

## Appendix D

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### Trinity College Water Quality Monitoring Results

# Baseline Water Quality Analysis of the North Branch of the Park River Watershed

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Summer 2008

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## Table of Contents

### Executive Summary

Water Chemistry.....	Part I
Biological Assessment with Macroinvertebrates.....	Part II
Anion Chromatography.....	Part III
Fecal Coliform .....	Part IV
Temperature .....	Part V
Site Descriptions .....	Part VI

# Executive Summary

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For the North Branch Park River and Tributaries

Dr. Jonathan R. Gourley

7/24/2008

This report presents the results of water quality data collected by five undergraduate research students from Trinity College in the North Branch sub-basin of the Park River Watershed (Fig. 1-A). The sampling period was between May 19, 2008 and July 14, 2008 and covered twelve sites from the headwaters of the watershed to the main trunk of the North Branch of the Park River. This sampling was conducted as an in-kind service to Fuss & O'Neill and the Farmington River Watershed Association for the North Branch of the Park River Watershed Management Plan. The report is designed to provide the management team with baseline data of several basic water quality parameters for the purpose of understanding the expected conditions of the watershed in general and to highlight potential locations for further in-depth study. The reported data include: temperature, pH, conductivity, total dissolved solids (TDS), salinity, dissolved oxygen (DO), hardness, major anions (chloride, nitrates and sulfates), fecal coliform, and macroinvertebrates.

Our overall assessment of the watershed during the study period is good, especially when comparing results to similar water analyses in the South Branch of the Park River. The majority of the sub-basin's area drains rural to suburban landscapes with only the most downstream reaches flowing through urban neighborhoods.

We present all of our data with respect to both location and time. In order to make spatial plots useful to the reader, all sites were given a numeric position relative to its location with respect to the headwaters. The position assignments are listed in Table A-1 along with site code names. These positions are used throughout the report when plotting data from upstream to downstream. In addition we have standardized the plot symbols for each tributary so that the reader may quickly recognize data from a particular section of the river. For example all Wash Brook data is plotted with green triangles. Some storm water was collected throughout the summer using a flow triggered auto-sampler. These results are distinguished from baseline data using a different color scheme.

In general, pH values are consistent over the study period but conductivity, TDS and salinity data decrease steadily. However anions such as a chloride, nitrate and sulfate clearly increase spatially from the headwaters to the main trunk of the North Branch. Anions concentrations in the Tumble Brook just downstream of the Tumble Brook and Wampanoag golf course (site ETB 6) show higher values compared to the overall trend. These results are not surprising considering the assumed run-off of fertilizers from the golf courses.

We would like to recommend further study of Filley Brook, a small yet noticeably and consistently more polluted section of the watershed than the other tributaries. Macroinvertebrates were not collected successfully at this site due to stagnant flows and a deep muddy bottom. However, chemical parameters of the site EFB 11 returned values higher than expected. It is not clear at the moment what the source(s) of pollution are in Filley Brook.

All questions or comment about this report should be directed to:

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Table A-1. Key to Site locations and downstream position (for the purpose of graphing data) of sampling locations on the North Branch of the Park River at its tributaries. See Map (Fig. A-1) for spatial reference.

<b>Name of Site</b>	<b>Position</b>	<b>Code Name</b>
<b>Top of Park River</b>	<b>5</b>	<b>TNBPR 1</b>
<b>Middle of Park River</b>	<b>6</b>	<b>MNBPR 2</b>
<b>Middle of Park River</b>	<b>7</b>	<b>MNBPR 3</b>
<b>End of Park River</b>	<b>8</b>	<b>ENBPR 4</b>
<b>Top of Tumble Brook</b>	<b>1</b>	<b>TTB 5</b>
<b>Middle of Tumble Brook</b>	<b>2</b>	<b>MTB 5.5</b>
<b>End of Tumble Brook</b>	<b>3</b>	<b>ETB 6</b>
<b>Top of Wash Brook</b>	<b>2</b>	<b>TWB 7</b>
<b>End of Wash Brook</b>	<b>3.5</b>	<b>EWB 8</b>
<b>Top of Beamans Brook</b>	<b>2</b>	<b>TBB 9</b>
<b>End of Beamans Brook</b>	<b>3</b>	<b>EBB 10</b>
<b>End of Filley Brook</b>	<b>4</b>	<b>EFB 11</b>

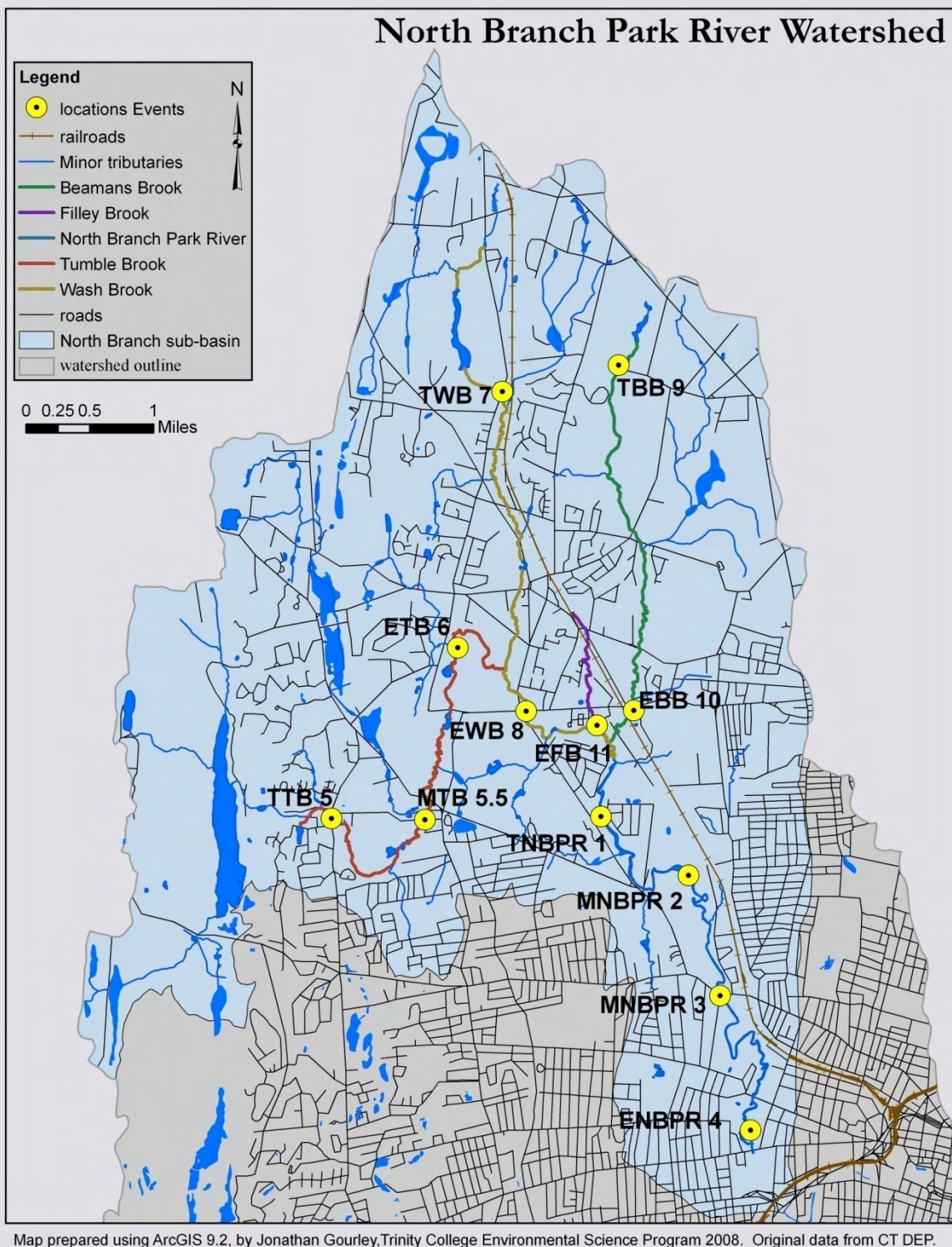


Figure A-1. Sampling site locations for North Branch or the Park River and its tributaries.

# Part I: A Chemical Water Quality Assessment

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For the North Branch Park River and Tributaries

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**Project Supervisor: Dr. Jonathan Gourley**

**7/24/2008**



## Discussion

After data collection was finished, the three readings were averaged together and standard deviation was derived. The data was then graphed in two different ways. The first graph of each parameter portrays the data by tributary and its location in the watershed so it is possible to observe how data changes along the watershed. Each site has its own position number according to how far upstream or downstream it is in the watershed. For example, the most upstream site has a value of 1 and the most downstream site has a value of 8. The second graph of each parameter portrays the changes over time. All of the raw data is in the form of data tables by tributary. Graphs 1 and 2 show the pH values graphed both ways. Both have a general trend of not showing any change over time or along the watershed. There are no clear outliers present. Therefore the results show that there are not any abnormalities concerning pH values in any of the tributaries.

Graphs 3 and 4 illustrate temperature readings for the tributaries. Graph 3 has a slight decreasing trend but when the data is graphed over time, there is an upward trend over the study period. Graphs 5, 7, 9, and 11 are the graphs for TDS, salinity, conductivity, and hardness respectively and show how these parameters change through the watershed. None of these graphs really have very strong consistent trends. Salinity is the only parameter with a trend. It has a slightly increasing trend across the watershed which could be due to the fact that the Park River is a more urban setting than its tributaries. However when these parameters are graphed over time, there is an obvious decreasing trend. This is illustrated in graphs 6, 8, 10, and 12.

However, Filley Brook site's data shows an increasing trend in these graphs. This site seems to be the most polluted; the water is very turbid and it has a pungent odor. It is located between parking lots and a large apartment complex whose storm water runoff could be contributing to the condition of the site. This also may account for the abnormal increasing trends. Also there is an outlier present in the TDS, conductivity, and salinity graphs. According to tables 11, 16, and 21, this data was collected on June 16<sup>th</sup> at site MNBPR 2 which is located in the University Hartford. This site is adjacent to several parking lots and a road so perhaps that could have influenced these high readings. This data could also be a result of the equipment malfunctioning on that particular day because the rest of the data for the site is normal.

The last four graphs show dissolved oxygen in both % air saturation and in mg/L. Graphs 13 and 15, which show the dissolved oxygen readings across the watershed, do not have a clear trend. When graphed over time (graphs 14 and 16) the results show a trend that decreases and then instantly increases. In fact DO readings are dependent on the temperature of the water (EPA, 2006) because warm water holds less dissolved oxygen than cold water. Graphs 14 and 16 should look like the TDS, conductivity, salinity, and hardness graphs and have a clear decreasing trend. This could be something significant in the quality of the water or the DO meter could have malfunctioned during that period of testing. Also some of the DO readings are very low when they should not be. For example, table 39 shows that the readings for TBB 9 change from 2.6 to 6.77 in one week which does not seem plausible because the most of the other readings are more or less stable. The meter constantly flashed error messages and despite some of our attempts to try and clean the probe, it would still malfunction and take long periods of time to stabilize.

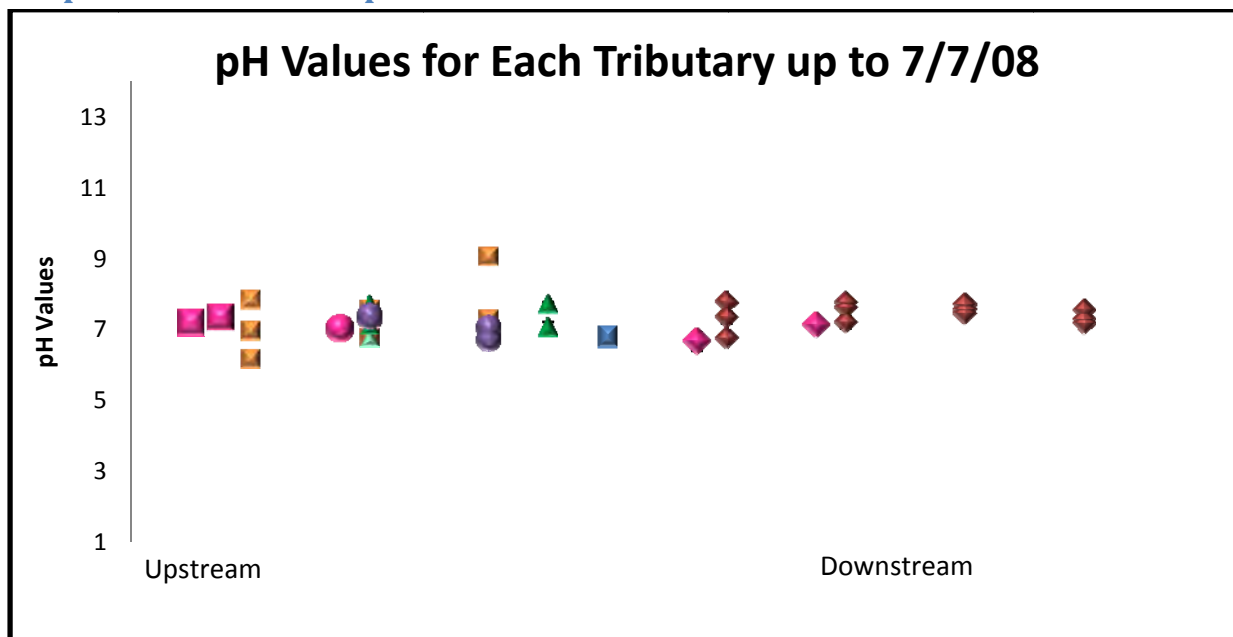
The results and data convey that the water quality of the North Branch Park River watershed is good. The results all fall within the normal range of good water quality set forth by the EPA. These standards encompass both the Drinking Water Standard and the Biological Standards. The EPA standard for pH is between 6.5 – 8.5 and all of the sites fall within this range (EPA, 2006). The EPA standard for



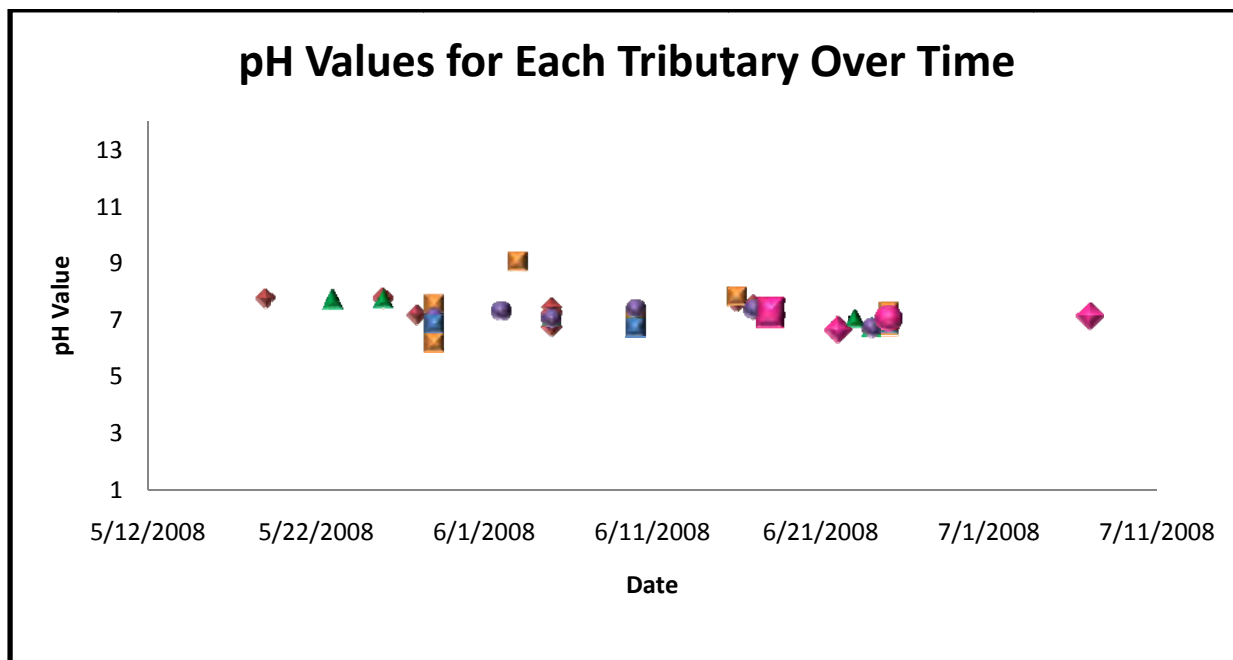
## Table Information

Position refers to how upstream or downstream a site is in the watershed. The positions can run from 1 to 8. For example, a site with a position of 1 is at the top of the watershed while a position of 8 means the site is at the very end of the watershed.

## Graphs and Tables for pH Values



Graph 1: This graph shows the pH values by tributary.



Graph 2: This graph shows the pH values over time for each site.

Table 1: pH values for the North Branch of the Park River

Date	Site	Position	Average pH	SD
5/19/2008	TNBPR 1	5	7.77	0.05
5/26/2008	MNBPR 2	6	7.78	0.1
5/26/2008	MNBPR 3	7	7.72	0.09
5/28/2008	ENBPR 4	8	7.18	0.01
5/29/2008	TNBPR 1	5	7.34	0.17
6/5/2008	TNBPR 1	5	6.75	0.05
6/5/2008	ENBPR 4	8	7.29	0.01
6/5/2008	MNBPR 3	7	7.46	0.06
6/5/2008	MNBPR 2	6	7.21	0.18
6/16/2008	MNBPR 2	6	7.64	0.05
6/17/2008	TNBPR 1	5	7.35	0.03
6/17/2008	MNBPR 3	7	7.57	0.01
6/17/2008	ENBPR 4	8	7.55	0.03
Storm Water				
6/22/2008	TNBPR 1	4.75	6.66	0.26
7/7/2008	MNBPR 2	5.75	7.13	0.01

Table 2: pH values for Tumble Brook

Date	Site	Position	Average pH	SD
5/29/2008	TTB 5	1	6.19	0.11
5/29/2008	MTB 5.5	2	7.56	0.05
6/3/2008	ETB 6	3	9.06	0.06
6/10/2008	MTB 5.5	2	6.78	0.16
6/10/2008	TTB 5	1	6.97	0.4
6/10/2008	ETB 6	3	7.13	0.06
6/16/2008	TTB 5	1	7.84	0.02
6/25/2008	MTB 5.5	2	6.77	0.15
6/25/2008	ETB 6	3	7.3	0.17
Storm Water				
6/18/2008	TTB Storm 1	0.5	7.19	0.08
6/18/2008	TTB Storm 2	0.75	7.33	0.01

Table 3: pH values for Wash Brook

Date	Site	Position	Average pH	SD
5/23/2008	TWB 7	2	7.71	0.03
5/26/2008	EWB 8	3.5	7.73	0.05
6/5/2008	EWB 8	3.5	7.1	0.12
6/10/2008	TWB 7	2	7.1	0
6/23/2008	EWB 8	3.5	7.06	0.05
6/24/2008	TWB 7	2	6.77	0.04

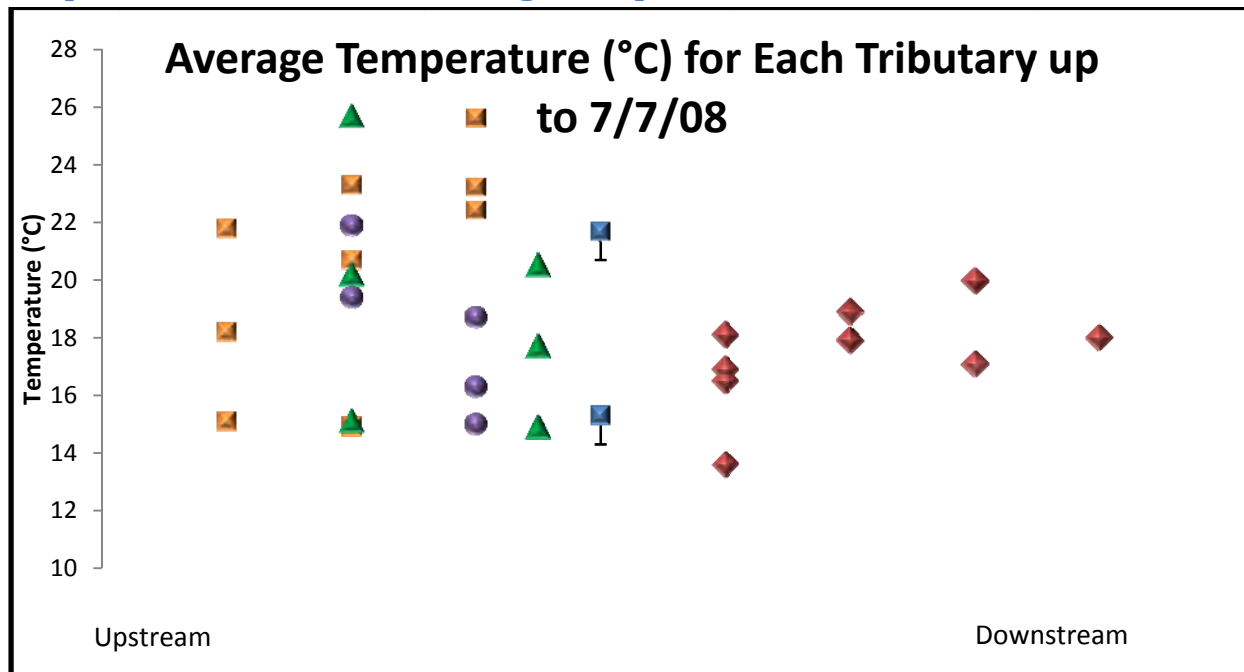
Table 4: pH values for Beaman's Brook

Date	Site	Position	Average pH	SD
5/29/2008	EBB 10	3	7.07	0.02
6/2/2008	TBB 9	2	7.32	0.13
6/5/2008	EBB 10	3	7.04	0.13
6/10/2008	TBB 9	2	7.4	0
6/17/2008	TBB 9	2	7.4	0.02
6/24/2008	EBB 10	3	6.73	0.1
Storm Water				
6/25/2008	TBB 9	1.75	7.04	0.05

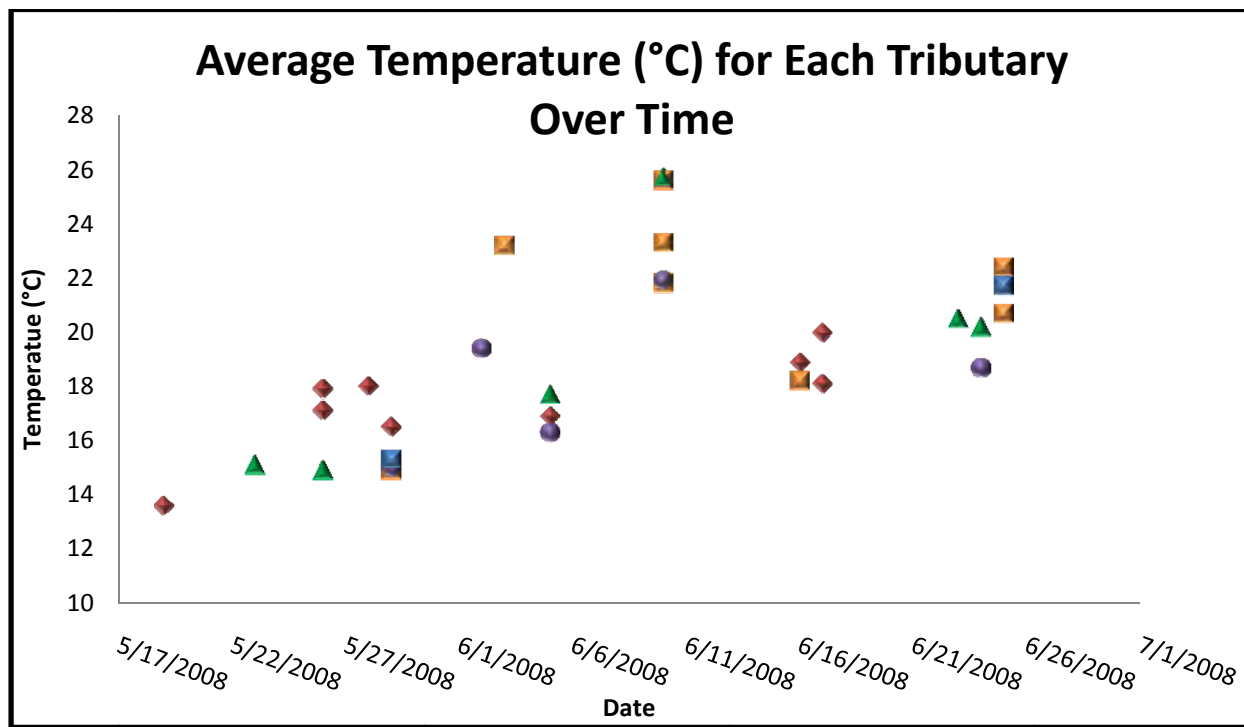
Table 5: pH values for Filley Brook

Date	Site	Position	Average pH	SD
5/29/2008	EFB 11	4	6.84	0.03
6/10/2008	EFB 11	4	6.73	0.06
6/25/2008	EFB 11	4	6.83	0.06

## Graphs and Tables for the Average Temperatures



Graph 3: This graph shows the temperature in °C for each tributary.



