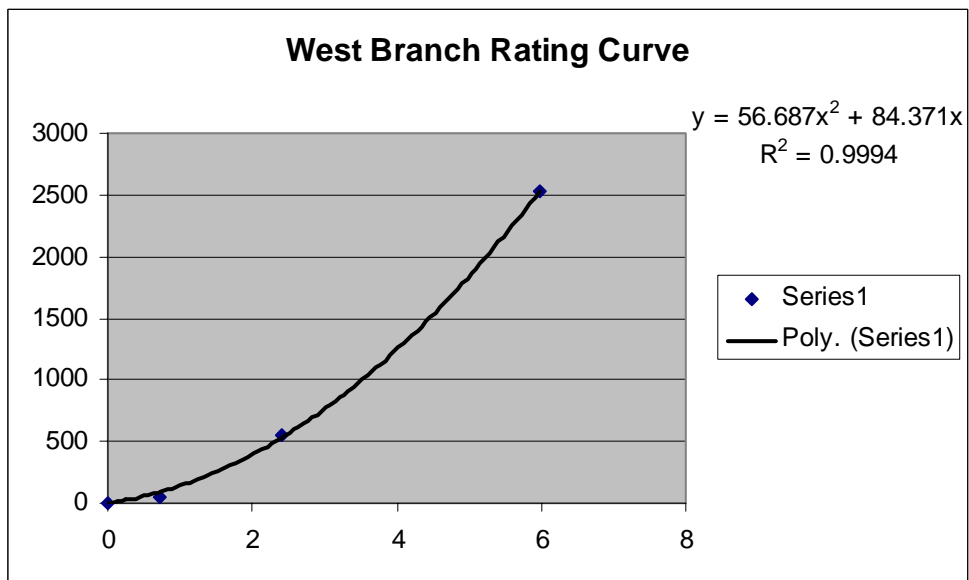
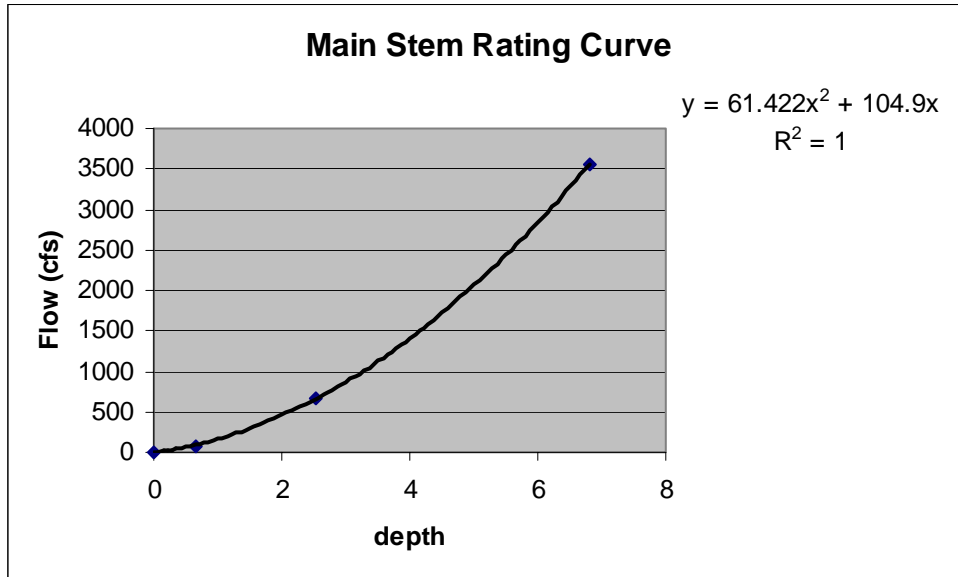
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Appendix A
Stream Station Rating Curves







Appendix B

Wet and Dry Weather Water Quality Data

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Ariel Creek Dry Weather and Wet Weather Stream Water Quality Data Lake Wallenpaupack Watershed Assessment Project