Graph 4: This graph shows the temperature in °C of each tributary over time.

**Table 6: Average temperature values in °C for the North Branch of the Park River**

Date	Site	Position	Average T	SD
5/19/2008	TNBPR 1	5	13.6	0.1
5/26/2008	MNBPR 2	6	17.9	0.1
5/26/2008	MNBPR 3	7	17.1	0.1
5/28/2008	ENBPR 4	8	18	0
5/29/2008	TNBPR 1	5	16.5	0.1
6/5/2008	TNBPR 1	5	16.9	0.1
6/16/2008	MNBPR 2	6	18.9	0.1
6/17/2008	TNBPR 1	5	18.1	0.1
6/17/2008	MNBPR 3	7	20	0

**Table 7: Average temperature values in °C for Tumble Brook**

Date	Site	Position	Average T	SD
5/29/2008	TTB 5	1	15.1	0.1
5/29/2008	MTB 5.5	2	14.9	0.1
6/3/2008	ETB 6	3	23.2	0.1
6/10/2008	MTB 5.5	2	23.3	0.1
6/10/2008	TTB 5	1	21.8	0
6/10/2008	ETB 6	3	25.6	0
6/16/2008	TTB 5	1	18.2	0.1
6/25/2008	MTB 5.5	2	20.7	0.1
6/25/2008	ETB 6	3	22.4	0.1

**Table 8: Average temperature values in °C for Wash Brook**

Date	Site	Position	Average T	SD
5/23/2008	TWB 7	2	15.1	0.1
5/26/2008	EWB 8	3.5	14.9	0.1
6/5/2008	EWB 8	3.5	17.7	0.1
6/10/2008	TWB 7	2	25.7	0
6/23/2008	EWB 8	3.5	20.5	0.1
6/24/2008	TWB 7	2	20.2	0

**Table 9: Average temperature values in °C for Beaman's Brook**

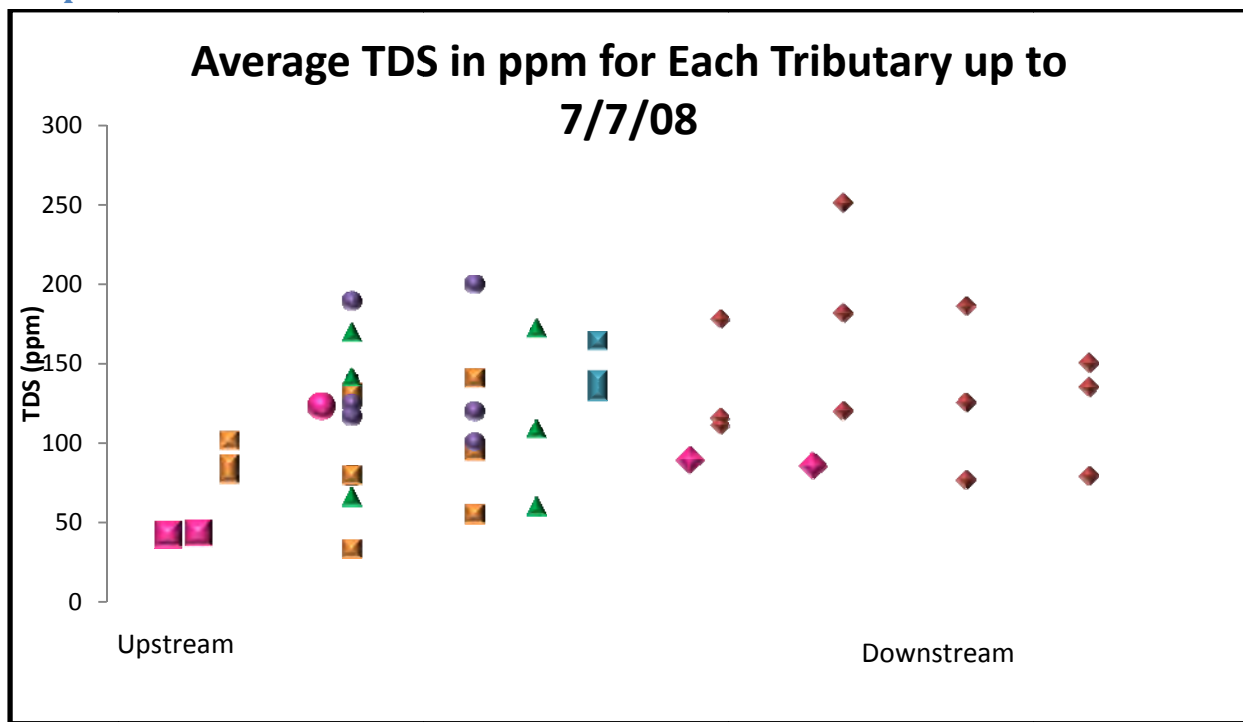
Date	Site	Position	Average T	SD
5/29/2008	EBB 10	3	15	0
6/2/2008	TBB 9	2	19.4	0.1
6/5/2008	EBB 10	3	16.3	0
6/10/2008	TBB 9	2	21.9	0
6/24/2008	EBB 10	3	18.7	0.1

**Table 10: Average temperatures in °C for Filley Brook**

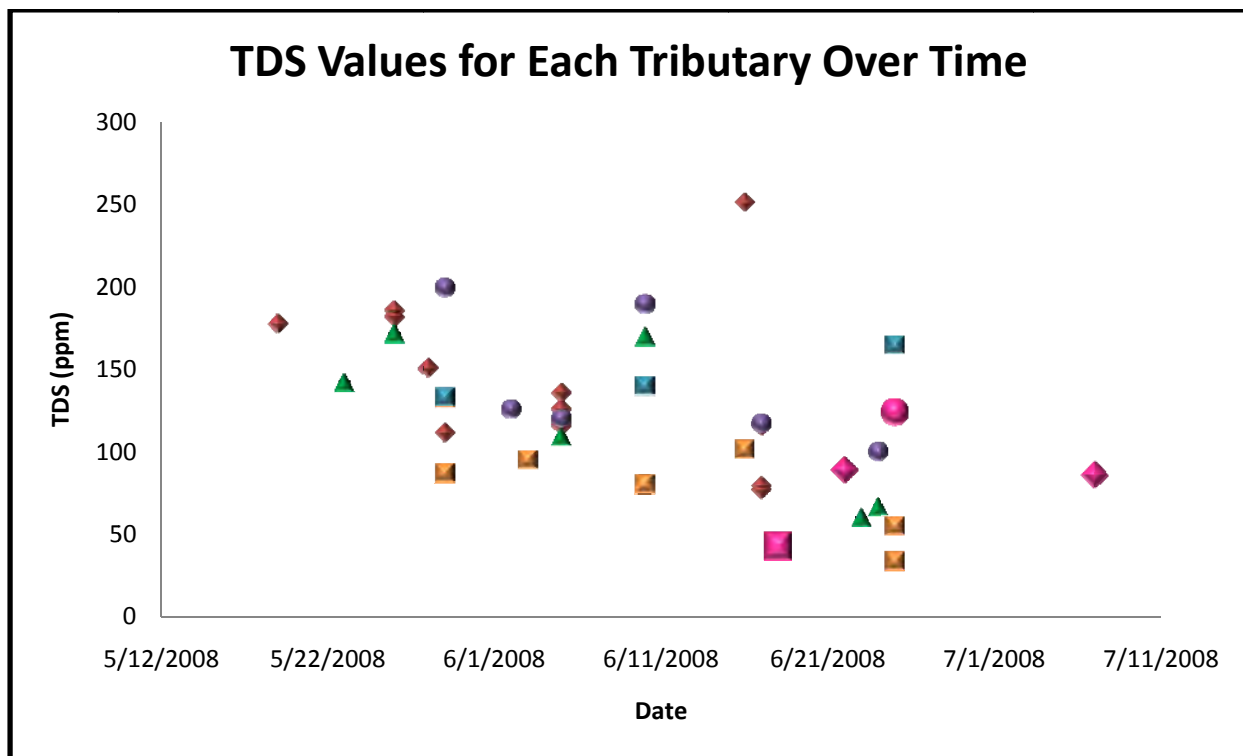
Date	Site	Position	Average T	SD
5/29/2008	EFB 11	4	15.3	0.2
6/25/2008	EFB 11	4	21.7	0.3



## Graphs and Tables for the Total Dissolved Solids



Graph 5: This graph shows the total dissolved solids in ppm in each tributary.



Graph 6: This graph shows the amount of total dissolved solids in ppm in each tributary over time.

**Table 11: Total dissolved solids value in ppm for the North Branch of the Park River**

Date	Site	Position	Average TDS	SD
5/19/2008	TNBPR 1	5	177.7	0.3
5/26/2008	MNBPR 2	6	181.9	1.6
5/26/2008	MNBPR 3	7	185.8	0.3
5/28/2008	ENBPR 4	8	150.6	0.6
5/29/2008	TNBPR 1	5	111	0.3
6/5/2008	TNBPR 1	5	115.5	0.3
6/5/2008	ENBPR 4	8	135.3	0.1
6/5/2008	MNBPR 3	7	125.4	0.2
6/5/2008	MNBPR 2	6	120.4	0.2
6/16/2008	MNBPR 2	6	251.3	0.6
6/17/2008	TNBPR 1	5	115.4	0.2
6/17/2008	MNBPR 3	7	76.9	0
6/17/2008	ENBPR 4	8	79.3	0.3
Storm Water				
6/22/2008	TNBPR 1	4.75	88.8	0.1
7/7/2008	MNBPR 2	5.75	85.9	0.2

**Table 12: Total dissolved solids value in ppm for Tumble Brook**

Date	Site	Position	Average TDS	SD
5/29/2008	TTB 5	1	86.4	0.1
5/29/2008	MTB 5.5	2	132	0.1
6/3/2008	ETB 6	3	94.5	0.4
6/10/2008	MTB 5.5	2	80	5.4
6/10/2008	TTB 5	1	80	0
6/10/2008	ETB 6	3	140	0
6/16/2008	TTB 5	1	101.4	0.1
6/25/2008	MTB 5.5	2	33.4	0.1
6/25/2008	ETB 6	3	54.8	0.1
Storm Water				
6/18/2008	TTB Storm 1	0.5	42.2	0.3
6/18/2008	TTB Storm 2	0.75	43	0.1

Table 13: Total dissolved solids value in ppm for Wash Brook

Date	Site	Position	Average TDS	SD
5/23/2008	TWB 7	2	141.7	0.9
5/26/2008	EWB 8	3.5	171.7	0.2
6/5/2008	EWB 8	3.5	108.4	0.4
6/10/2008	TWB 7	2	170	0
6/23/2008	EWB 8	3.5	59.9	0.1
6/24/2008	TWB 7	2	66.5	0

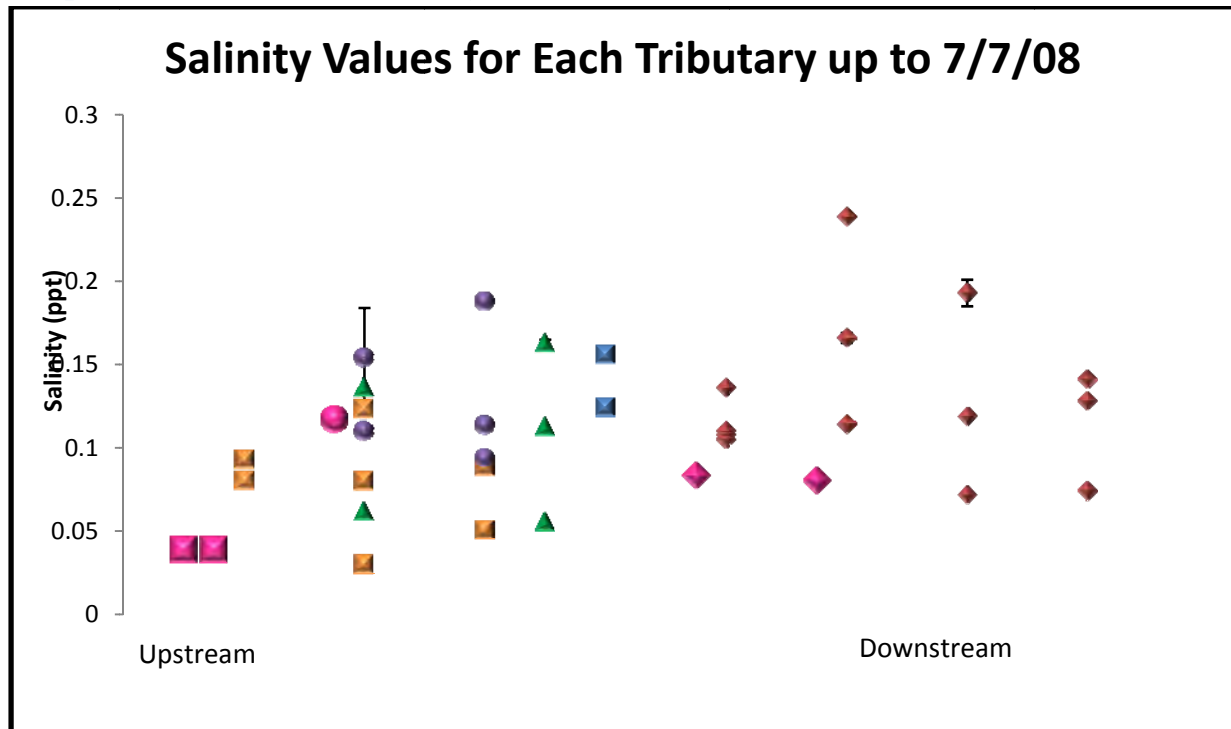
Table 14: Total dissolved solids value in ppm for Beaman's Brook

Date	Site	Position	Average TDS	SD
5/29/2008	EBB 10	3	199.6	0.4
6/2/2008	TBB 9	2	125.4	2.9
6/5/2008	EBB 10	3	119.5	0.4
6/10/2008	TBB 9	2	190	0
6/17/2008	TBB 9	2	117.2	0.1
6/24/2008	EBB 10	3	100	0.2
Storm Water				
6/25/2008	TBB 9	1.75	123.8	1.6

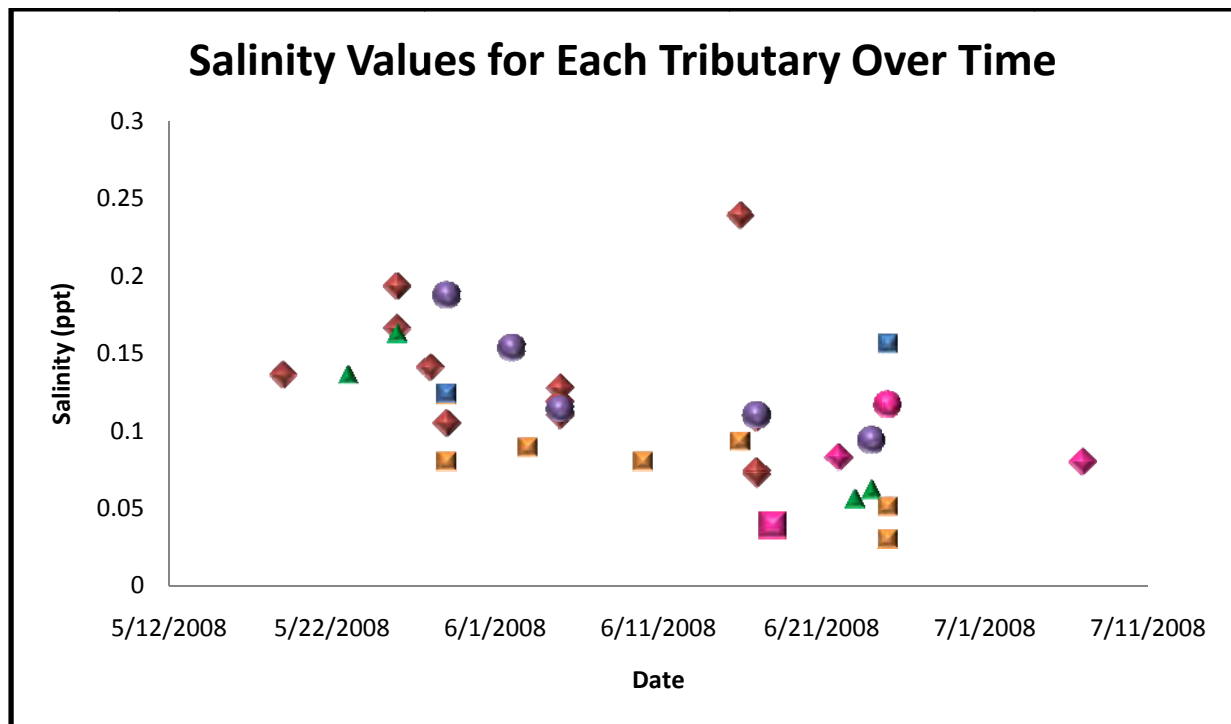
Table 15: Total dissolved solids value in ppm for Filley Brook

Date	Site	Position	Average TDS	SD
5/29/2008	EFB 11	4	132.6	0.4
6/10/2008	EFB 11	4	140	0
6/25/2008	EFB 11	4	164.2	0.9

## Graphs and Tables for Salinity Values



Graph 7: This graph shows the salinity values in ppt for each tributary.



Graph 8: This graph shows the salinity values in ppt for each tributary over time.

Table 16: Salinity values in ppt for the North Branch of the Park River

Date	Site	Position	Average Salinity	SD
5/19/2008	TNBPR 1	5	0.136	0
5/26/2008	MNBPR 2	6	0.166	0.003
5/26/2008	MNBPR 3	7	0.193	0.008
5/28/2008	ENBPR 4	8	0.141	0.001
5/29/2008	TNBPR 1	5	0.105	0
6/5/2008	TNBPR 1	5	0.11	0.001
6/5/2008	ENBPR 4	8	0.128	0
6/5/2008	MNBPR 3	7	0.119	0.001
6/5/2008	MNBPR 2	6	0.114	0.001
6/16/2008	MNBPR 2	6	0.239	0.002
6/17/2008	TNBPR 1	5	0.108	0
6/17/2008	MNBPR 3	7	0.072	0
6/17/2008	ENBPR 4	8	0.074	0
Storm Water				
6/23/2008	TNBPR 1	4.75	0.083	0
7/7/2008	MNBPR 2	5.75	0.08	0

Table 17: Salinity values in ppt for Tumble Brook

Date	Site	Position	Average S	SD
5/29/2008	TTB 5	1	0.08	0.001
5/29/2008	MTB 5.5	2	0.123	0.001
6/3/2008	ETB 6	3	0.089	0
6/10/2008	MTB 5.5	2	0.08	0
6/16/2008	TTB 5	1	0.093	0.002
6/25/2008	MTB 5.5	2	0.03	0
6/25/2008	ETB 6	3	0.051	0
Storm Water				
6/18/2008	TTB Storm 1	0.5	0.039	0.001
6/18/2008	TTB Storm 2	0.75	0.039	0

Table 18: Salinity values in ppt for Wash Brook

Date	Site	Position	Average S	SD
5/23/2008	TWB 7	2	0.136	0
5/26/2008	EWB 8	3.5	0.163	0.002
6/5/2008	EWB 8	3.5	0.113	0
6/23/2008	EWB 8	3.5	0.056	0
6/24/2008	TWB 7	2	0.062	0

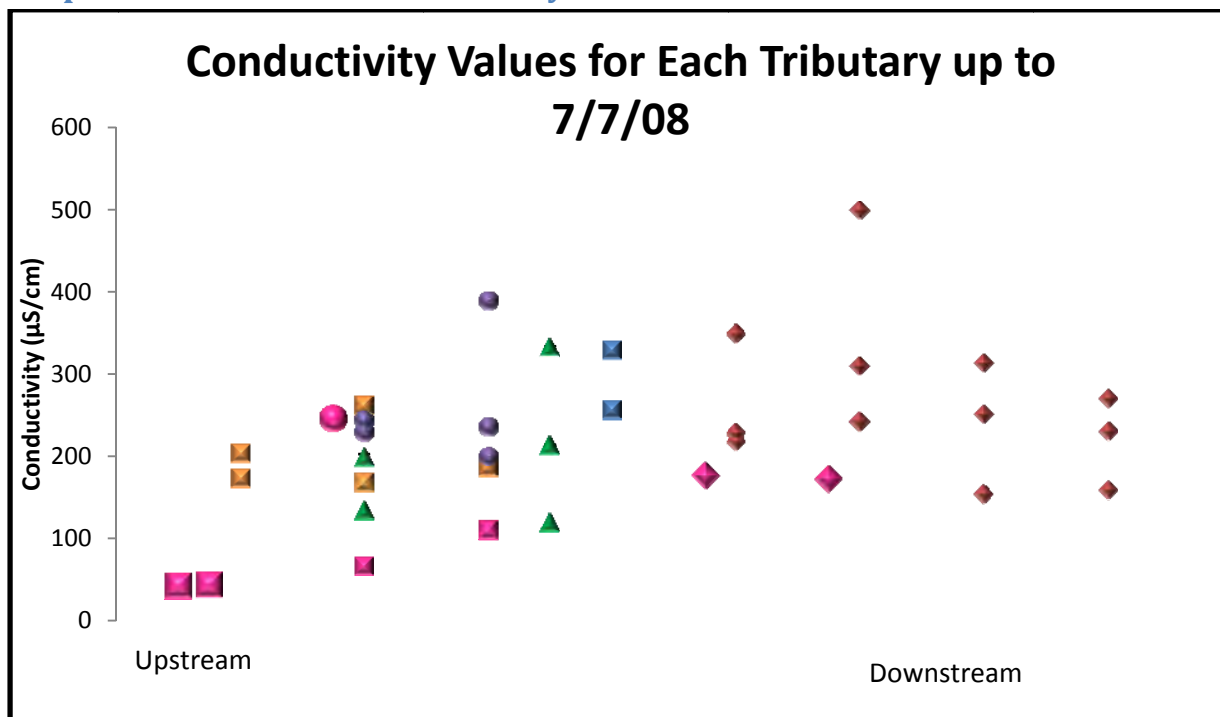
Table 19: Salinity values in ppt for Beaman's Brook