Dry Weather Stream Data		Specific								
Date	pH (s.u.)	Alkalinity	Conductance	TP	DRP	TKN	NH ₃ -N	NO ₃ /NO ₂ -N	TSS	
	(s.u.)	(mg/L as CaCO ₃)	(umhos/cm)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	
4/29/2004	7.0	18	131	0.048	0.018	0.41	< 0.10	0.17	6.8	
5/12/2004	7.1	22	125	0.056		0.35	< 0.10	0.11	8.0	
6/7/2004	7.1	26	137	0.079	0.042	0.43	< 0.10	0.52	4.4	
7/7/2004	7.4	34	148	0.064		0.34	< 0.10	0.45	1.2	
8/4/2004	7.2	36	180	0.086	0.041	0.50	0.11	0.58	3.2	
9/8/2004	7.3	38	168	0.069		0.35	< 0.10	0.69	1.2	
10/6/2004	7.2	24	106	0.044	0.023	0.37	< 0.10	0.30	1.6	
11/2/2004	7.2	24	107	0.043		0.64	< 0.10	0.40	< 1.0	
12/14/2004	6.9	22	96	0.045	0.012	0.39	< 0.10	0.18	1.2	
1/3/2005	6.9	22	107	0.036		0.50	0.11	0.40	4.4	
2/2/2005	6.9	22	119	0.049	0.024	0.37	< 0.10	0.64	3.5	
3/2/2005	7.0	24	122	0.035		0.26	< 0.10	0.46	< 1.0	
Mean	7.1	26	129	0.055	0.027	0.41	0.10	0.41	3.1	
Min	6.9	18	96	0.035	0.012	0.26	0.10	0.11	1.0	
Max	7.4	38	180	0.086	0.042	0.64	0.11	0.69	8.0	

Wet Weather Stream Data		Specific								
Date	pH (s.u.)	Alkalinity	Conductance	TP	DRP	TKN	NH ₃ -N	NO ₃ /NO ₂ -N	TSS	
	(s.u.)	(mg/L as CaCO ₃)	(umhos/cm)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	
8/12-14/04				0.161		0.95	< 0.10	0.20	38.0	
9/9-12/04		30	136	0.124		1.20	0.14	0.34	17.0	
9/18-19/04	6.8	12	54	0.330		1.60	< 0.10	0.18	140.0	
12/23-24/04	7.0	12	75	0.220		1.40	< 0.10	0.30	77.0	
2/16-17/05	7.0	16	107	0.056	0.015	0.98	< 0.10	0.49	28.5	
3/27-29/05	6.6	14	85	0.220	0.010	0.84	< 0.10	0.26	104.0	
4/2-3/05	6.8	14	71	0.230		0.89	< 0.10	0.15	140.0	
4/23-24/05	7.0	20	94	0.250	0.013	1.40	< 0.10	0.56	110.0	
10/8-10/10	7.4	40	213	0.059	0.018	0.90	0.10	0.64	17.3	
11/15-11/18/05	7.2	30	121	0.069	0.014	0.91	< 0.10	0.49	7.6	
11/29-11/30/05	6.6	14	76	0.112	0.011	1.13	< 0.10	0.34	30.0	
Mean	6.9	20	103	0.166	0.014	1.11	0.10	0.36	64.5	
Min	6.6	12	54	0.056	0.010	0.84	0.10	0.15	7.6	
Max	7.4	40	213	0.330	0.018	1.60	0.14	0.64	140.0	

TP = Total Phosphorus
 DRP = Dissolved Reactive Phosphorus
 TKN = Total Kjeldahl Nitrogen
 NH₃-N = Ammonia Nitrogen
 NO₃/NO₂-N = Nitrate/Nitrite Nitrogen
 TSS = Total Suspended Solids

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Diamond Run Dry Weather and Wet Weather Stream Water Quality Data Lake Wallenpaupack Watershed Assessment Project