Date	Site	Position	Average S	SD
5/29/2008	EBB 10	3	0.188	0.001
6/2/2008	TBB 9	2	0.154	0.03
6/5/2008	EBB 10	3	0.114	0
6/17/2008	TBB 9	2	0.11	0.001
6/24/2008	EBB 10	3	0.094	0
Storm Water				
6/25/2008	TBB 9	1.75	0.117	0.002

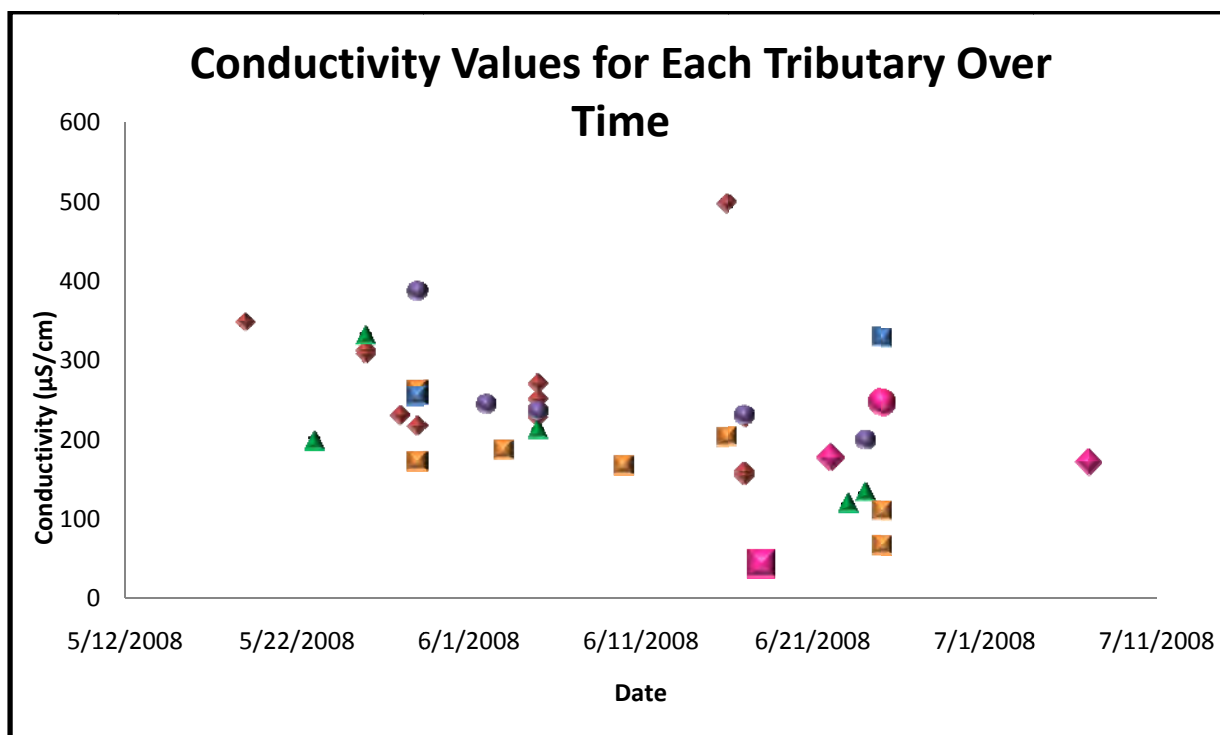
Table 20: Salinity values in ppt for Filley Brook

Date	Site	Position	Average S	SD
5/29/2008	EFB 11	4	0.124	0
6/25/2008	EFB 11	4	0.156	0.001

## Graphs and Tables for Conductivity Values



Graph 9: This graph shows the conductivity values in  $\mu\text{S/cm}$  for each tributary.



Graph 10: This graph shows the conductivity values in  $\mu\text{S/cm}$  for each tributary over time.

Table 21: Conductivity values in  $\mu\text{S}/\text{cm}$  for the North Branch of the Park River

Date	Site	Position	Average Conductivity	S.D.
5/19/2008	TNBPR 1	5	348.3	4
5/26/2008	MNBPR 2	6	308.7	1.2
5/26/2008	MNBPR 3	7	313.3	1.5
5/28/2008	ENBPR 4	8	230.7	0.6
5/29/2008	TNBPR 1	5	217.3	1.5
6/5/2008	TNBPR 1	5	228	1
6/5/2008	ENBPR 4	8	270.7	0.6
6/5/2008	MNBPR 3	7	251	0
6/5/2008	MNBPR 2	6	241	0
6/16/2008	MNBPR 2	6	498.3	4.7
6/17/2008	TNBPR 1	5	227	1
6/17/2008	MNBPR 3	7	153.8	0.1
6/17/2008	ENBPR 4	8	158.6	0.1
Storm Water				
6/22/2008	TNBPR 1	4.75	176.4	1.3
7/7/2007	MNBPR 2	5.75	171.3	0.4

Table 22: Conductivity values in  $\mu\text{S}/\text{cm}$  for Tumble Brook

Date	Site	Position	Average conductivity	S.D.
5/29/2008	TTB 5	1	172.2	0.3
5/29/2008	MTB 5.5	2	262.3	0.6
6/3/2008	ETB 6	3	186.5	1
6/10/2008	MTB 5.5	2	167.4	0.8
6/16/2008	TTB 5	1	203.3	0.6
6/25/2008	MTB 5.5	2	66.2	0.3
6/25/2008	ETB 6	3	109.6	0.2
Storm Water				
6/18/2008	TTB Storm 1	0.5	42.2	0.3
6/18/2008	TTB Storm 2	0.75	43	0.1



Table 23: Conductivity values in  $\mu\text{S}/\text{cm}$  for Wash Brook

Date	Site	Position	Average conductivity	S.D.
5/23/2008	TWB 7	2	198.7	4
5/26/2008	EWB 8	3.5	332	2
6/5/2008	EWB 8	3.5	213	1
6/23/2008	EWB 8	3.5	119.2	0.3
6/24/2008	TWB 7	2	133.2	0.1

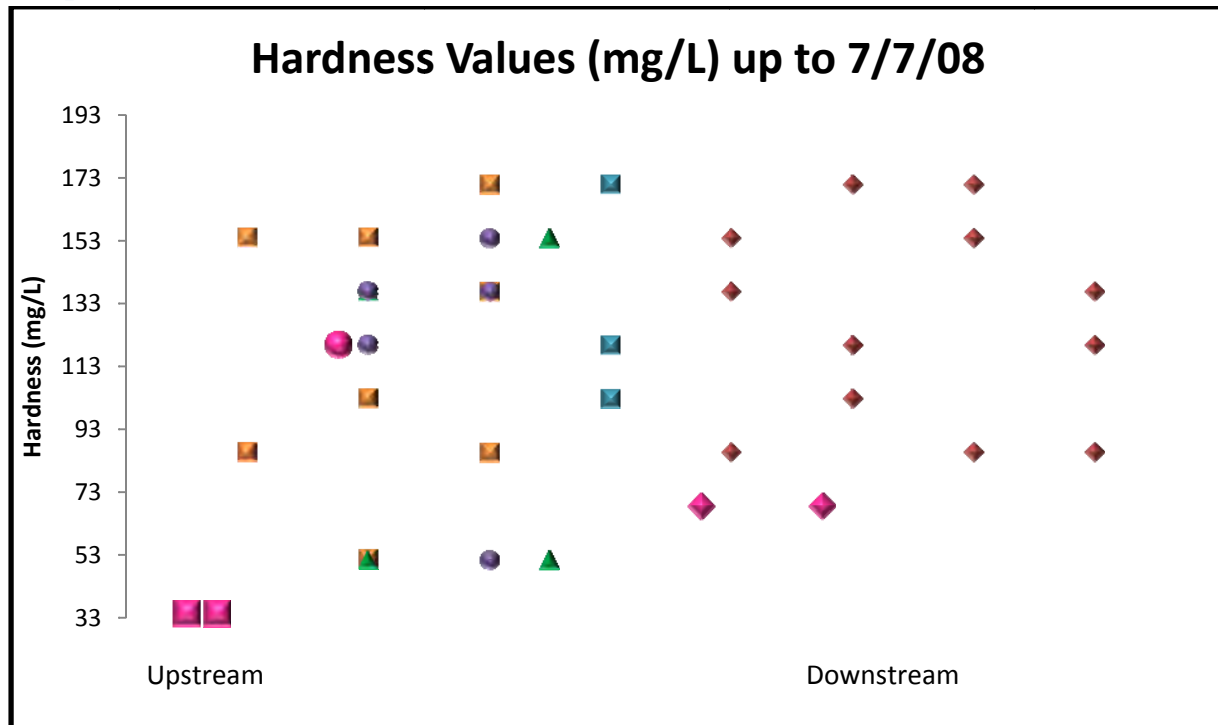
Table 24: Conductivity values in  $\mu\text{S}/\text{cm}$  for Beaman's Brook

Date	Site	Position	Average conductivity	S.D.
5/29/2008	EBB 10	3	388.3	3.1
6/2/2008	TBB 9	2	244.7	1.5
6/5/2008	EBB 10	3	235.3	1.5
6/17/2008	TBB 9	2	230	1
6/24/2008	EBB 10	3	198.7	0.5
Storm Water				
6/25/2008	TBB 9	1.75	246.7	4.2

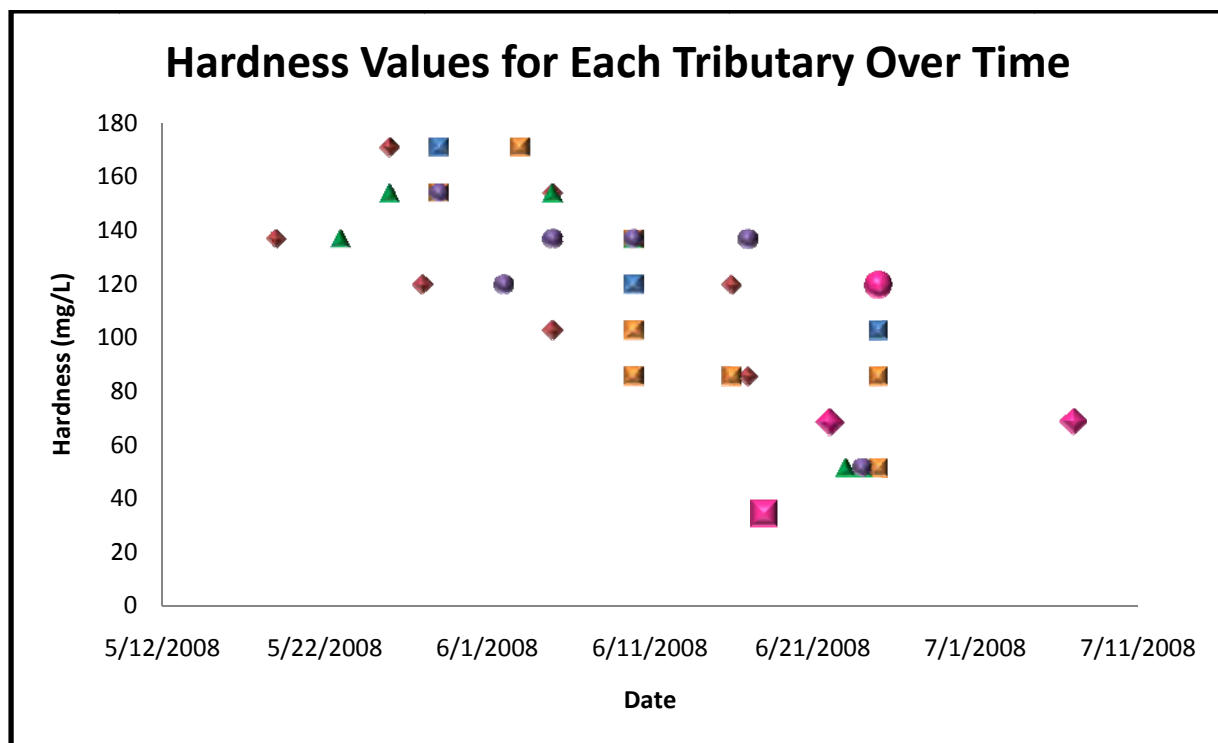
Table 25: Conductivity values in  $\mu\text{S}/\text{cm}$  for Filley Brook

Date	Site	Position	Average conductivity	S.D.
5/29/2008	EFB 11	4	255.3	3.1
6/25/2008	EFB 11	4	328.3	1.5

## Graphs and Tables for Hardness Values



Graph 11: This graph shows the hardness values in mg/L for each tributary.



Graph 12: This graph shows the hardness values in mg/L for each tributary over time.

Table 26: Hardness values in mg/L for the North Branch of the Park River

Date	Site	Position	Hardness
5/19/2008	TNBPR 1	5	136.8
5/26/2008	MNBPR 2	6	171
5/26/2008	MNBPR 3	7	171
5/28/2008	ENBPR 4	8	119.7
5/29/2008	TNBPR 1	5	153.9
6/5/2008	TNBPR 1	5	136.8
6/5/2008	ENBPR 4	8	136.8
6/5/2008	MNBPR 3	7	153.9
6/5/2008	MNBPR 2	6	102.6
6/16/2008	MNBPR 2	6	119.7
6/17/2008	TNBPR 1	5	85.5
6/17/2008	MNBPR 3	7	85.5
6/17/2008	ENBPR 4	8	85.5
Storm Water			
6/22/2008	TNBPR 1	4.75	68.4
7/7/2008	MNBPR 2	5.75	68.4

Table 27: Hardness values in mg/L for Tumble Brook

Date	Site	Position	Hardness
5/29/2008	TTB 5	1	153.9
5/29/2008	MTB 5.5	2	153.9
6/3/2008	ETB 6	3	171
6/10/2008	MTB 5.5	2	102.6
6/10/2008	TTB 5	1	85.5
6/10/2008	ETB 6	3	136.8
6/16/2008	TTB 5	1	85.5
6/25/2008	MTB 5.5	2	51.3
6/25/2008	ETB 6	3	85.5
Storm Water			
6/18/2008	TTB Storm 1	0.5	34.2
6/18/2008	TTB Storm 2	0.75	34.2

Table 28: Hardness values in mg/L for Wash Brook

Date	Site	Position	Hardness
5/23/2008	TWB 7	2	136.8
5/26/2008	EWB 8	3.5	153.9
6/5/2008	EWB 8	3.5	153.9
6/10/2008	TWB 7	2	136.8
6/23/2008	EWB 8	3.5	51.3
6/24/2008	TWB 7	2	51.3

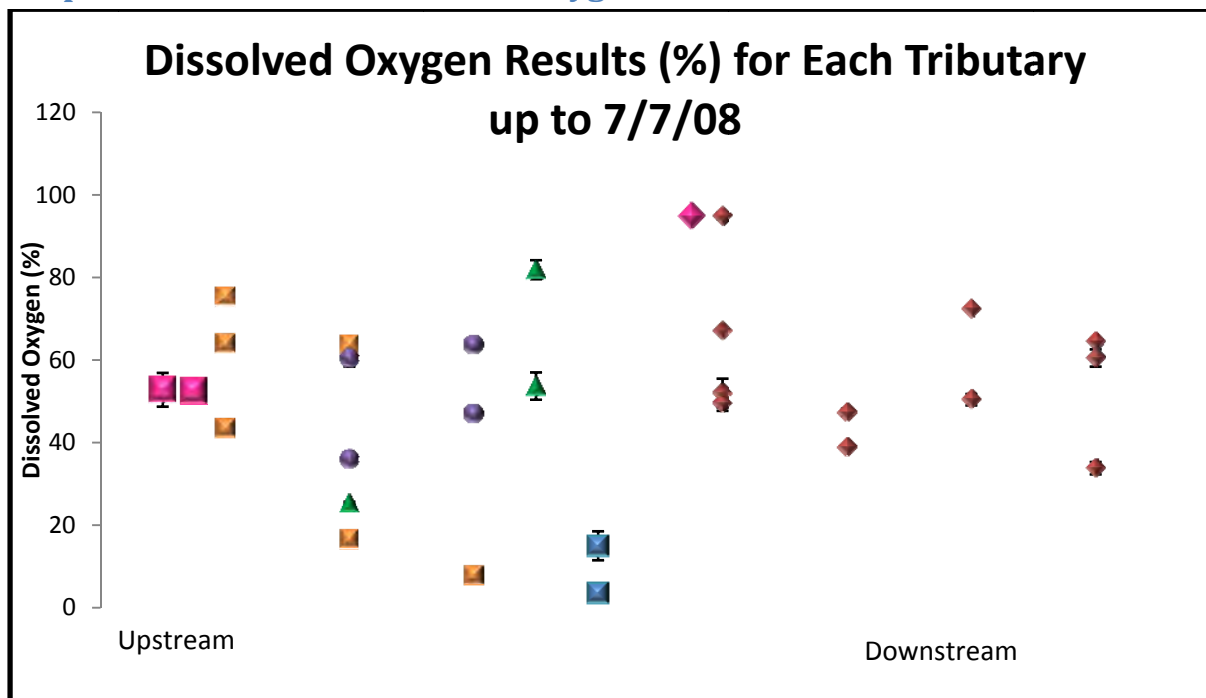
Table 29: Hardness values in mg/L for Beaman's Brook

Date	Site	Position	Hardness
5/29/2008	EBB 10	3	153.9
6/2/2008	TBB 9	2	119.7
6/5/2008	EBB 10	3	136.8
6/10/2008	TBB 9	2	136.8
6/17/2008	TBB 9	2	136.8
6/24/2008	EBB 10	3	51.3
Storm Water			
6/25/2008	TBB 9	1.75	119.7

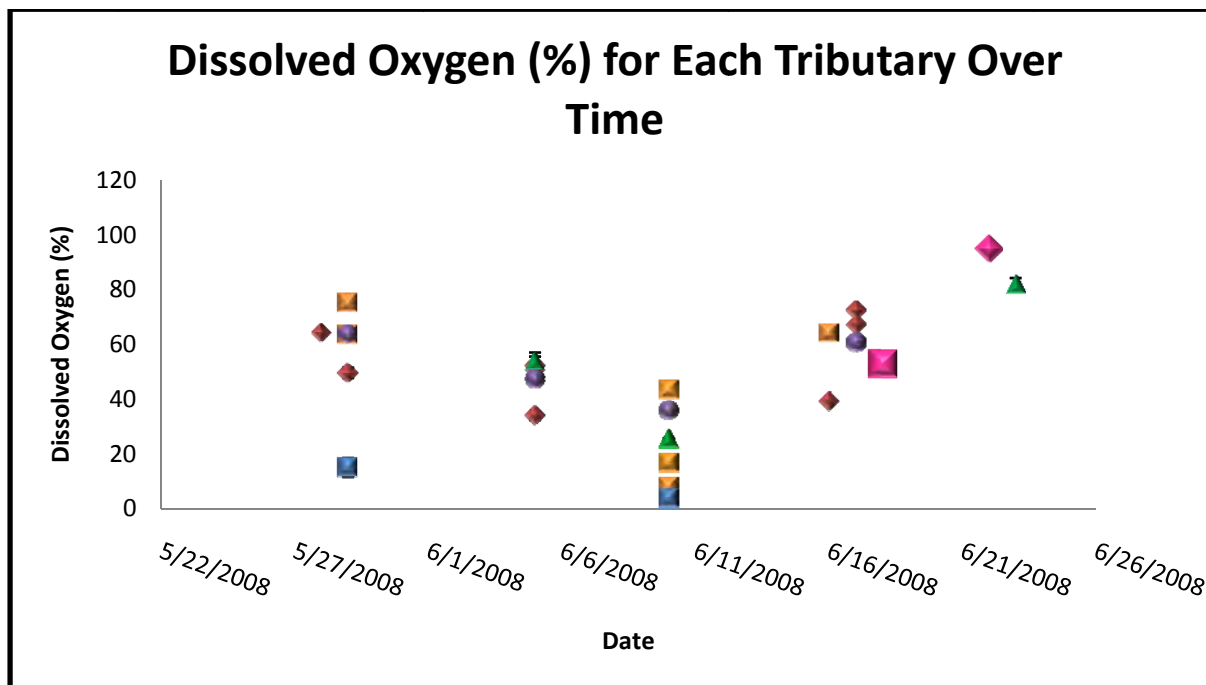
Table 30: Hardness values in mg/L for Filley Brook

Date	Site	Position	Hardness
5/29/2008	EFB 11	4	171
6/10/2008	EFB 11	4	119.7
6/25/2008	EFB 11	4	102.6

## Graphs and Tables for Dissolved Oxygen % Air Saturation Results



Graph 13: This graph shows dissolved oxygen readings in % air saturation for each tributary.



Graph 14: This graph shows the dissolved oxygen readings in % air saturation for each tributary over time.