Dry Weather Stream Data										
Date	pH (s.u.)	Alkalinity	Specific	TP	DRP	TKN	NH ₃ -N	NO ₃ /NO ₂ -N	TSS	
	(s.u.)	(mg/L as CaCO ₃)	Conductance	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
			(umhos/cm)							
4/29/2004	7.0	18	131	0.048	0.018	0.41	< 0.1	0.17		6.8
5/12/2004	6.5	10	63.3	0.026		0.17	< 0.1	0.02		2.8
6/7/2004	7.1	12	74.0	0.030	0.013	0.26	< 0.1	0.08		2.4
7/7/2004	6.7	14	105	0.040		0.33	< 0.1	0.20	<	1.0
8/4/2004	6.8	12	78.2	0.051	0.018	0.45	< 0.1	0.04		2.0
9/8/2004	6.9	12	85.0	0.025		0.27	< 0.1	0.05	<	1.0
10/6/2004	6.8	10	64.8	0.024	0.009	0.34	< 0.1	0.05		2.0
11/2/2004	7.2	12	73.7	0.035		0.20	< 0.1	< 0.01		1.6
12/14/2004	6.3	8	60.2	0.016	0.006	0.22	< 0.1	0.03	<	1.0
1/3/2005	6.6	10	61.7	0.014		0.21	< 0.1	0.07		2.0
2/2/2005	6.3	10	69.2	0.016	0.007	0.20	< 0.1	0.11		1.5
3/2/2005	6.4	10	68.8	0.016		0.14	< 0.1	0.10		1.2
Mean	6.7	12	78	0.028	0.012	0.27	0.10	0.08		2.1
Min	6.3	8	60	0.014	0.006	0.14	0.10	0.01		1.0
Max	7.2	18	131	0.051	0.018	0.45	0.10	0.20		6.8

Wet Weather Stream Data										
Date	pH (s.u.)	Alkalinity	Specific	TP	DRP	TKN	NH ₃ -N	NO ₃ /NO ₂ -N	TSS	
	(s.u.)	(mg/L as CaCO ₃)	Conductance	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
			(umhos/cm)							
8/12-13/04				0.22		1.2	< 0.1	0.02		68
9/8-10/04		10	64.5	0.076		0.86	0.11	< 0.01		14
9/18-19/04	5.6	6	29.8	0.2		1.07	< 0.1	0.02		64
12/23-24/04	6.3	6	49.6	0.062		0.54	< 0.1	0.05		18
3/27-30/05	6.2	8	42.4	0.051	0.008	0.37	< 0.1	0.05		17
4/2/2005	6.2	4	33.6	0.126		0.67	< 0.1	0.03		63
4/23-24/05	6.6	12	61.8	0.053	0.010	0.67	< 0.1	0.16		20
10/8-10/10	6.6	10	85.1	0.268	0.007	1.76	< 0.1	0.08		88
11/15-11/18/05	7.1	12	60.3	0.052	0.006	0.82	< 0.1	0.02	<	1
11/29-11/30/05	5.9	14	45.1	0.064	0.005	0.72	< 0.1	0.04		14
Mean	6.3	9	52	0.117	0.007	0.87	0.10	0.05		36.7
Min	5.6	4	30	0.051	0.005	0.37	0.10	0.01		1.0
Max	7.1	14	85	0.268	0.010	1.76	0.11	0.16		88.0

TP = Total Phosphorus
 DRP = Dissolved Reactive Phosphorus
 TKN = Total Kjeldahl Nitrogen
 NH₃-N = Ammonia Nitrogen
 NO₃/NO₂-N = Nitrate/Nitrite Nitrogen
 TSS = Total Suspended Solids

F. X. Browne, Inc.

Main Branch Wallenpaupack Creek Dry Weather and Wet Weather Stream Water Quality Data Lake Wallenpaupack Watershed Assessment Project

Dry Weather Stream Data		Specific								
Date	pH (s.u.)	Alkalinity	Conductance	TP	DRP	TKN	NH ₃ -N	NO ₃ /NO ₂ -N	TSS	
	(s.u.)	(mg/L as CaCO ₃)	(umhos/cm)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
4/29/2004	7.1	10	71.6	0.011	0.002	0.32	< 0.1	0.13		4.4
5/12/2004	6.8	12	65.9	0.028		0.31	< 0.1	0.12		5.5
6/7/2004	6.8	14	75.1	0.021	0.008	0.19	< 0.1	0.23	<	1.0
7/7/2004	7.4	18	95.9	0.014		0.17	< 0.1	0.27	<	1.0
8/4/2004	7.0	14	75.6	0.024	0.006	0.26	< 0.1	0.14		2.0
9/8/2004	6.9	16	78.0	0.011		0.22	< 0.1	0.25		3.2
10/6/2004	6.9	14	62.5	0.015	0.006	0.18	< 0.1	0.20		2.8
11/2/2004	7.1	14	69.7	0.012		0.23	< 0.1	0.19	<	1.0
12/14/2004	6.5	12	56.0	0.014	0.005	0.18	< 0.1	0.24		1.6
1/3/2005	6.6	12	58.6	0.012		0.20	< 0.1	0.28		4.8
2/2/2005	6.6	12	68.5	0.018	0.006	0.28	< 0.1	0.36		2.0
3/2/2005	6.6	12	71.3	0.010		0.11	< 0.1	0.33	<	1.0
Mean	6.9	13	71	0.016	0.006	0.22	0.10	0.23		2.5
Min	6.5	10	56	0.010	0.002	0.11	0.10	0.12		1.0
Max	7.4	18	96	0.028	0.008	0.32	0.10	0.36		5.5