**Table 31: Dissolved oxygen in % air saturation for the North Branch of the Park River**

Date	Site	Position	Average DO	S.D.
5/28/2008	ENBPR 4	8	64.4	0
5/29/2008	TNBPR 1	5	49.6	1.9
6/5/2008	TNBPR 1	5	52	3.5
6/5/2008	ENBPR 4	8	33.8	1.5
6/5/2008	MNBPR 3	7	50.4	1.4
6/5/2008	MNBPR 2	6	47.4	0.8
6/16/2008	MNBPR 2	6	39	0
6/17/2008	TNBPR 1	5	67.1	0.1
6/17/2008	MNBPR 3	7	72.4	0.6
6/17/2008	ENBPR 4	8	60.5	2.1
Storm Water				
6/22/2008	TNBPR 1	4.75	94.9	0.8

**Table 32: Dissolved oxygen in % air saturation for Tumble Brook**

Date	Site	Position	Average DO	S.D.
5/29/2008	TTB 5	1	75.3	0
5/29/2008	MTB 5.5	2	63.7	0
6/10/2008	MTB 5.5	2	16.6	0.1
6/10/2008	TTB 5	1	43.5	1.9
6/10/2008	ETB 6	3	7.8	0.1
6/16/2008	TTB 5	1	63.9	0
Storm Water				
6/18/2008	TTB 5	0.5	52.8	4.1
6/18/2008	TTB 5	0.75	52.5	0.6

**Table 33: Dissolved oxygen in % air saturation for Wash Brook**

Date	Site	Position	Average DO	S.D.
6/5/2008	EWB 8	3.5	53.7	3.3
6/10/2008	TWB 7	2	25.4	0.3
6/23/2008	EWB 8	3.5	81.9	2.3

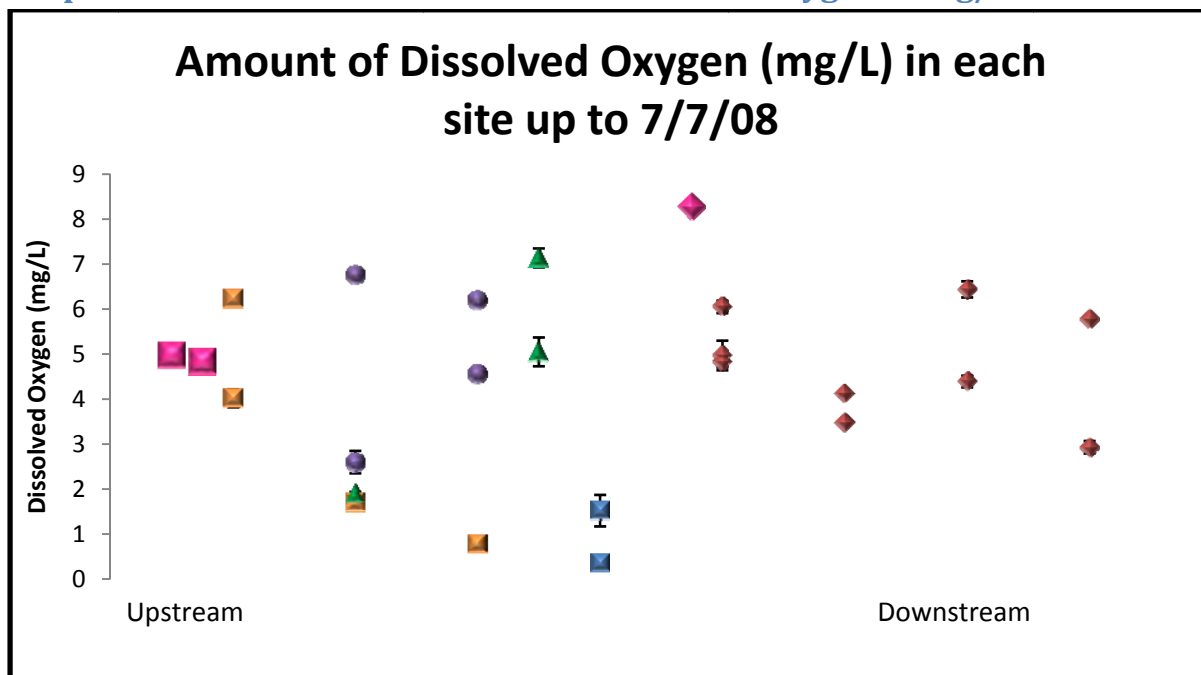
**Table 34: Dissolved oxygen in % air saturation for Beaman's Brook**

Date	Site	Position	Average DO	S.D.
5/29/2008	EBB 10	3	63.8	0
6/5/2008	EBB 10	3	47.1	1.6
6/10/2008	TBB 9	2	36	0.7
6/17/2008	TBB 9	2	60.5	2.1

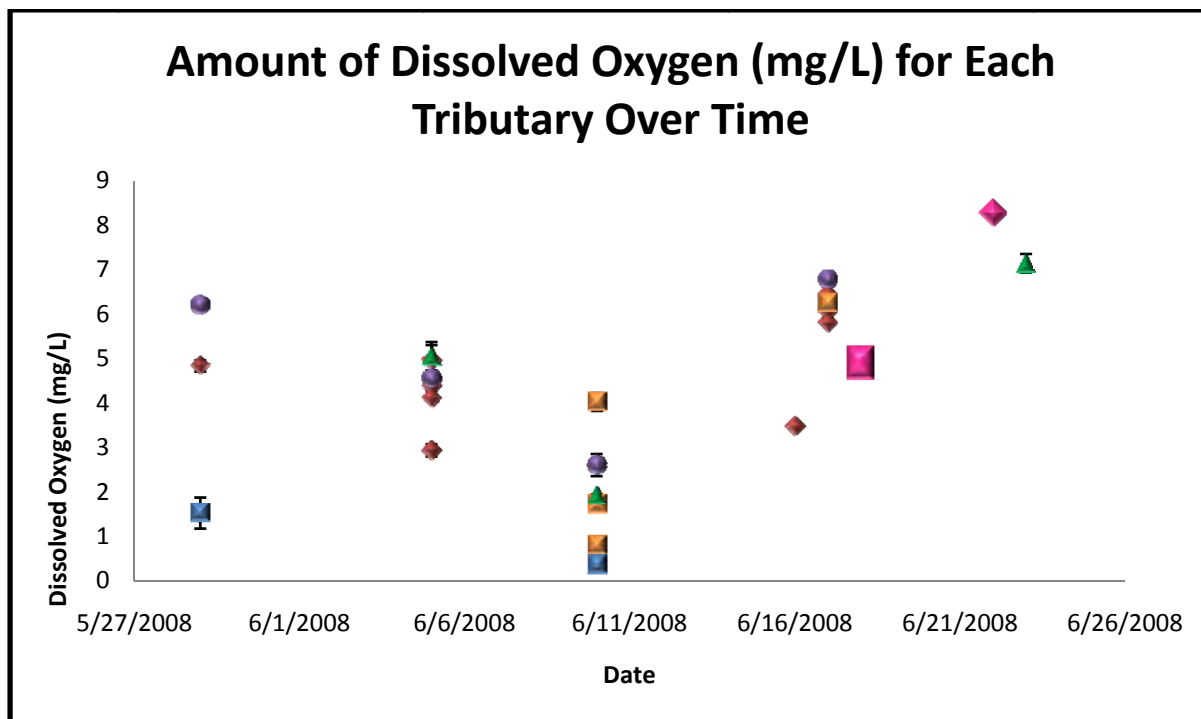
**Table 35: Dissolved oxygen in % air saturation for Filley Brook**

Date	Site	Position	Average DO	S.D.
5/29/2008	EFB 11	4	15	3.5
6/10/2008	EFB 11	4	3.5	0.1

## Graphs and Tables for the Amount of Dissolved Oxygen in mg/L



Graph 15: This graph shows the amount of dissolved oxygen in mg/L for each tributary.



Graph 16: This graph shows the amount of dissolved oxygen in mg/L for each tributary over time.



Table 36: Dissolved oxygen in mg/L for the North Branch of the Park River

Date	Site	Position	Average DO	S.D.
5/29/2008	TNBPR 1	5	4.83	0.13
6/5/2008	TNBPR 1	5	4.97	0.33
6/5/2008	ENBPR 4	8	2.93	0.14
6/5/2008	MNBPR 3	7	4.39	0.13
6/5/2008	MNBPR 2	6	4.12	0.06
6/16/2008	MNBPR 2	6	3.47	0
6/17/2008	TNBPR 1	5	6.05	0.14
6/17/2008	MNBPR 3	7	6.44	0.18
6/17/2008	ENBPR 4	8	5.8	0.04
Storm Water				
6/22/2008	TNBPR 1	4.75	8.28	0.02

Table 37: Dissolved oxygen in mg/L for Tumble Brook

Date	Site	Position	Average DO	S.D.
6/10/2008	MTB 5.5	2	1.72	0.01
6/10/2008	TTB 5	1	4.02	0.2
6/10/2008	ETB 6	3	0.79	0.03
6/17/2008	TTB 5	1	6.24	0
Storm Water				
6/18/2008	TTB Storm 1	0.5	4.96	0.12
6/18/2008	TTB Storm 2	0.75	4.82	0.04

Table 38: Dissolved oxygen in mg/L for Wash Brook

Date	Site	Position	Average DO	S.D.
6/5/2008	EWB 8	3.5	5.05	0.32
6/10/2008	TWB 7	2	1.91	0.03
6/23/2008	EWB 8	3.5	7.14	0.21

Table 39: Dissolved oxygen in mg/L for Beaman's Brook

Date	Site	Position	Average DO	S.D.
5/29/2008	EBB 10	3	6.2	0.01
6/5/2008	EBB 10	3	4.56	0.15
6/10/2008	TBB 9	2	2.6	0.25
6/17/2008	TBB 9	2	6.77	0.09

Table 40: Dissolved oxygen in mg/L for Filley Brook

Date	Site	Position	Average DO	S.D.
5/29/2008	EFB 11	4	1.52	0.35
6/10/2008	EFB 11	4	0.36	0.03

## Conclusion

In conclusion, the North Branch Park River watershed is healthy. Most of our data confirms and strengthens this assertion. All of the parameters that were tested for were all up to the standards set forth by the EPA. The only site that may be of concern is the Filley Brook site where sediment analysis might reveal more of the condition of the site and what may be polluting it.

## Works Cited

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# Part II: Biological Assessment Using Macroinvertebrate Populations

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For the North Branch Park River and Tributaries

**Data Preparer: Caroline Lewis**

**Assistants: Lucy Schiffman, Jeffrey McNamara, Victoria Doñé, Andrew Kennedy**

**Project Supervisor: Dr. Jonathan Gourley**

**7/24/2008**

## Discussion

There was no visible change in the biotic index (Figures 1 and 2), Simpson's Index (Figures 3 and 4), or taxa richness (Figures 5 and 6) over time or by position in the watershed. There was no visible change in the percent EPT (ephemeroptera, plecoptera, and trichoptera populations) by position (Figure 8); however there are some trends over time: the percent EPT increased in the Wash Brook over time (Figure 7) and decreased in the Beaman's Brook over time (Figure 7). It is good to have high EPT percentages because ephemeroptera, plecoptera, and trichoptera are sensitive to pollution.

Looking at percent EPT alone, The Wash Brook was overall the healthiest, followed by the Park River. The Tumble Brook was the least healthy by this indicator (Tables 1-5). The Wash Brook was also the healthiest section tested by the results of the biotic index, again followed by the Park River (Tables 6-10). By this measure, the Beamans Brook was the least healthy. On average, the quality of the Park River, Tumble Brook, and Wash Brook can be classified as "good" according to the Biotic Index. This means there is only some organic pollution. On average, the Beamans Brook and Tumble Brook tributary have "substantially likely" organic pollution and fair water quality according to the Biotic Index.

The Simpson's Index shows that the Tumble Brook Tributary is the most diverse, followed by the Beamans Brook, and the Tumble Brook is the least (Tables 11-15). On average, the Wash Brook had the most aquatic invertebrates, followed by the Tumble Brook. The Tumble Brook tributary had the least, besides the Filley Brook, where no bugs were found because of the muddy bottom, which does not provide a suitable habitat for aquatic macro invertebrates.

## Data Tables for EPT

**Table 1. The Percent EPT at various sites along the North Branch Park River.**

Site Name	Date	Percent EPT
TNBPR 1	5/29/2008	27
MNBPR 2	5/26/2008	35
MNBPR 3	5/26/2008	63
ENBPR 4	5/29/2008	22
MNBPR 2	6/5/2008	16
MNBPR 3	6/5/2008	21
TNBPR 1	6/5/2008	39
ENBPR 4	6/5/2008	7
MNBPR 2	6/16/2008	2
MNBPR 3	6/17/2008	3
TNBPR 1	6/17/2008	31
Average	NA	24.18181818

Table 2. The Percent EPT at various sites along the Tumble Brook.

Site name	Date	Percent EPT
TTB 5	5/29/2008	12
TTB 5	6/2/2008	6
ETB 6	6/3/2008	3
MTB 5.5	6/10/2008	0
ETB 6	6/10/2008	6
TTB 5	6/10/2008	16
TTB 5	6/16/2008	18
ETB 6	6/25/2008	1
Average	NA	7.75

Table 3. The Percent EPT at various sites along the Wash Brook.

Site Name	Date	Percent EPT
TWB 7	5/23/2008	38
EWB 8	5/26/2008	31
EWB 8	6/5/2008	22
TWB 7	6/10/2008	57
EWB 8	6/23/2008	65
TWB 7	6/24/2008	0
Average	NA	35.5

Table 4. The Percent EPT at various sites along the Beamans Brook.

Site Name	Date	Percent EPT
EBB 10	5/29/2008	45
EBB 10	6/5/2008	23
EBB 10	6/24/2008	0
Average	NA	22.66666667

Table 5. The Percent EPT at various sites along the Tumble Brook tributary.

Site Name	Date	Percent EPT
ETBT	6/2/2008	10

## Data tables for biotic index

Table 6. The biotic Index from locations along the Park River.

Site Name	Date	Biotic Index
TNBPR 1	5/29/2008	4.08
MNBPR 2	5/26/2008	4
MNBPR 3	5/26/2008	4.05
ENBPR 4	5/29/2008	5.24
MNBPR 2	6/5/2008	5.41
MNBPR 3	6/5/2008	4.14
TNBPR 1	6/5/2008	3.61
ENBPR 4	6/5/2008	4.93
MNBPR 2	6/16/2008	5.24
MNBPR 3	6/17/2008	4.75
TNBPR 1	6/17/2008	4.38
Average	NA	4.53

Table 7. The biotic Index at locations along the Tumble Brook.

Site name	Date	Biotic Index
TTB 5	5/29/2008	4.6
TTB 5	6/2/2008	4.71
ETB 6	6/3/2008	4.8
MTB 5.5	6/10/2008	4.65
ETB 6	6/10/2008	5.16
TTB 5	6/10/2008	4.59
TTB 5	6/16/2008	4.33
ETB 6	6/25/2008	5.35
Average	NA	4.77375

Table 8. The biotic Index from locations along the Wash Brook.

Site Name	Date	Simpson's Diversity Index
TWB 7	5/23/2008	5.02
EWB 8	5/26/2008	3.08
EWB 8	6/5/2008	4.43
TWB 7	6/10/2008	3.63
EWB 8	6/23/2008	3.57
TWB 7	6/24/2008	6.73
Average	NA	4.41

Table 9. The biotic index from the Beamans Brook.

Site Name	Date	Biotic Index
EBB 10	5/29/2008	6.16
EBB 10	6/5/2008	4.92
EBB 10	6/24/2008	5.39
Average	NA	5.49

Table 10. The biotic Index from one sample at the Tumble Brook tributary.

Site Name	Date	Biotic Index
ETBT	6/2/2008	5.03

## Data Tables for Simpson's Diversity Index

Table 11. The Simpson's Diversity Index from locations on the Park River.

Site Name	Date	Simpson's Diversity Index
TNBPR 1	5/29/2008	2.7
MNBPR 2	5/26/2008	4.24
MNBPR 3	5/26/2008	2.23
ENBPR 4	5/29/2008	3.24
MNBPR 2	6/5/2008	2.27
MNBPR 3	6/5/2008	3.25
TNBPR 1	6/5/2008	3.07
ENBPR 4	6/5/2008	2.58
MNBPR 2	6/16/2008	2.8
MNBPR 3	6/17/2008	2.91
TNBPR 1	6/17/2008	2.03
Average	NA	2.847272727



**Table 12. The Simpson's Diversity Index from locations along the Tumble Brook.**

Site name	Date	Simpsons Diversity Index
TTB 5	5/29/2008	1.53
TTB 5	6/2/2008	1.46
ETB 6	6/3/2008	2.08
MTB 5.5	6/10/2008	5.33
ETB 6	6/10/2008	2.32
TTB 5	6/10/2008	1.51
TTB 5	6/16/2008	2.37
ETB 6	6/25/2008	1.98
Average	NA	2.3225

**Table 13. The Simpson's Diversity Index from locations on the Wash Brook.**

Site Name	Date	Simpson's Diversity Index
TWB 7	5/23/2008	3.86
EWB 8	5/26/2008	3.3
EWB 8	6/5/2008	2.56
TWB 7	6/10/2008	3.82
EWB 8	6/23/2008	1.63
TWB 7	6/24/2008	3.95
Average	NA	3.186666667

**Table 14. The Simpson's Diversity Index from the Beamans Brook.**

Site Name	Date	Simpson's Diversity Index
EBB 10	5/29/2008	2.66
EBB 10	6/5/2008	4.41
EBB 10	6/24/2008	3.89
Average	NA	3.653333333

**Table 15. The Simpson's Diversity Index from one location of the Tumble Brook tributary.**

Site Name	Date	Simpson's Diversity Index
ETBT	6/2/2008	4.74

## Graphs

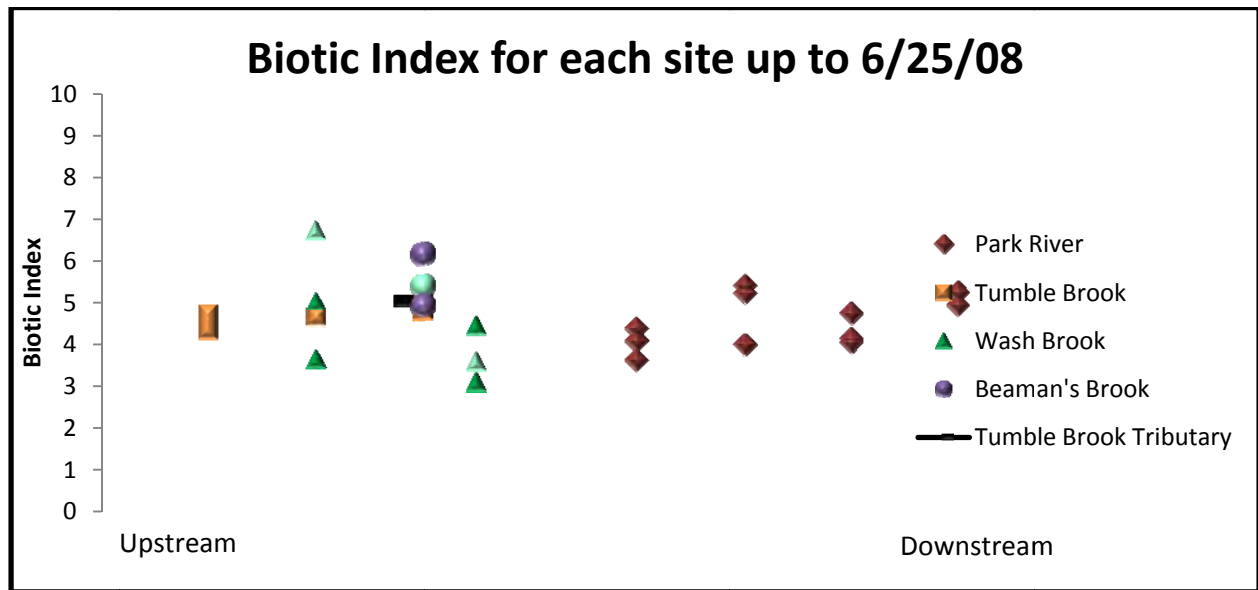


Figure 1. The biotic indices of each sample taken from all sites along the Park River and each Tributary by position.

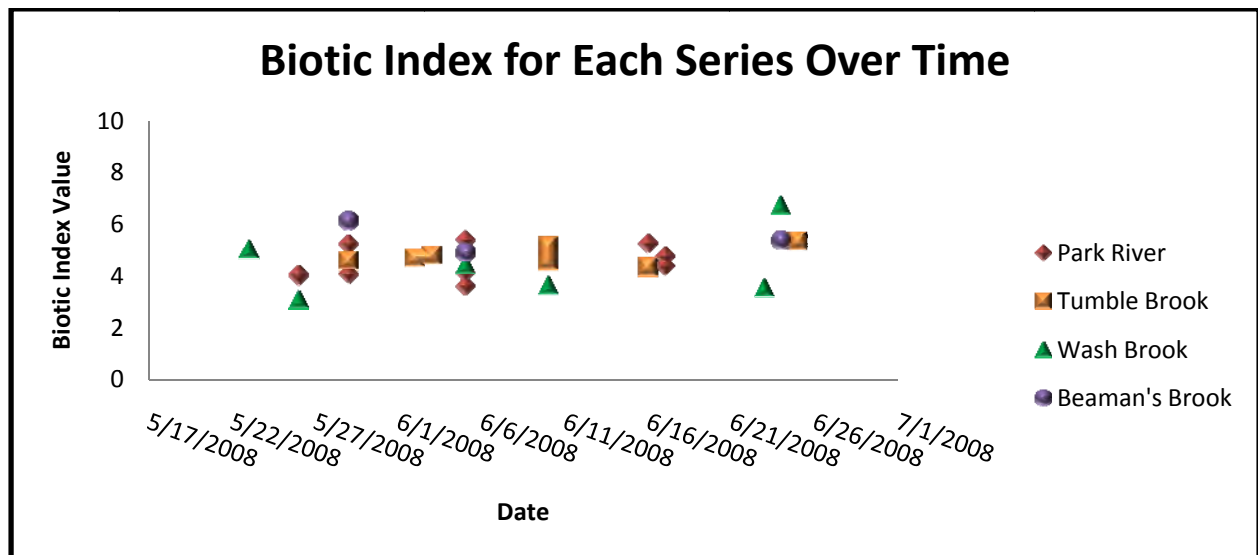


Figure 2. The biotic indices from each sample taken from all sites graphed by time.

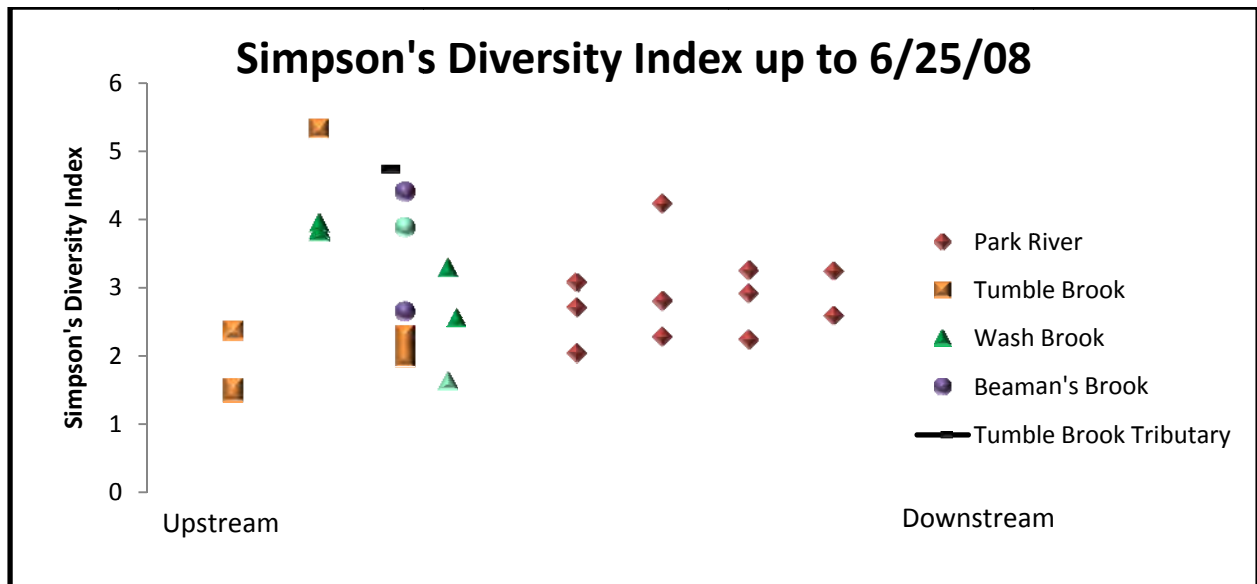


Figure 3. The Simpson's Diversity Index for each sample taken graphed by position.