Wet Weather Stream Data		Specific								
Date	pH (s.u.)	Alkalinity	Conductance	TP	DRP	TKN	NH ₃ -N	NO ₃ /NO ₂ -N	TSS	
	(s.u.)	(mg/L as CaCO ₃)	(umhos/cm)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
8/12/2004				0.93		2.9	< 0.1	0.23		370
9/9-11/04		10	54.8	0.035		0.56	< 0.1	0.06		13
12/23-24/04	6.7	8	54.5	0.121		0.61	< 0.1	0.27		71
2/16-17/05	6.7	14	84.2	0.114	0.011	0.61	< 0.1	0.27		42
3/28-30/05	6.6	12	87.5	0.113	0.005	0.49	< 0.1	0.26		57
4/2-4/05	6.5	8	39.1	1.1		2.8	< 0.1	0.22		570
4/23-24/05	6.7	12	72.1	0.95	0.049	1.1	< 0.1	0.14		430
10/8-10/10	6.6	14	88.6	0.113	0.003	1.27	0.28	0.16		49
11/15-11/18/05	6.9	18	76.3	0.202	0.007	1.68	0.68	0.21		114
11/29-11/30/05	6.8	18	74.6	0.291	0.021	3.95	2.6	0.18		149
Mean	6.7	13	70	0.397	0.016	1.60	0.43	0.20		186.5
Min	6.5	8	39	0.035	0.003	0.49	0.10	0.06		13.0
Max	6.9	18	89	1.100	0.049	3.95	2.60	0.27		570.0

TP = Total Phosphorus
 DRP = Dissolved Reactive Phosphorus
 TKN = Total Kjeldahl Nitrogen
 NH₃-N = Ammonia Nitrogen
 NO₃/NO₂-N = Nitrate/Nitrite Nitrogen
 TSS = Total Suspended Solids

F. X. Browne, Inc.

Purdy Creek Dry Weather and Wet Weather Stream Water Quality Data Lake Wallenpaupack Watershed Assessment Project

Dry Weather Stream Data		Specific								
Date	pH (s.u.)	Alkalinity	Conductance	TP	DRP	TKN	NH ₃ -N	NO ₃ /NO ₂ -N	TSS	
	(s.u.)	(mg/L as CaCO ₃)	(umhos/cm)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
4/29/2004	7.0	14	83	0.031	0.003	0.44	< 0.10	0.05		7.2
5/12/2004	6.9	16	81	0.034		0.28	< 0.10	0.04		4.8
6/7/2004	6.9	16	85	0.045	0.011	0.35	< 0.10	0.08		3.2
7/7/2004	7.0	26	108	0.047		0.31	< 0.10	0.37	<	1.0
8/4/2004	7.1	26	112	0.043	0.023	0.42	< 0.10	0.34	<	1.0
9/8/2004	7.1	26	112	0.046		0.32	< 0.10	0.41	<	1.0
10/6/2004	7.0	16	73	0.029	0.005	0.43	< 0.10	0.06		4.0
11/2/2004	7.2	16	73	0.026		0.22	< 0.10	0.06	<	1.0
12/14/2004	6.8	14	67	0.029	0.006	0.33	< 0.10	0.08		3.2
1/3/2005	6.6	12	71	0.021		0.39	< 0.10	0.12		3.6
2/2/2005	6.8	14	72	0.018	0.008	0.33	< 0.10	0.18	<	1.0
3/2/2005	6.8	16	79	0.018		0.20	< 0.10	0.23	<	1.0
Mean	6.9	18	85	0.032	0.009	0.34	0.10	0.17		2.7
Min	6.6	12	67	0.018	0.003	0.20	0.10	0.04		1.0
Max	7.2	26	112	0.047	0.023	0.44	0.10	0.41		7.2