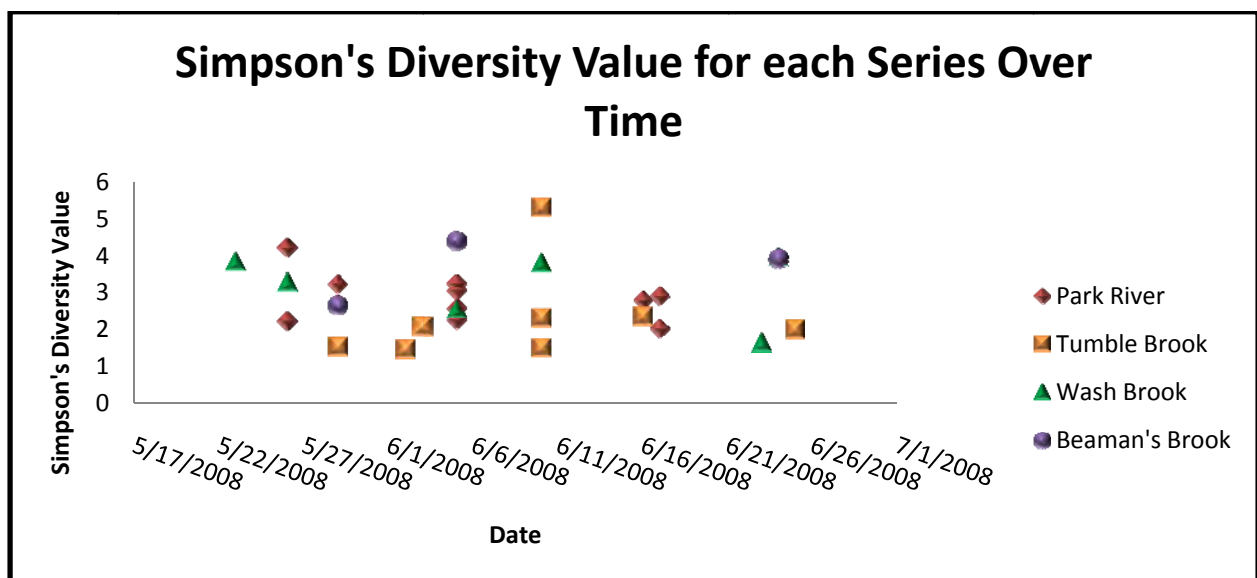


Figure 4. The Simpson's Diversity index for each sample graphed over time.

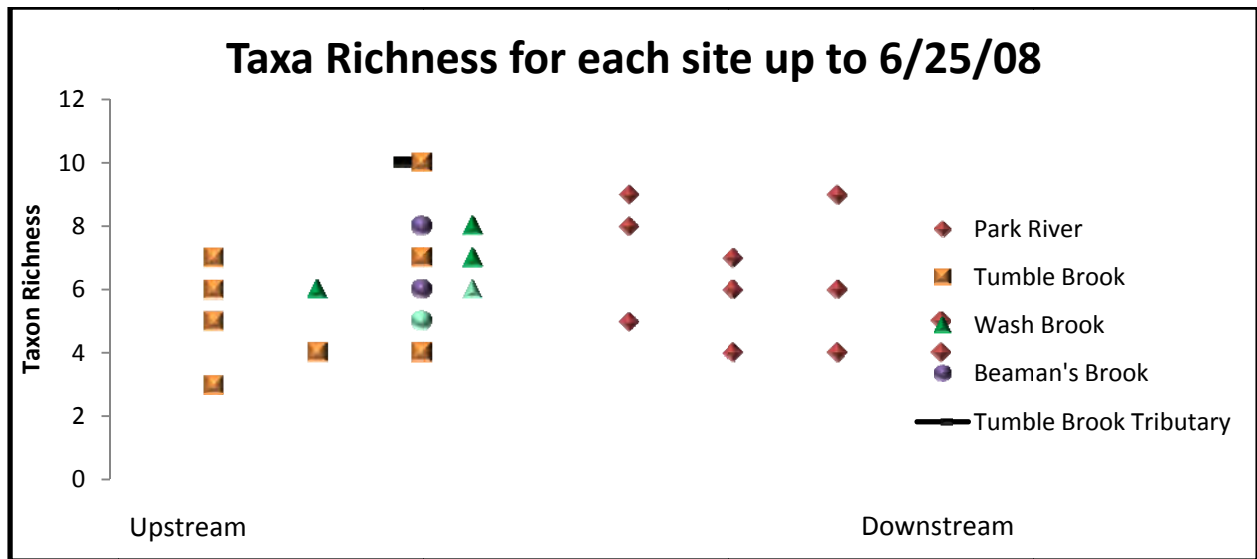


Figure 5. The taxa richness of each sample from all sites graphed by position.

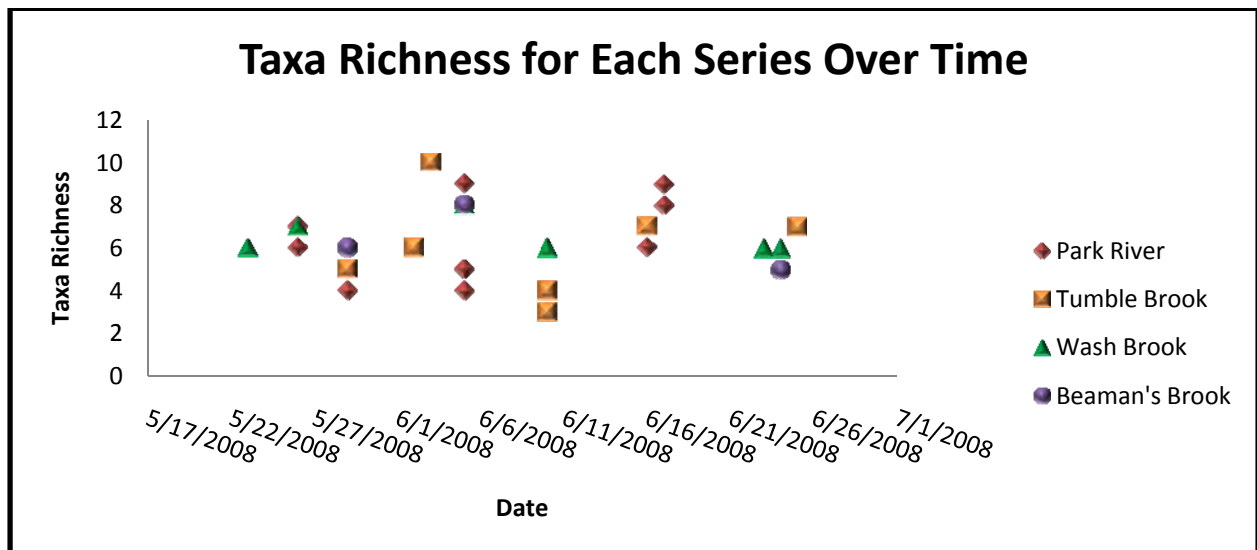


Figure 6. The taxa richness from each sample graphed over time.

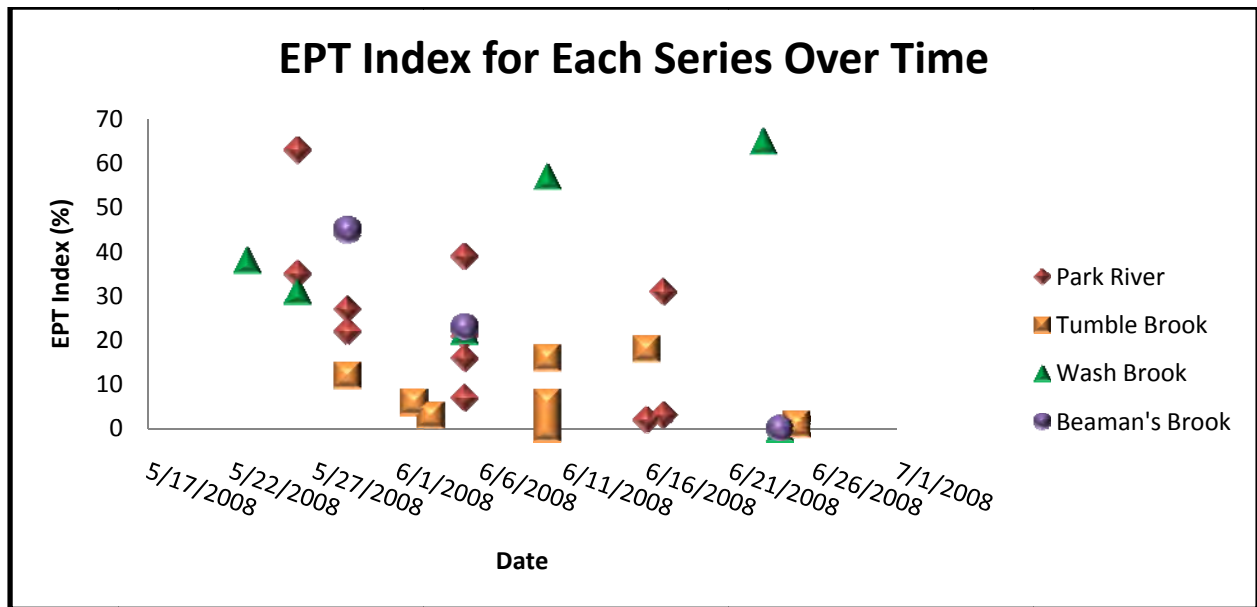


Figure 7. The percent EPT for each site over time.

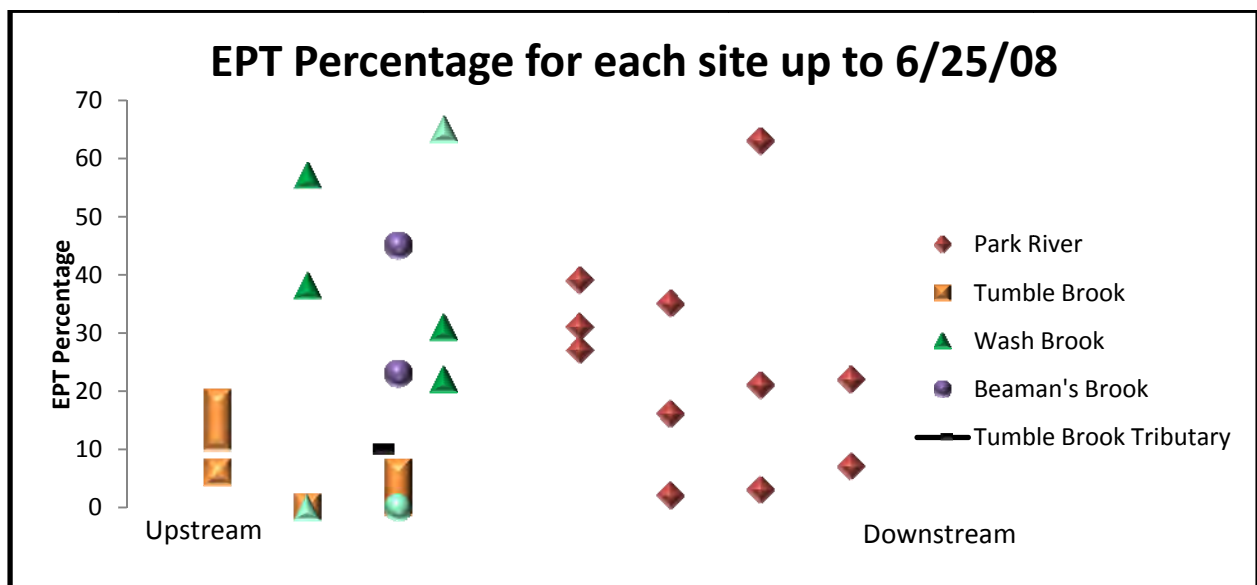


Figure 8. The percent EPT for each site by position.

# Part III: Anion Chromatography

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For the North Branch Park River and Tributaries

**Data Preparer: Lucy Schiffman**

**Assistants: Victoria Doñé, Caroline Lewis, Andrew Kennedy, Jeffrey McNamara**

**Project Supervisor: Dr. Jonathan Gourley**

**7/24/2008**

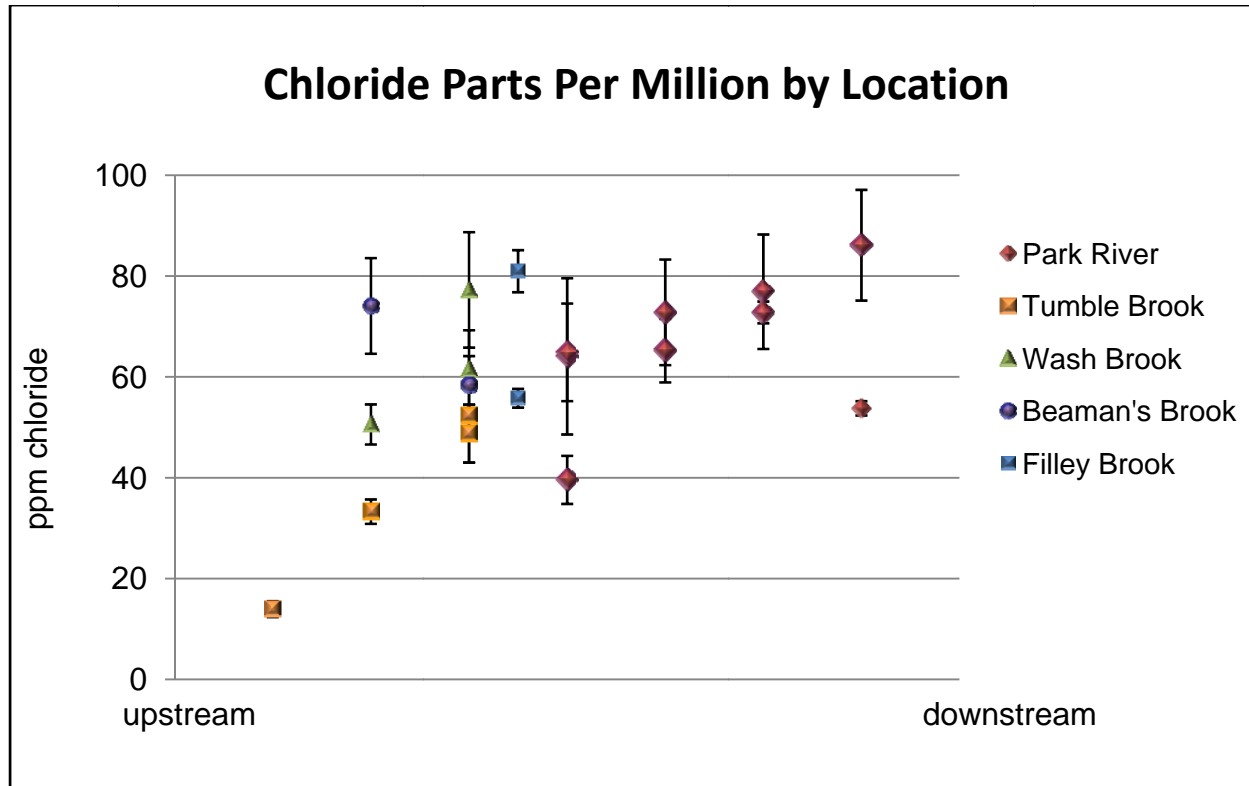
## Discussion

All anion concentrations were obtained in triplicate and result averages reflect three independent analysis trials. The data is graphed by location in the watershed as well as over time. Each site has its own position number according to how far upstream or downstream it is in the watershed. For example, the most upstream site has a value of 1 and the most downstream site has a value of 8. The sites also have code names, for instance MTB stands for the middle of Tumble Brook, EFB stands for the end of Filley Brook, etc . See figure A-1 in the executive summary for a full listing of location names and codes.

The graphs made from the ion chromatograph data show that anion content generally increases moving downstream in the north branch of the Park River. When the graphs are organized by date there is not an obvious pattern in anion concentration, but when organized by location in the watershed, there appears to be a rise in both chloride and sulfate anions. This may indicate increased runoff and pollutants further downstream. One tributary that has higher anion concentrations than expected is the Tumble Brook, specifically at the sites directly downstream from several golf courses (MTB, the middle of Tumble Brook, and ETB, the end of Tumble Brook). A site along the Beamans Brook right next to a construction project also has comparatively high nitrate anion concentrations (see tables 6-10). The main trunk of the Park River also shows a rise in all anions, which is expected as you move downstream and the river collects runoff from a larger area of the watershed.

## Chloride

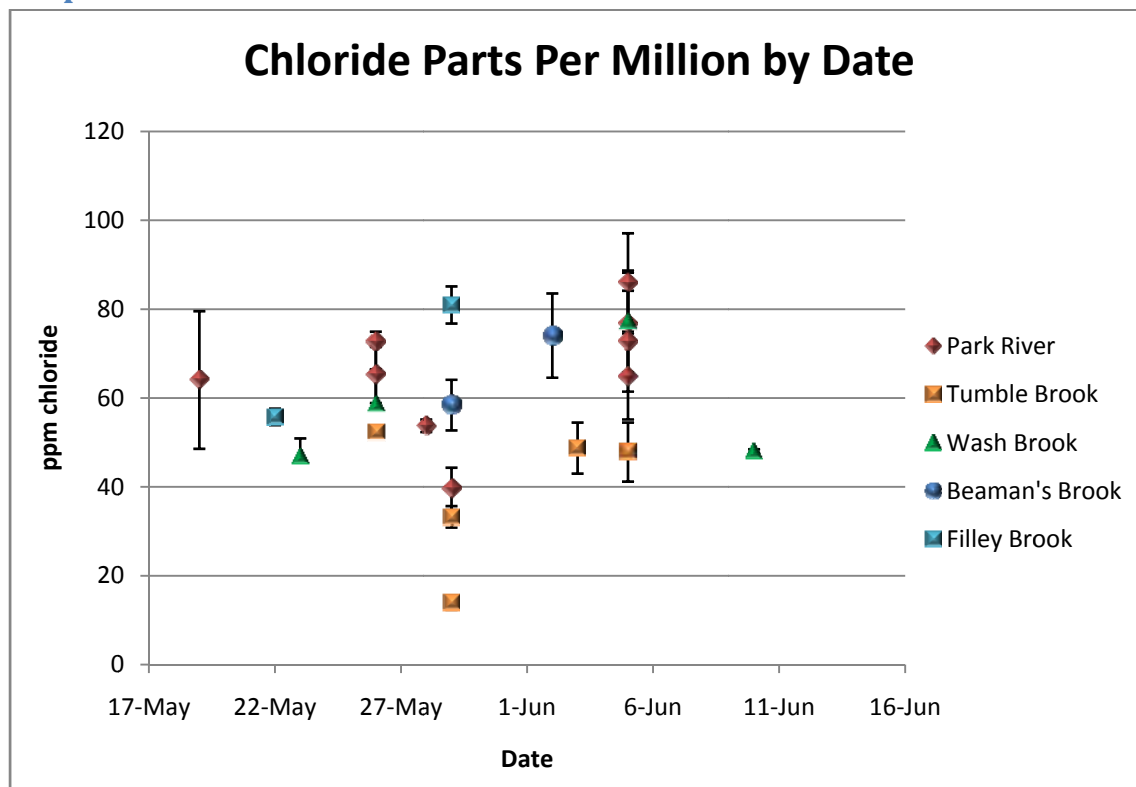
Graph 1:



Graph 1 shows the chloride anion concentration in parts per million organized by position in the watershed. There is generally a steady upward trend in chloride anion concentration across the watershed. However, not all tributaries show this trend. There is no trend evident in Filley Brook since there are so few data points. Beamans Brook anion concentration decreases, however, there are only two data points, both with large margins of error. The Tumble Brook tributary shows an upward trend, as does Wash Brook and the Park River, not including the one obvious outlier for the Park River. There are three data points, one for Beamans Brook, Wash Brook, and Filley Brook, that have higher anion concentrations than would be expected so far upstream in the watershed.



Graph 2:



Graph 2 shows the chloride anion concentration in parts per million organized by date collected. There is not a trend in chloride anion concentration across time.

Table 1: Chloride anion concentrations in parts per million for the North Branch of the Park River

Date	Site	Position	Average ppm	SD
5/19/2008	TNBPR 1	5	64.067	15.494
5/26/2008	MNBPR 2	6	65.213	6.310
5/26/2008	MNBPR 3	7	72.784	2.161
5/28/2008	ENBPR 4	8	53.757	1.414
5/29/2008	TNBPR 1	5	39.565	4.770
6/5/2008	TNBPR 1	5	64.871	9.681
6/5/2008	ENBPR 4	8	86.1102	10.980
6/5/2008	MNBPR 3	7	76.890	11.353
6/5/2008	MNBPR 2	6	72.807	10.476

Table 2: Chloride anion concentrations in parts per million for Tumble Brook

Date	Site	Position	Average ppm	SD
5/26/2008	ETB 6	3	52.303	5.736
5/29/2008	TTB 5	1	13.935	1.581
5/29/2008	MTB 5.5	2	32.260	2.418
6/3/2008	ETB 6	3	48.742	5.736
6/5/2008	ETB 6	3	47.844	6.641
6/10/2008	TTB 5	1	42.957	34.503

Table 3: Chloride anion concentrations in parts per million for Wash Brook

Date	Site	Position	Average ppm	SD
5/23/2008	TWB 7	2	50.565	3.980
5/26/2008	EWB 8	3.5	61.501	7.747
6/5/2008	EWB 8	3.5	77.250	11.452
6/10/2008	TWB 7	2	48.077	0.401

Table 4: Chloride anion concentrations in parts per million for Beaman's Brook

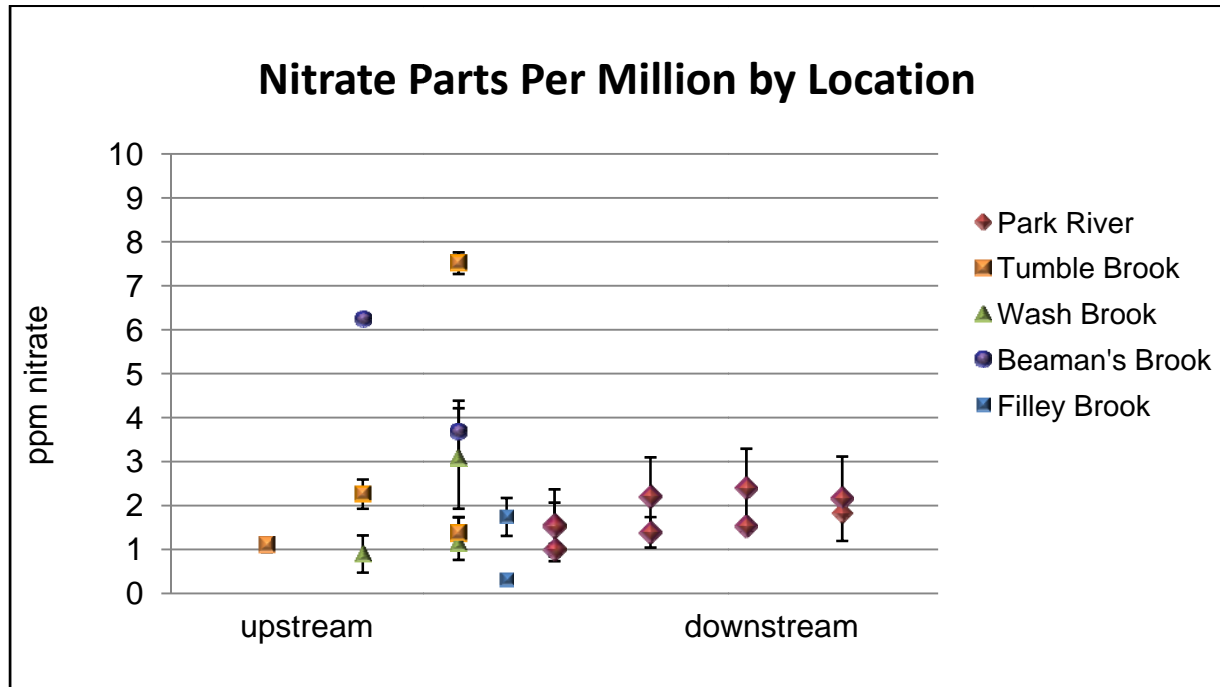
Date	Site	Position	Average ppm	SD
5/29/2008	EBB 10	3	58.428	5.697
6/2/2008	TBB 9	2	74.074	9.490

Table 5: Chloride anion concentrations in parts per million for Filley Brook

Date	Site	Position	Average ppm	SD
5/22/2008	EFB 11	4	55.761	1.861
5/29/2008	EFB 11	4	80.970	4.176

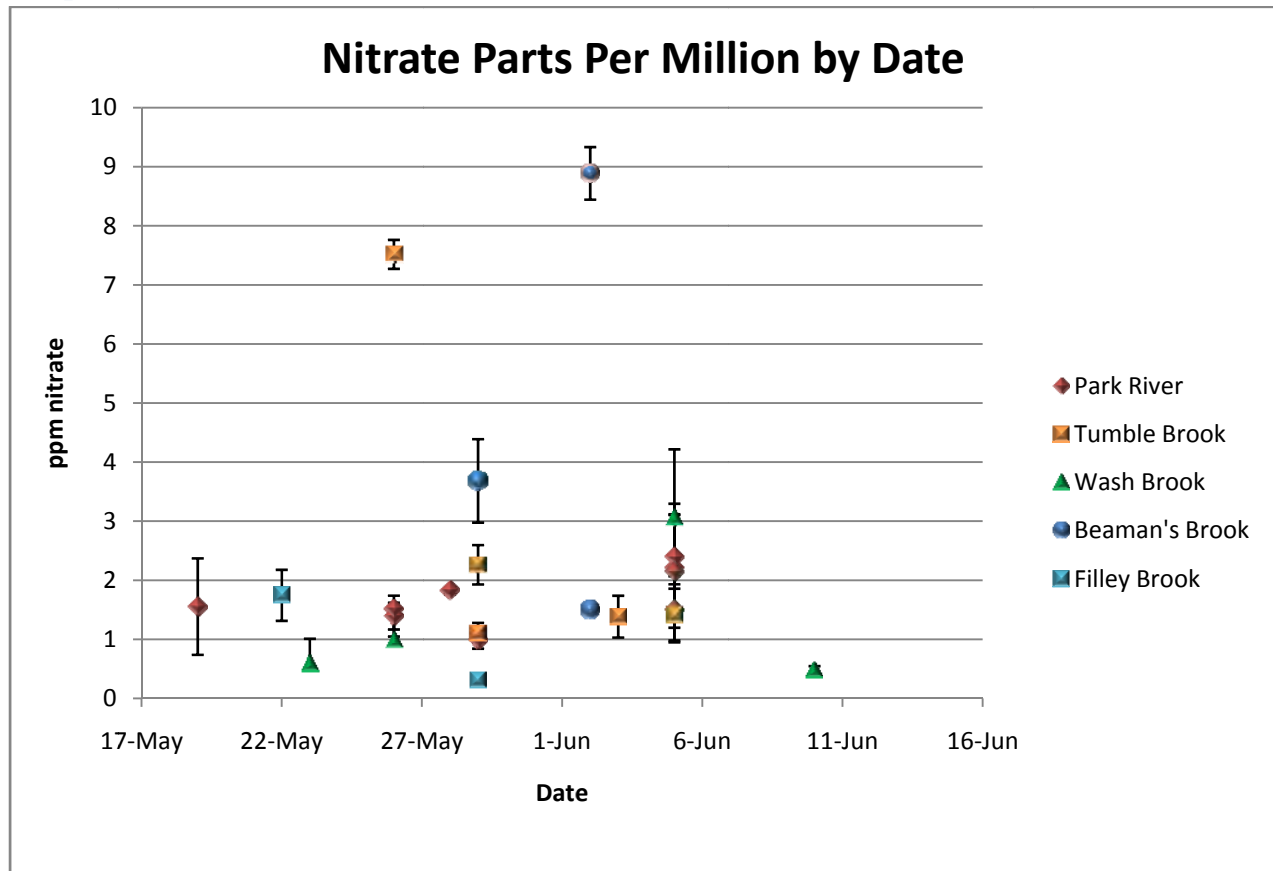
## Nitrate

Graph 3:



Graph 3 shows the nitrate anion concentration in parts per million organized by position in the watershed. There may be a slight upward trend in nitrate anion concentration across the watershed, visible in the Park River, but not in any of the tributaries. There is a spike of nitrate anions on two different dates at Tumble Brook and Beaman's Brook. The spike in nitrates at Tumble Brook could be due to runoff from fertilizers from the golf course that is located directly upstream from our testing site. The spike at the Beaman's Brook site could be due to a current construction project occurring there.

Graph 4:



Graph 4 shows the nitrate anion concentration in parts per million organized by date collected. There is not an obvious trend in nitrate anion concentration across time. There is the same spike of nitrate anions in Tumble Brook and Beaman's Brook as seen in graph 3.

Table 6: Nitrate anion concentrations in parts per million for the North Branch of the Park River

Date	Site	Position	Average ppm	SD
5/19/2008	TNBPR 1	5	1.555	0.817
5/26/2008	MNBPR 2	6	1.394	0.346
5/26/2008	MNBPR 3	7	1.514	0.106
5/28/2008	ENBPR 4	8	1.818	0.058
5/29/2008	TNBPR 1	5	0.9878	0.145
6/5/2008	TNBPR 1	5	1.510	0.560
6/5/2008	ENBPR 4	8	2.158	0.960
6/5/2008	MNBPR 3	7	2.397	0.900
6/5/2008	MNBPR 2	6	2.205	0.896

Table 7: Nitrate anion concentrations in parts per million for Tumble Brook

Date	Site	Position	Average ppm	SD
5/26/2008	ETB 6	3	7.518	0.246
5/29/2008	TTB 5	1	1.118	0.168
5/29/2008	MTB 5.5	2	2.263	0.333
6/3/2008	ETB 6	3	1.384	0.357
6/5/2008	ETB 6	3	1.419	0.439
6/10/2008	TTB 5	1	0.846	0.181

Table 8: Nitrate anion concentrations in parts per million for Wash Brook

Date	Site	Position	Average ppm	SD
5/23/2008	TWB 7	2	0.901	0.423
5/26/2008	EWB 8	3.5	1.161	0.393
6/5/2008	EWB 8	3.5	3.074	1.142
6/10/2008	TWB 7	2	0.477	0.071

Table 9: Nitrate anion concentrations in parts per million for Beaman's Brook

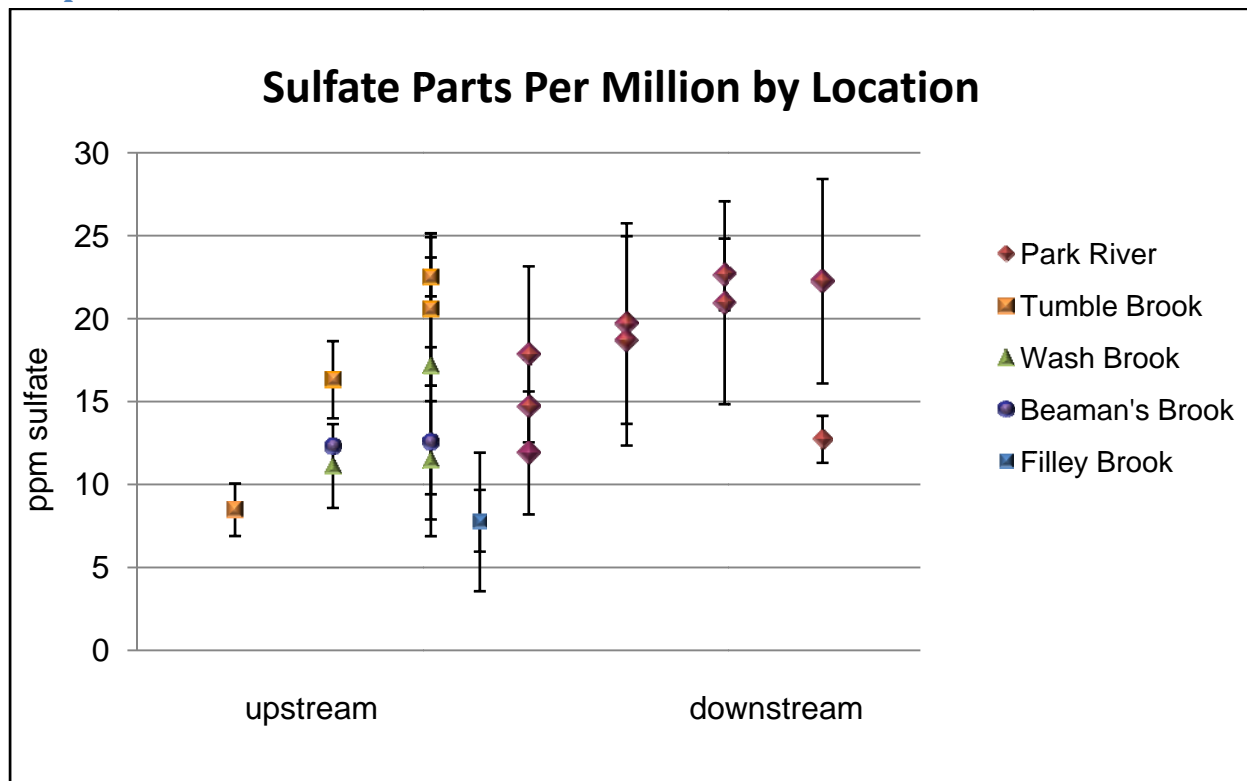
Date	Site	Position	Average ppm	SD
5/29/2008	EBB 10	3	3.683	0.707
6/2/2008	TBB 9	2	6.243	0.987

Table 10: Nitrate anion concentrations in parts per million for Filley Brook

Date	Site	Position	Average T	SD
5/22/2008	EFB 11	4	1.745	0.432
5/29/2008	EFB 11	4	0.311	0.017

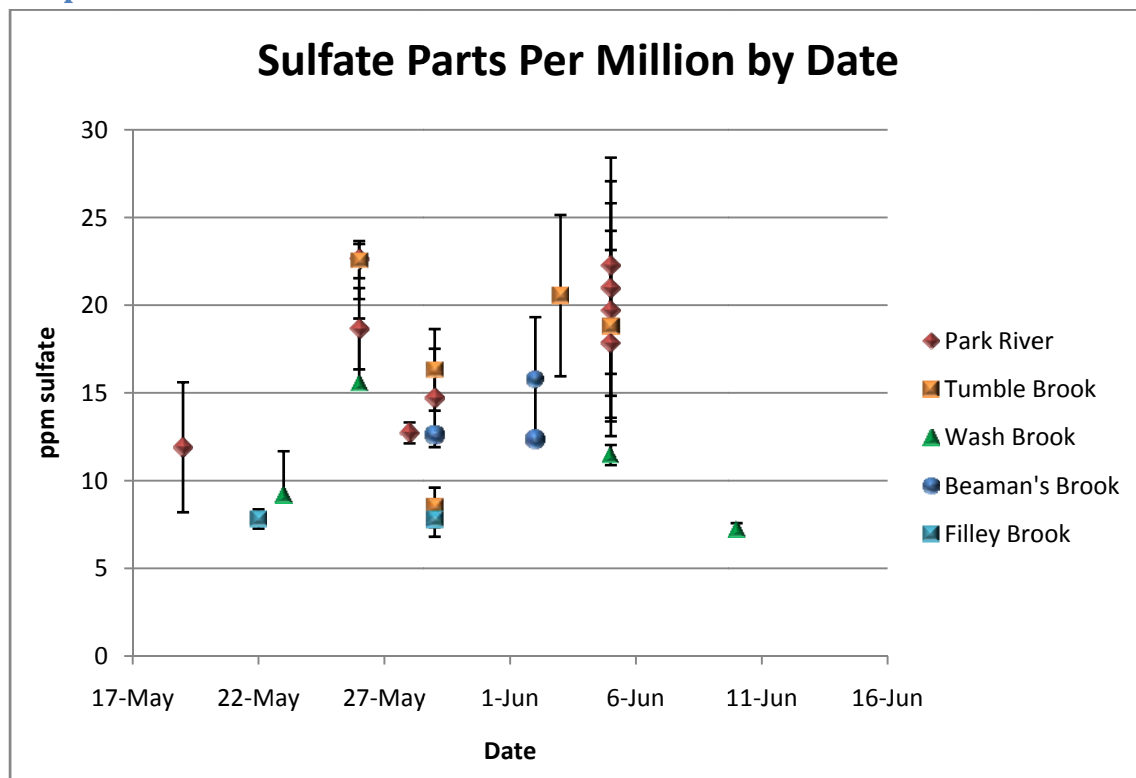
## Sulfate

Graph 5:



Graph 5 shows the sulfate anion concentration in parts per million organized by position in the watershed. There appears to be an upward trend in sulfate anion concentration across the watershed. The trends in sulfate content are very similar to those of chloride content. Like chloride, there is generally a steady upward trend in sulfate anion concentration across the watershed, but not all tributaries show this trend. Beaman's Brook anion concentration stays about the same. The Tumble Brook tributary shows a strong upward trend, as does the Park River, not including the one obvious outlier for the Park River. The Tumble Brook sulfate concentrations likely spike so sharply due to runoff from the golf courses directly upstream from the middle and end of the Tumble Brook. The margins of error for sulfate are much larger than those for the other anions. This is due to the fact that sulfate anions, as evident in tables 11-15, are found at much lower concentrations than chloride anions.

**Graph 6:**



Graph 6 shows the sulfate anion concentration in parts per million organized by date collected. There is not an obvious trend in sulfate anion concentration across time.

**Table 11: Sulfate anion concentrations in parts per million for the North Branch of the Park River**

Date	Site	Position	Average ppm	SD
5/19/2008	TNBPR 1	5	11.910	3.705
5/26/2008	MNBPR 2	6	18.665	2.314
5/26/2008	MNBPR 3	7	22.672	0.995
5/28/2008	ENBPR 4	8	12.728	0.597
5/29/2008	TNBPR 1	5	14.720	2.804
6/5/2008	TNBPR 1	5	17.851	5.303
6/5/2008	ENBPR 4	8	22.259	6.164
6/5/2008	MNBPR 3	7	20.961	6.116
6/5/2008	MNBPR 2	6	19.707	6.044



Table 12: Sulfate anion concentrations in parts per million for Tumble Brook

Date	Site	Position	Average ppm	SD
5/26/2008	ETB 6	3	22.522	0.984
5/29/2008	TTB 5	1	8.483	1.126
5/29/2008	MTB 5.5	2	16.322	2.327
6/3/2008	ETB 6	3	20.555	4.595
6/5/2008	ETB 6	3	18.814	5.433
6/10/2008	TTB 5	1	7.280	0.242

Table 13: Sulfate anion concentrations in parts per million for Wash Brook

Date	Site	Position	Average ppm	SD
5/23/2008	TWB 7	2	11.119	2.526
5/26/2008	EWB 8	3.5	17.163	3.734
6/5/2008	EWB 8	3.5	11.466	3.567
6/10/2008	TWB 7	2	7.220	0.055

Table 14: Sulfate anion concentrations in parts per million for Beaman's Brook

Date	Site	Position	Average ppm	SD
5/29/2008	EBB 10	3	12.586	2.354
6/2/2008	TBB 9	2	15.777	3.551

Table 15: Sulfate anion concentrations in parts per million for Filley Brook

Date	Site	Position	Average ppm	SD
5/22/2008	EFB 11	4	7.821	0.548
5/29/2008	EFB 11	4	7.747	0.938

# Part IV: Fecal Coliform Testing

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For the North Branch Park River and  
Tributaries

**Data Preparer: Caroline Lewis**

**Assistants: Victoria Doñé, Lucy Schiffman, Andrew Kennedy, Jeffery McNamara**

**Lab Supervisor: Dr. Jonathan Gourley**

**7/24/2008**

## Discussion

No fecal coliform colonies were found in the Park River, Filley Brook, Beaman's Brook, or Tumble Brook from any samples. One fecal coliform colony (type 1B) was found at EWB 8 (end of Wash Brook) on June 24<sup>th</sup>, 2008. Another fecal coliform colony was found from a storm water sample at the top of the North Branch Park River from 6/23/2008. This was also type 1B. This occurrence of fecal coliform could be due to storm drains carrying urban runoff, especially since no fecal coliform colonies were found in the North Branch Park River during baseline conditions. Most of our samples from each site contained non-fecal coliform colonies. All samples from Wash Brook and Tumble Brook had non-fecal coliform colonies present. All but one sample from Filley Brook, Beaman's Brook, and The North Branch Park River contained non-fecal coliform colonies.

The most commonly occurring non-fecal coliform colony was type 3, which made up 85% of all non-fecal coliform colonies. This type is of the *Enterobacter* genera, which normally occurs in soil and water. All samples from each site had colonies that were neither *E. coli* or coliform colonies (types 5, 6, and 7).

There is no visible change in the type or amount of colonies over time or by position. For graphing purposes, a position number was assigned to each site: one being the most upstream, and eight being the farthest downstream. See the following table for position assignments:

**Table 1. The site names and corresponding position numbers.**

Site Name	Position Number
TTB 5	1
MTB 5.5	2
ETB 6	3
TWB 7	2
EWB 8	3.5
EBB 10	3
ETBT	2.75
EFB 11	4
TNBPR 1	5
MNBPR 2	6
MNBPR 3	7
ENBPR 4	8
TBB 9	4

One spike in type 7 was found at the end of Tumble Brook on 6/3/2008, where there were 612 colonies. Though this number is higher than at other locations, the type of colony is neither a fecal colony nor a coliform colony, so it is not of concern.

Table 2. The types of colonies.

Colony Number	Colony Number
1A	Fecal coliform
1B	Fecal coliform
2	Non-fecal coliform
3	Non-fecal coliform
4	Non-fecal coliform
5	This colony should not be counted as E. coli or coliform
6	This colony should not be counted as E. coli or coliform
7	This colony should not be counted as E. coli or coliform

## Fecal Coliform Graphs

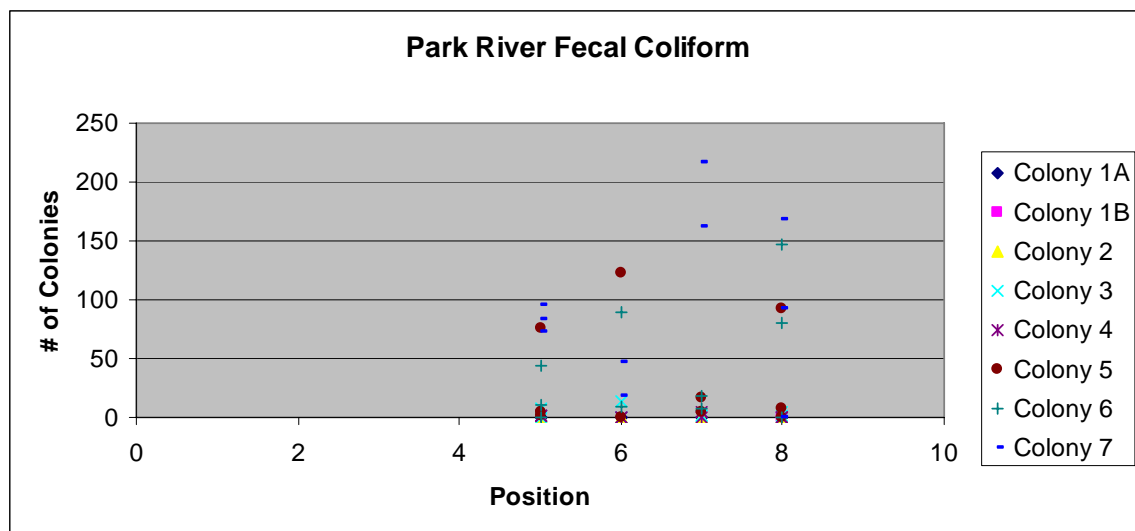


Figure 1. The number of each type of colony from samples of 5 ml of water taken from the Park River, graphed by position.