Wet Weather Stream Data		Specific								
Date	pH (s.u.)	Alkalinity	Conductance	TP	DRP	TKN	NH ₃ -N	NO ₃ /NO ₂ -N	TSS	
	(s.u.)	(mg/L as CaCO ₃)	(umhos/cm)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
8/12-14/04				0.104		1.00	< 0.10	0.06		18.0
9/9-11/04		20	83	0.077		0.90	< 0.10	0.04		11.0
9/18/2004	6.7	12	55	0.250		1.20	< 0.10	0.18		73.0
12/23-24/04	6.9	12	63	0.095		0.78	< 0.10	0.17		23.0
4/23-24/05	6.6	14	67	0.290	0.012	1.20	< 0.10	0.09		130.0
11/15-11/18/05	6.8	20	85	0.660	0.017	3.25	0.11	0.17		9.2
Mean	6.8	16	71	0.246	0.015	1.39	## 0.10	0.12		44.0
Min	6.6	12	55	0.077	0.012	0.78	## 0.10	0.04		9.2
Max	6.9	20	85	0.660	0.017	3.25	## 0.11	0.18		130.0

TP = Total Phosphorus
 DRP = Dissolved Reactive Phosphorus
 TKN = Total Kjeldahl Nitrogen
 NH₃-N = Ammonia Nitrogen
 NO₃/NO₂-N = Nitrate/Nitrite Nitrogen
 TSS = Total Suspended Solids

F. X. Browne, Inc.

Mill Brook Dry Weather and Wet Weather Stream Water Quality Data Lake Wallenpaupack Watershed Assessment Project

Dry Weather Stream Data

Date	pH (s.u.) (s.u.)	Alkalinity (mg/L as CaCO ₃)	Specific Conductance (umhos/cm)	TP (mg/L)	DRP (mg/L)	TKN (mg/L)	NH ₃ -N (mg/L)	NO ₃ /NO ₂ -N (mg/L)	TSS (mg/L)
4/29/2004	6.7	8	105	0.017	0.006	0.19	0.16	0.05	3.2
5/12/2004	6.5	8	102	0.030		0.23	< 0.10	0.02	4.8
6/7/2004	7.1	10	88	0.018	0.010	0.18	< 0.10	0.11	2.4
7/7/2004	7.1	12	87	0.030		0.13	< 0.10	0.12	< 1.0
8/4/2004	6.7	10	145	0.023	0.014	0.20	< 0.10	0.08	1.6
9/8/2004	6.8	10	100	0.018		< 0.10	< 0.10	0.08	< 1.0
10/6/2004	6.9	8	88	0.017	0.009	0.11	< 0.10	0.04	< 1.0
11/2/2004	7.1	12	76	0.016		< 0.10	< 0.10	0.02	4.0
12/14/2004	6.4	8	66	0.013	0.008	0.14	< 0.10	0.03	2.0
1/3/2005	6.5	8	73	0.016		0.27	< 0.10	0.03	4.0
2/2/2005	6.5	8	91	0.016	0.009	0.11	< 0.10	0.06	3.5
3/2/2005	6.6	8	97	0.012		< 0.10	< 0.10	0.05	< 1.0
Mean	6.7	9	93	0.019	0.009	0.16	0.11	0.06	2.5
Min	6.4	8	66	0.012	0.006	0.10	0.10	0.02	1.0
Max	7.1	12	145	0.030	0.014	0.27	0.16	0.12	4.8

Wet Weather Stream Data

Date	pH (s.u.) (s.u.)	Alkalinity (mg/L as CaCO ₃)	Specific Conductance (umhos/cm)	TP (mg/L)	DRP (mg/L)	TKN (mg/L)	NH ₃ -N (mg/L)	NO ₃ /NO ₂ -N (mg/L)	TSS (mg/L)
8/12-13/04				0.186		0.98	< 0.10	< 0.01	79
9/9-11/04		6	75	0.040		0.44	< 0.10	< 0.01	14
9/18-19/04	5.4	4	32	0.500		0.70	< 0.10	0.01	290
3/28-30/05	5.9	8	78	0.059	0.008	0.31	< 0.10	0.03	34
4/2-3/05	6.1	6	51	0.290		1.20	< 0.10	0.02	210
4/23-24/05	6.5	8	94	0.046	0.008	0.67	< 0.10	0.12	28
10/8-10/10	7.3	14	97	0.034	0.008	0.37	< 0.10	0.09	14
11/29-11/30/05	5.9	8	56	0.109	0.005	0.83	< 0.10	0.01	48
Mean	6.2	8	69	0.158	0.007	0.69	0.10	0.04	89.7
Min	5.4	4	32	0.034	0.005	0.31	0.10	0.01	14.0
Max	7.3	14	97	0.500	0.008	1.20	0.10	0.12	290.0

TP = Total Phosphorus

DRP = Dissolved Reactive Phosphorus

TKN = Total Kjeldahl Nitrogen

NH₃-N = Ammonia Nitrogen

NO₃/NO₂-N = Nitrate/Nitrite Nitrogen

TSS = Total Suspended Solids

F. X. Browne, Inc.

West Branch Wallenpaupack Creek Dry Weather and Wet Weather Stream Water Quality Data Lake Wallenpaupack Watershed Assessment Project

Dry Weather Stream Data		Specific Conductance								
Date	pH (s.u.)	Alkalinity	Conductance	TP	DRP	TKN	NH ₃ -N	NO ₃ /NO ₂ -N	TSS	
	(s.u.)	(mg/L as CaCO ₃)	(umhos/cm)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
4/29/2004	7.1	20	116	0.018	0.003	0.30	< 0.1	0.10		5.6
5/12/2004	7.4	22	115	0.027		0.32	< 0.1	0.05		4.4
6/7/2004	7.1	24	129	0.038	0.013	0.34	< 0.1	0.19		4.8
7/7/2004	7.7	34	152	0.018		0.29	< 0.1	0.14	<	1.0
8/4/2004	7.5	32	149	0.038	0.015	0.45	< 0.1	0.10	<	1.0
9/8/2004	7.3	36	148	0.021		0.30	< 0.1	0.25		2.4
10/6/2004	7.2	24	111	0.023	0.009	0.28	< 0.1	0.15		3.2
11/2/2004	7.2	26	111	0.018		0.48	< 0.1	0.09	<	1.0
12/14/2004	6.8	16	84.5	0.020	0.006	0.28	< 0.1	0.16		2.4
1/3/2005	6.9	20	102.6	0.020		0.27	< 0.1	0.28		6.8
2/2/2005	6.8	20	124.4	0.178	0.012	0.62	< 0.1	0.44		56.0
3/2/2005	6.9	20	130.7	0.023		0.13	< 0.1	0.37		2.8
Mean	7.2	25	123	0.037	0.010	0.34	0.10	0.19		7.6
Min	6.8	16	85	0.018	0.003	0.13	0.10	0.05		1.0
Max	7.7	36	152	0.178	0.015	0.62	0.10	0.44		56.0

Wet Weather Stream Data		Specific Conductance								
Date	pH (s.u.)	Alkalinity	Conductance	TP	DRP	TKN	NH ₃ -N	NO ₃ /NO ₂ -N	TSS	
	(s.u.)	(mg/L as CaCO ₃)	(umhos/cm)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
8/12-14/04				0.22		0.92	< 0.1	0.03		76
9/9-11/04		24	107	0.076		0.73	< 0.1	0.03		24
12/23-24/04	7.0	12	83.8	0.201		0.77	< 0.1	0.23		109
2/16-17/05	6.9	16	135	0.188	0.026	0.81	< 0.1	0.26		117
3/27-29/05	6.6	14	113.6	0.196	0.008	0.48	< 0.1	0.23		110
4/23-25/05	7.1	22	130.2	0.087	0.015	0.52	< 0.1	0.17		45
10/8-10/10	6.9	26	202	0.052	0.005	0.76	< 0.1	0.32		23.6
11/15-11/18/05	7	22	119.1	0.048	0.005	0.4	< 0.1	0.16		16.8
11/29-11/30/05	6.6	14	102.6	0.18	0.007	1.16	< 0.1	0.21		86
Mean	6.9	19	124	0.139	0.011	0.73	0.10	0.18		67.5
Min	6.6	12	84	0.048	0.005	0.40	0.10	0.03		16.8
Max	7.1	26	202	0.220	0.026	1.16	0.10	0.32		117.0

TP = Total Phosphorus
 DRP = Dissolved Reactive Phosphorus
 TKN = Total Kjeldahl Nitrogen
 NH₃-N = Ammonia Nitrogen
 NO₃/NO₂-N = Nitrate/Nitrite Nitrogen
 TSS = Total Suspended Solids