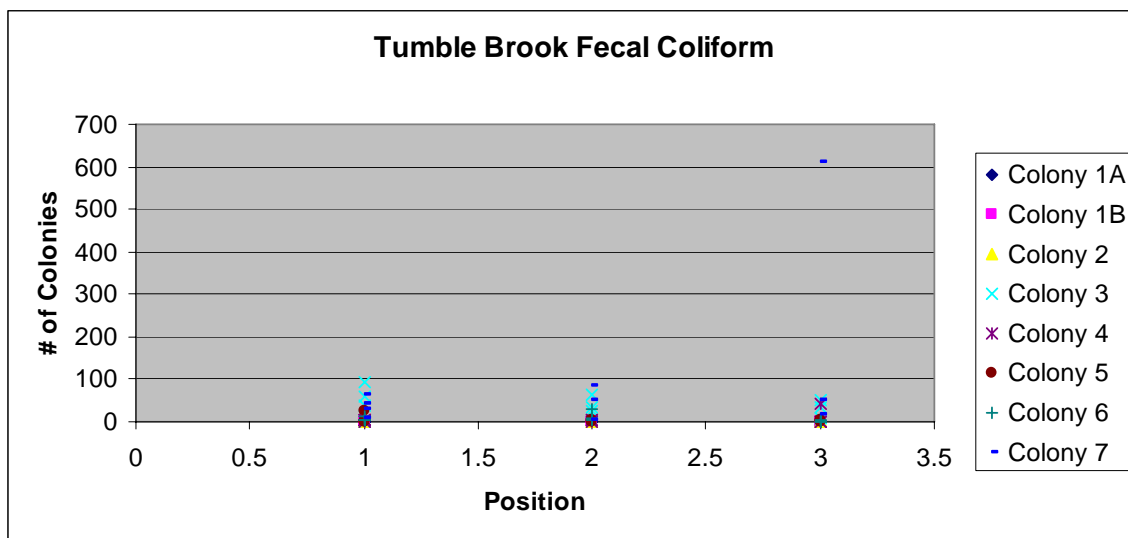


Figure 2. The number of each type of colony from samples of 5 ml of water taken from the Tumble Brook, graphed by position.

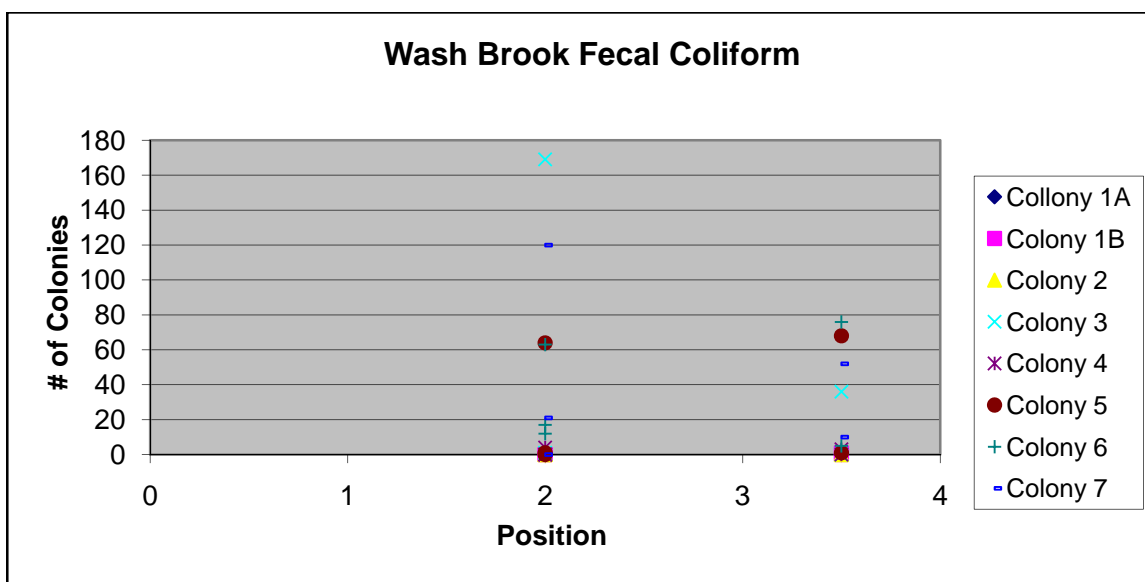


Figure 3. The number of each type of colony from samples of 5 ml of water taken from the Wash Brook, graphed by position.

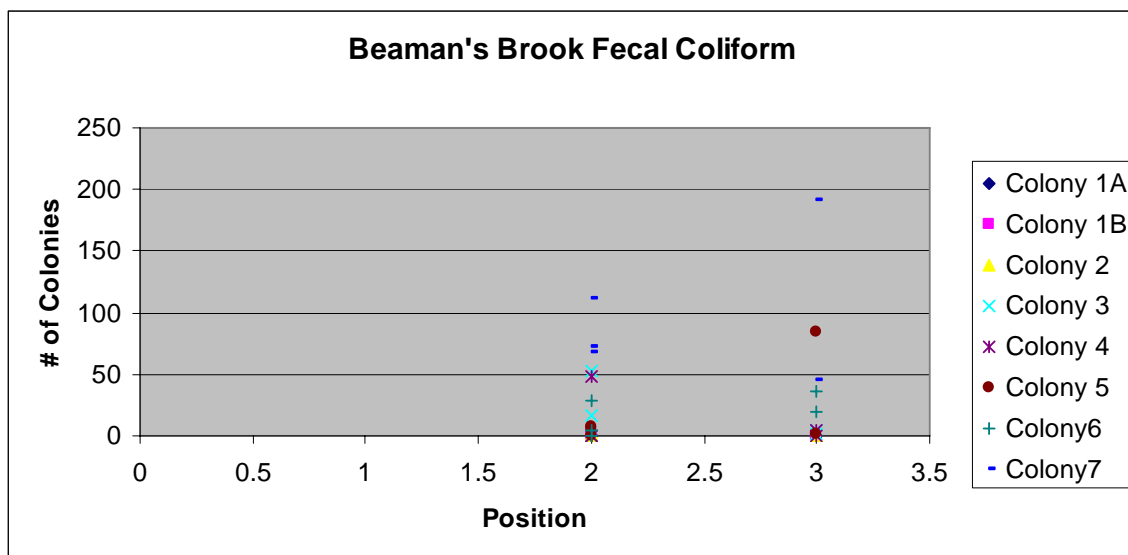


Figure 4. The number of each type of colony from samples of 5 ML of water taken from the Beaman's Brook, graphed by position.

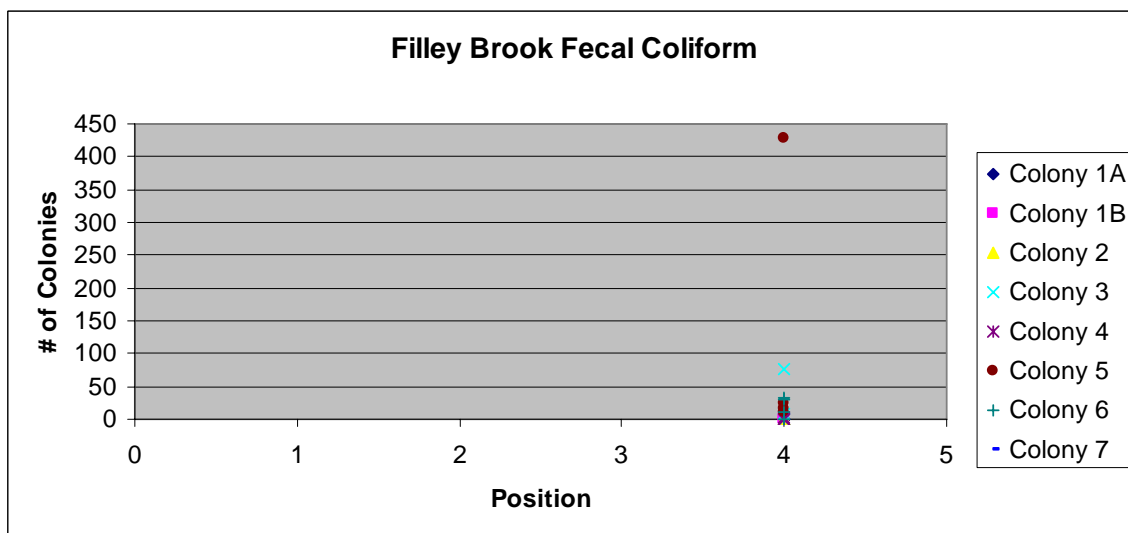


Figure 5. The number of each type of colony from samples of 5 ML of water taken from the Filley Brook, graphed by position.

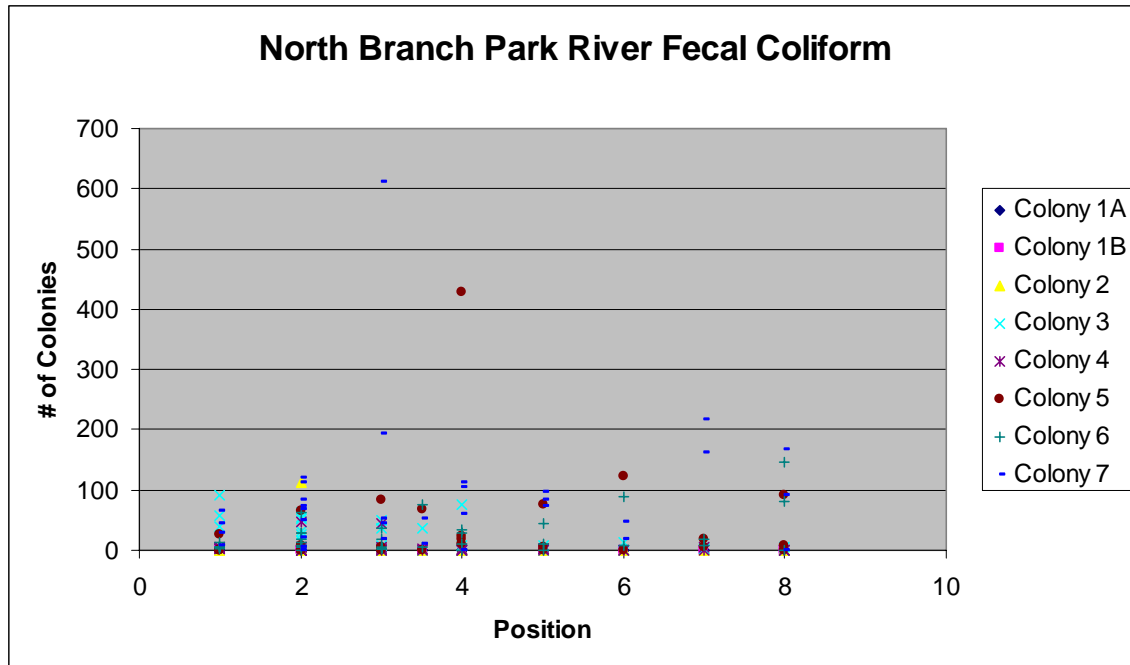


Figure 6. The fecal coliform colonies from all sites graphed by position.

## Data Tables

Table 3. Colonies from the Park River from a 5mL sample.

Site Name	Date	1A	1B	2	3	4	5	6	7
TNBPR storm	6/23/2008	0	1	0	6	2	5	14	304
TNBPR 1	5/29/2008	0	0	0	8	2	1	11	72
TNBPR 1	6/17/2008	0	0	0	2	1	5	0	84
TNBPR 1	6/24/2008	0	0	0	0	2	76	44	96
MNBPR 3	6/17/2008	0	0	0	2	5	5	7	216
MNBPR 3	6/24/2008	0	0	0	2	0	17	18	162
MNBPR 2	6/16/2008	0	0	0	13	0	0	9	18
MNBPR 2	6/24/2008	0	0	0	0	0	122	89	47
ENBPR 4	5/28/2008	0	0	0	1	0	0	147	0
ENBPR 4	6/17/2008	0	0	0	4	0	7	0	92
ENBPR 4	6/24/2008	0	0	0	1	0	92	80	168

**Table 4. The number of each type of colony in 5mL samples from Tumble Brook samples.**

Site Name	Date	1A	1B	2	3	4	5	6	7
TTB 5	5/29/2008	0	0	0	38	6	0	6	8
TTB 5	6/10/2008	0	0	0	58	2	1	4	44
TTB 5	6/16/2008	0	0	0	92	3	0	3	28
TTB 5	6/24/2008	0	0	0	2	4	27	14	64
MTB 5.5	5/29/2008	0	0	0	26	4	0	28	50
MTB 5.5	6/11/2008	0	0	0	62	0	0	7	84
MTB 5.5	6/25/2008	0	0	0	32	4	4	5	4
ETB 6	6/3/2008	0	0	0	49	44	2	2	612
ETB 6	6/11/2008	0	0	0	36	0	0	5	17
ETB 6	6/25/2008	0	0	0	7	2	4	2	53

**Table 5. The number of each type of colony from 5mL samples from Filley Brook samples.**

Site Name	Date	1A	1B	2	3	4	5	6	7
EFB 11	5/29/2008	0	0	0	1	0	11	33	104
EFB 11	6/25/2008	0	0	0	8	2	24	11	112
EFB 11	5/22/2008	0	0	0	0	0	428	0	0

**Table 6. The number of each type of coliform colony from 5mL samples from the Beaman's Brook samples.**

Site Name	Date	1A	1B	2	3	4	5	6	7
TBB 9	6/2/2008	0	0	0	0	0	0	0	72
TBB 9	6/10/2008	0	0	0	52	0	6	29	68
TBB 9	6/17/2008	0	0	1	16	48	7	5	112
EBB 10	5/29/2008	0	0	0	5	5	1	19	45
EBB 10	6/24/2008	0	0	0	1	0	84	36	192

**Table 7. The number of each colony from Wash Brook samples of 5mL.**

Site Name	Date	1A	1B	2	3	4	5	6	7
TWB 7	5/23/2008	0	0	0	113	0	1	12	0
TWB 7	6/10/2008	0	0	0	56	4	0	17	21
TWB 7	6/24/2008	0	0	0	1	0	64	63	120
EWB 8	6/23/2008	0	0	0	0	0	68	76	52
EWB 8	6/24/2008	0	1	0	36	3	1	5	10





# Part V: Water Temperature Data

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For the North Branch Park River and Tributaries

**Data Preparer: Andrew Kennedy and Jeffrey McNamara**  
**Assistants: Victoria Doñé, Caroline Lewis and Lucy Schiffman**  
**Project Supervisor: Dr. Jonathan Gourley**  
**7/24/2008**

## Temperature Data Discussion

A HOBO is a battery powered temperature data logger that is used to monitor underwater temperatures. One HOBO is deployed in the middle of the stream at each site (fig. A-1). The graphed HOBO water temperature data shows a gradual temperature increase from when the HOBOs were placed in the river on May 22<sup>nd</sup> 2008 and when they were taken out in mid July. Also, all of the data show a large spike in temperature around the date of June 11<sup>th</sup> 2008. This spike corresponds to the warmest air temperatures in Hartford for the summer from June 7<sup>th</sup> to June 10<sup>th</sup> when the high temperature was between 33 and 37 degrees Celsius (see fig. 13). All of the HOBOs also show a small peak in temperature around July 11<sup>th</sup> 2008. The average temperature increase per day for all twelve sites is 0.129 degrees Celsius with a standard deviation of 0.0250.

## Results

### Temperature Data Graphs

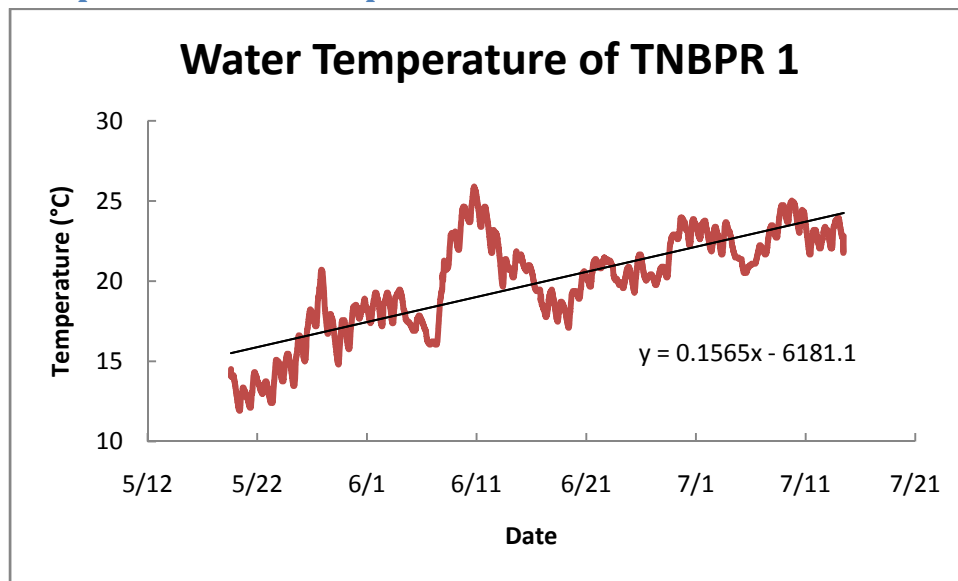


Figure 1: This graph shows the water temperature data from May 19th 2008 to July 14th for site 1

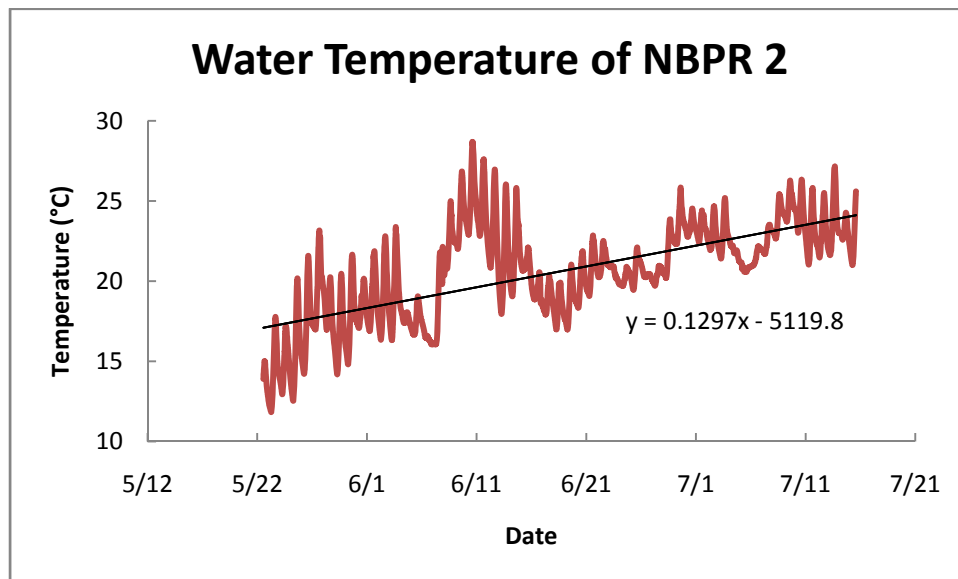


Figure 2: This graph shows the water temperature data from May 22nd to July 15th for site 2

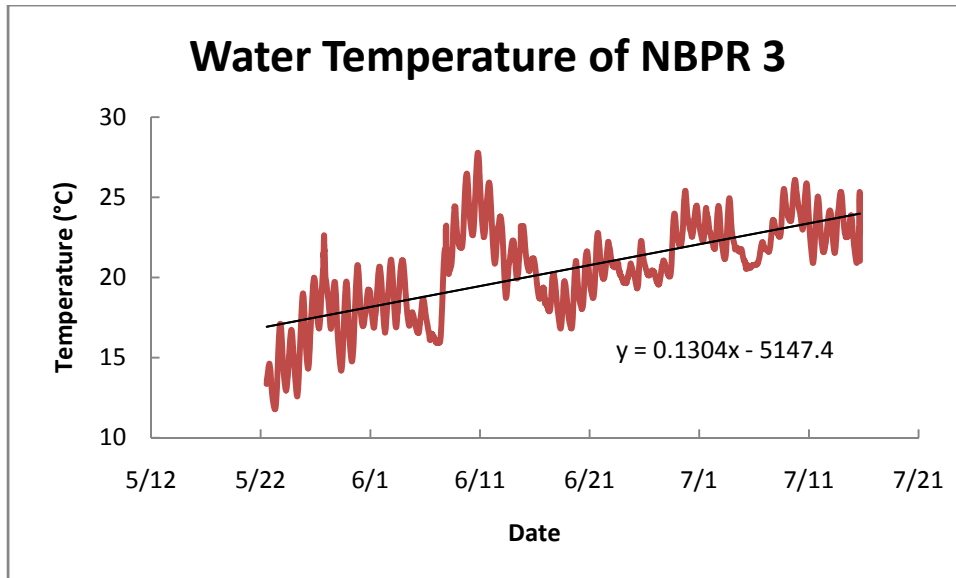


Figure 3: This graph shows the water temperature data from May 22nd to July 15th for site 3.

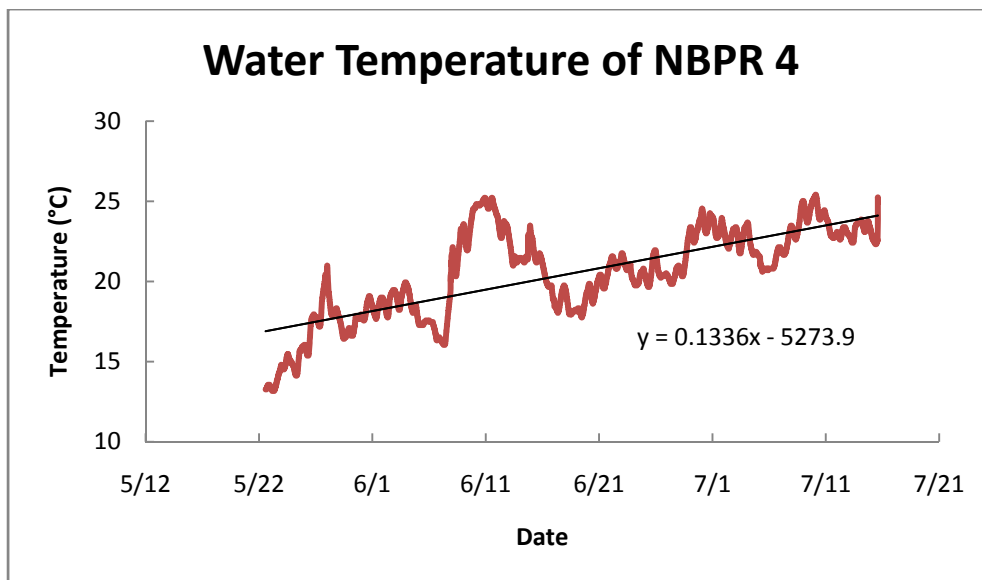


Figure 4: This graph shows the water temperature data from May 22nd to July 15th for site 4.

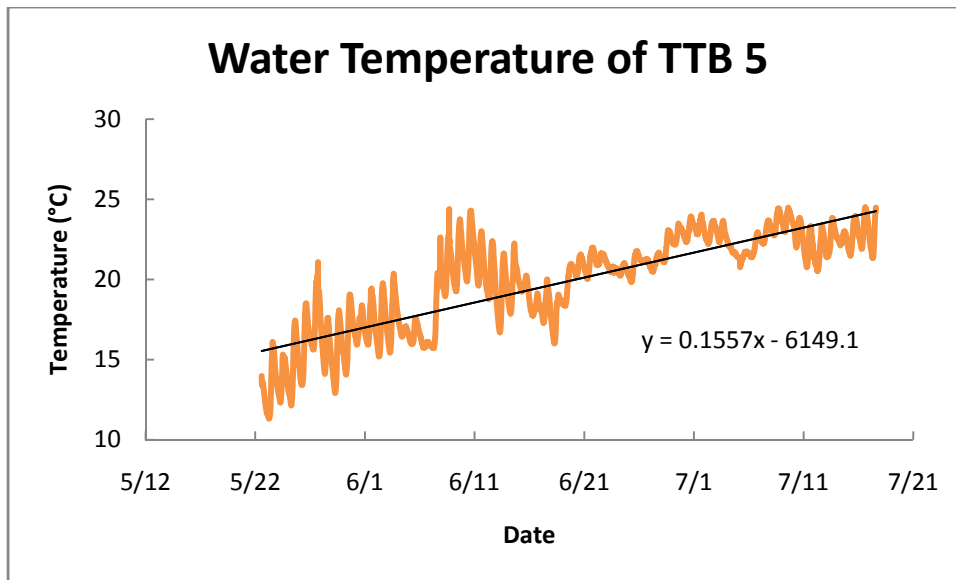


Figure 5: This graph shows the water temperature data from May 22nd to July 17th for site 5.

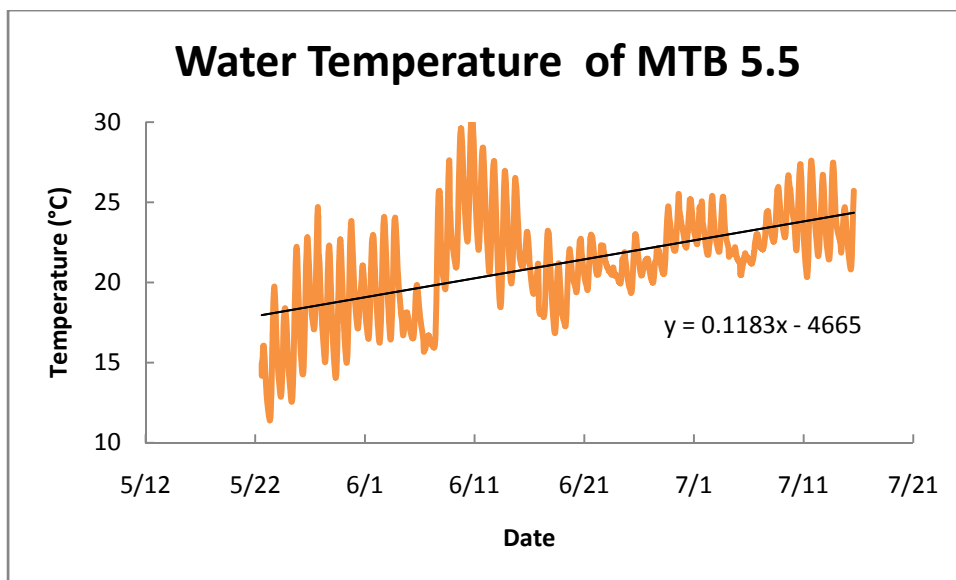


Figure 6: This graph shows the water temperature data from May 22nd to July 15th for site 5.5.

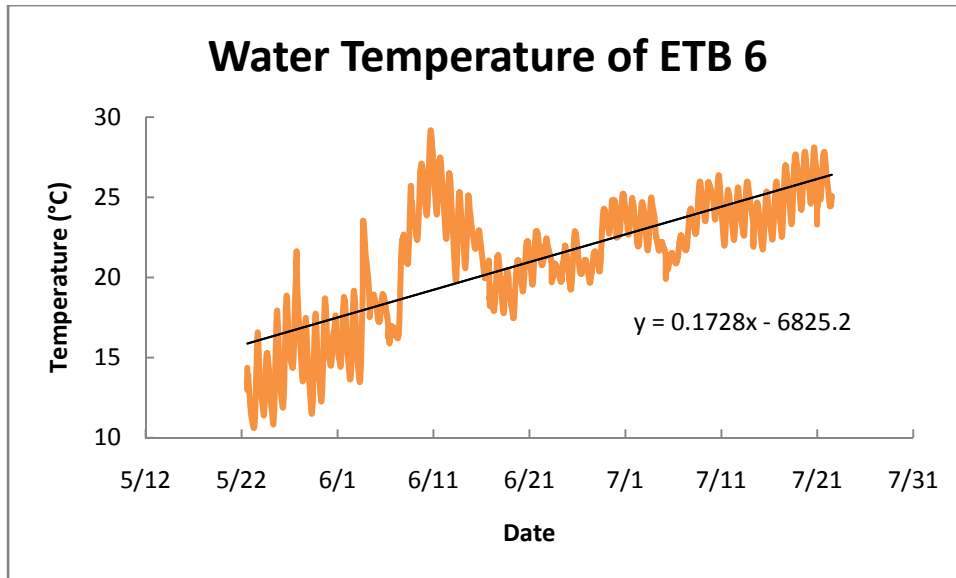


Figure 7: This graph shows the water temperature data from May 22nd to July 22nd for site 6.

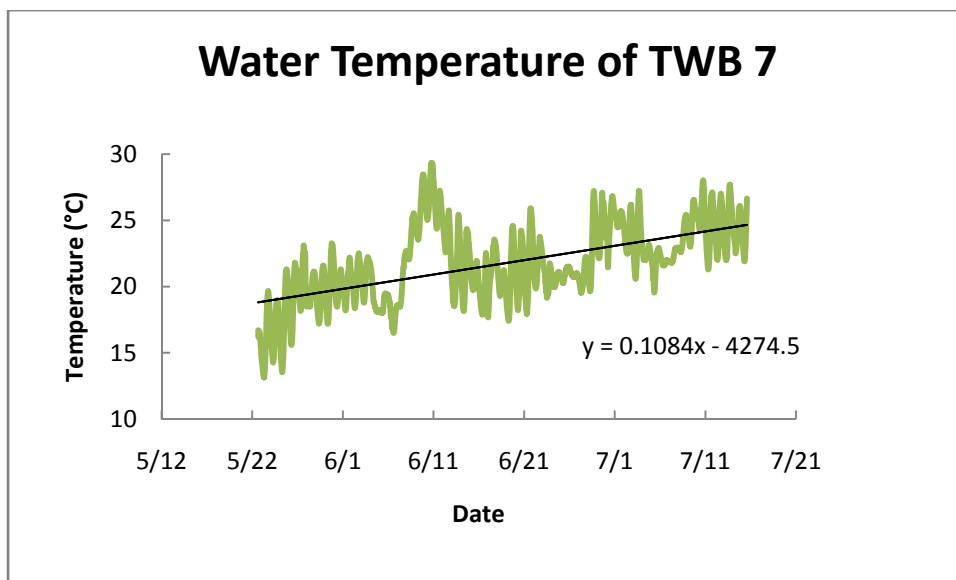


Figure 8: This graph shows the water temperature data from May 22nd to July 15th for site 7.

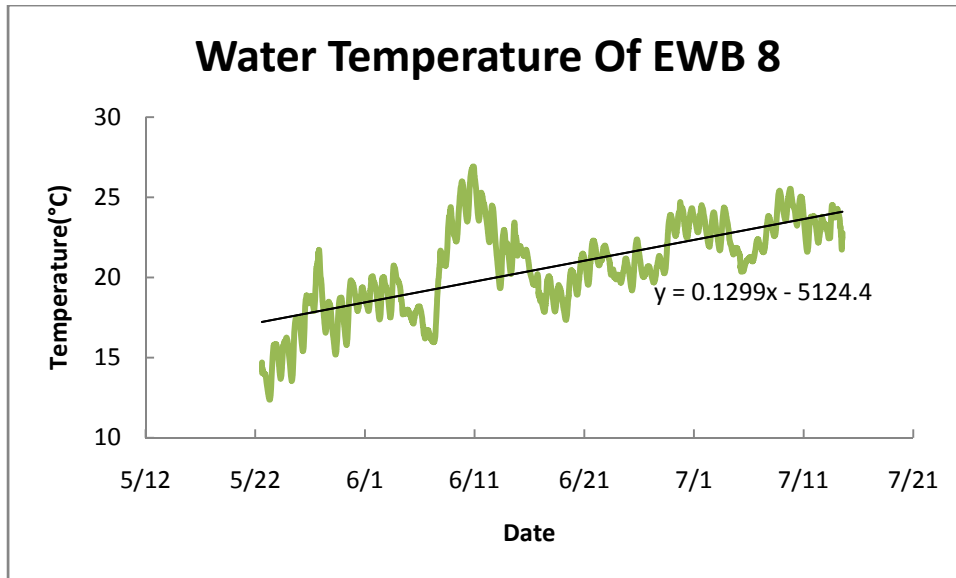


Figure 9: This graph shows the water temperature data from May 22nd to July 14th for site 8.

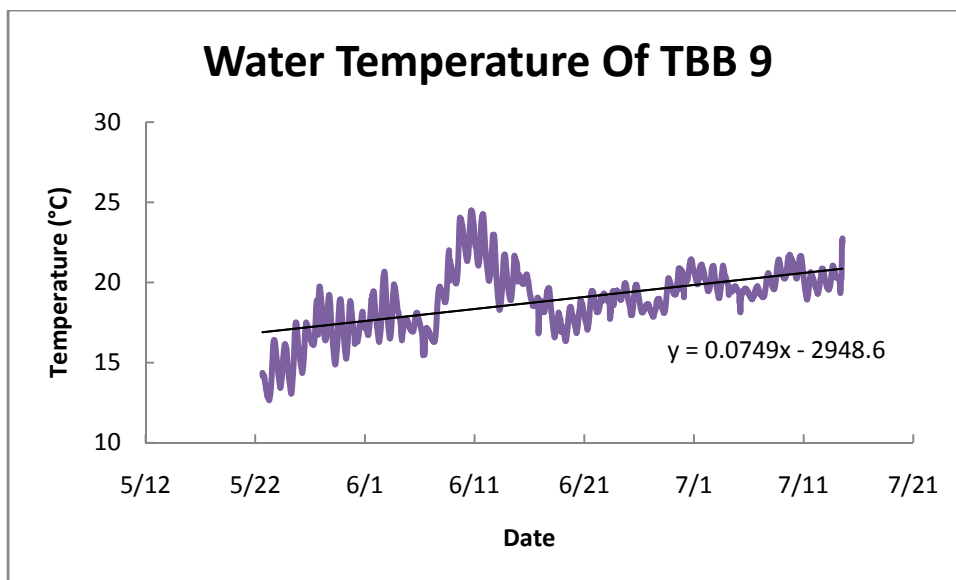


Figure 10: This graph shows the water temperature data from May 22nd to July 14th for site 9



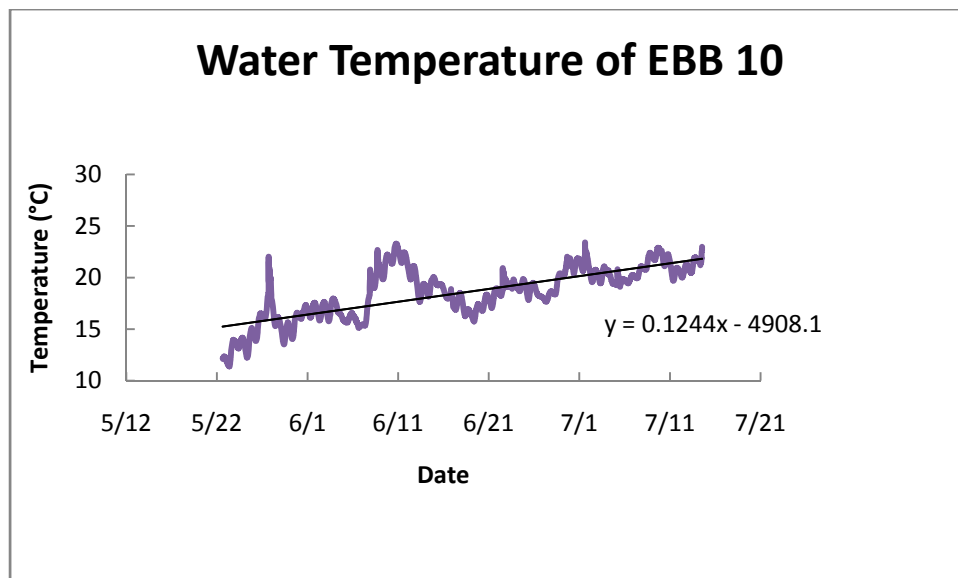


Figure 11: This graph shows the water temperature data from May 22nd to July 14th for site 10.

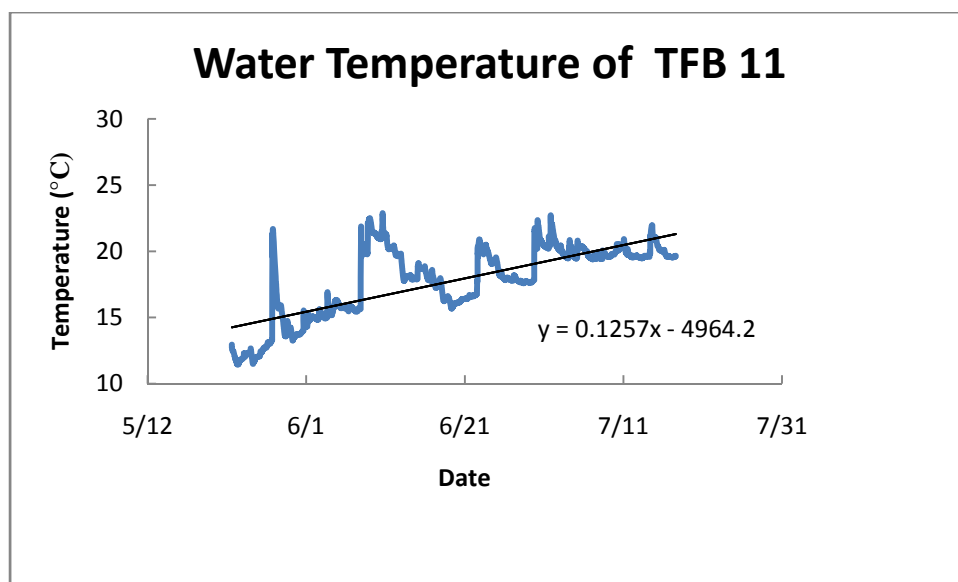


Figure 12: This graph shows the water temperature data from May 22nd to July 17th for site 11.

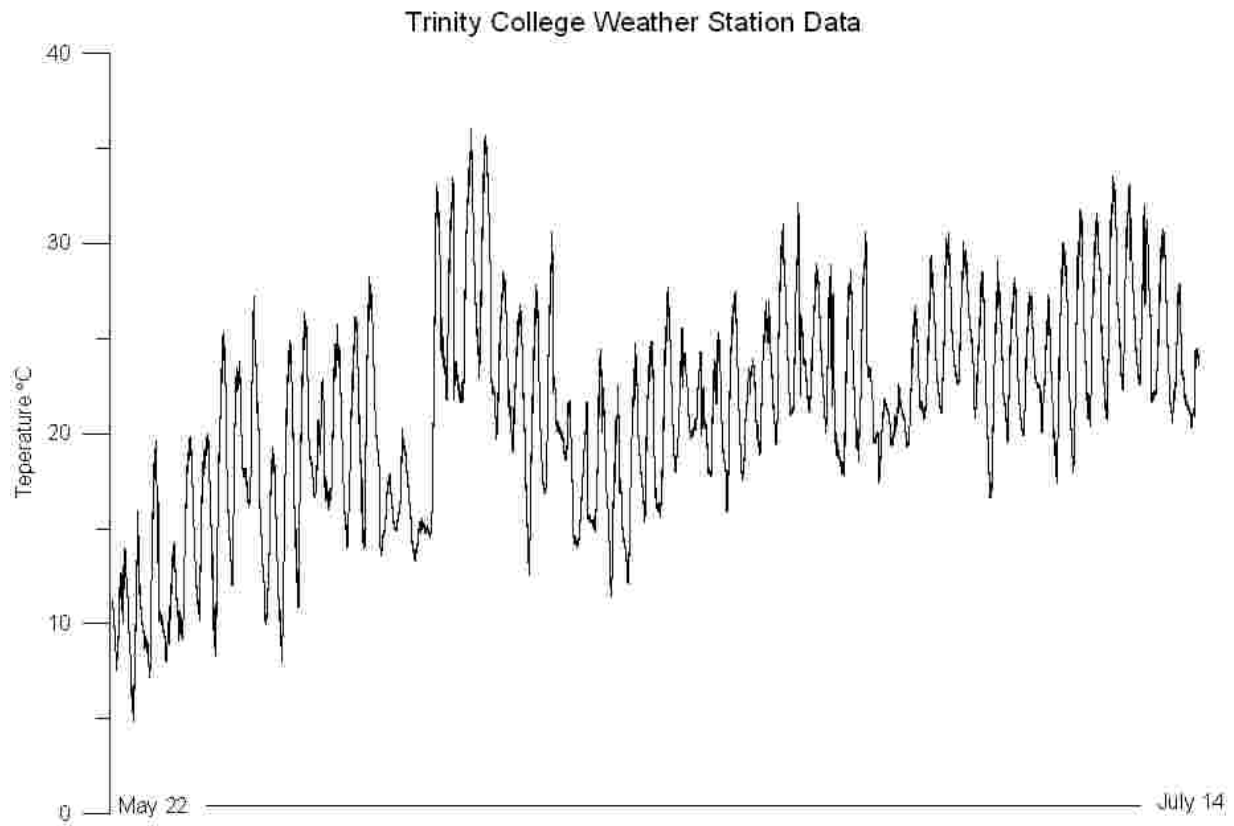


Figure 13: Air Temperature at Trinity College Weather Station

# Part VI: Pictures and Site Descriptions

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For the North Branch Park River and Tributaries

**Data Preparer: Andrew Kennedy and Jeffrey McNamara**  
**Assistants: Victoria Doñé, Caroline Lewis and Lucy Schiffman**  
**Project Supervisor: Dr. Jonathan Gourley**  
**7/24/2008**

## Site Descriptions

(all pictures taken looking downstream)



Site 5 (Top Tumble Brook) – TTB 5

This portion of the stream is in a residential area of West Hartford. It is lined with a concrete wall on both sides. A bridge crosses over the river, and there is a discarded refrigerator beneath it. The bridge, which supports Mountain Road, is located .2 miles south east of the intersection between Still Road and Mountain Road. The sampling site is located just downstream from the bridge. The water is deep near the bridge, about 1 meter, and gets very shallow, about 1 foot, downstream. There is a long riffle zone downstream. The bottom is covered with scattered cobbles and a few small boulders. Looking downstream, there are shrubs, weeds, overgrown grasses, and small bushes on the right bank.



Site 5.5 (Middle Tumble Brook) – MTB 5.5

This portion of the river runs through a residential area. The water is about 1 meter deep. The water is still and the bottom is muddy. There is little vegetation on the banks. There is a bridge, which supports Still Road, crossing over the river. Still Road intersects the Brook a half mile west of the intersection of Still Road and Route 173.



Site 7 (Top Wash Brook) – TWB 7

The site is located on Route 189,  $\frac{3}{4}$  of a mile North of where Terry Plains Road intersects Route 189. There is a small beaver dam downstream from the bridge/road. There are several outflow pipes draining into the river. The depth of the water varies; it is deeper under the bridge, and gets shallower downstream, near the beaver dam. It is mostly muddy bottom with a few small rocky parts (around 4 feet long). There are slow-flowing riffle zones directly after the beaver dams. There is rip rap surrounding the abutment of the bridge



Site 9 (Top Beamans Brook) – TBB 9

Site 9 is located at the end of an unmarked dirt road which runs west from Dudley Town Road, .65 miles south of Blue Hills avenue. This section of the brook is near a construction site that is home to a future animal rescue shelter. Other than the future animal shelter the area is relatively isolated. The brook is at the edge of a forest and a small wooden bridge crosses it. No riffle zones are present in this section. The bottom is sandy and without rocks.



Site 6 (End Tumble Brook) – ETB 6

A bridge crosses the river upstream from our sampling location. There are tall grasses surrounding the right bank (looking downstream) and a forested area on the left. There is a tree whose branches shade the river over the riffle zone. There are small-medium rocks covering the bottom. The sampling site is accessible from Medinah Drive .1 mile east of Maple Avenue.





Site 10 (End Beamans Brook) – EBB 10

Site 10 is located a few hundred feet West of where Goodman St. intersects Route 218. The sampling site is located just downstream of bridge, South of Route 218. The river is very shallow at the sampling site, about a foot deep, but it gets deeper downstream. The bottom is mostly muddy but with a small riffle zone up stream under the bridge.



Site 8 (End Wash Brook) – EWB 8

Site 8 is located at the intersection of Route 218 and Bloomfield Avenue. A bridge crosses downstream of our sampling site. The section under the bridge is channelized. The river is much shallower in the channelized section under the bridge, about a foot and a half deep. On the other side of the bridge, the water is calm, and still shallow. The section of the river used for sampling is downstream of the bridge, and is a fast-flowing riffle zone. The bottom is very rocky, containing rocks of various sizes. Trees, shrubs, and grass are present on both banks.



Site 11 (End Filley Brook) – EFB 11

Site 11 is located on the South side of Route 218 just east of the 600 Apartments. Water is about a meter and a half deep in the center. The mud is very thick and one sinks into it when walking in the stream. The banks are wooded on both sides of the stream. On one side there is an office park and on the other side there is an apartment complex. The water is also stagnant and brown in color.



Site 1 (Top North Branch Park River) – TNBPR 1

Site 1 is located just downstream of where Portage Road crosses over the river, approximately .1 miles east of where Portage Road intersects Bloomfield Avenue. This section of the river runs through a residential area with houses on both banks. It has a rocky bottom that includes a mixture of rock sizes.



Site 2 (Mid 2 North Branch Park River) – MNBPR 2

Site 2 is located on University Drive .44 miles north-east of the intersection of University Drive and Bloomfield Avenue. The river is surrounded by dense shrubs and weeds, including poison ivy. There is a series of tunnels that go into the river and under the bridge. There is rip rap surrounding the abutment of the bridge. The depth of the river varies upstream to downstream and across the width. The bottom is covered with large rocks in most areas. There is a very small island (about 3ft in diameter) directly downstream from the third tunnel. This is where our uppermost riffle zone is located. Another riffle zone lies slightly downstream and to the right. This is the largest riffle zone at the site. The last riffle zone is much farther downstream and far to the left. This riffle zone is calmer than the others.



Site 3 (Mid 3 North Branch Park River) – MRBPR 3

Site 3 is located just downstream from the intersection of Albany Ave and Scarborough Street. The river is deep even on the bank and only gets slightly deeper in the middle. The river reaches a depth of approximately 1 meter in the middle. The riffle zone is downstream from blocks of concrete that create a miniature waterfall. There is a fast current around the riffle zone.





Site 4 (End North Branch Park River) – ENBPR 4

Site 4 is accessible from the back of the Medical Arts Building parking lot off of Woodland Street, .1 mile North of Farmington Avenue. The river is separated from the parking lot of the medical arts building by a brief wooded area. The water is about  $\frac{3}{4}$  of a meter deep and there is a slight current. The bottom of the river is mostly sandy with a few scattered rocks.